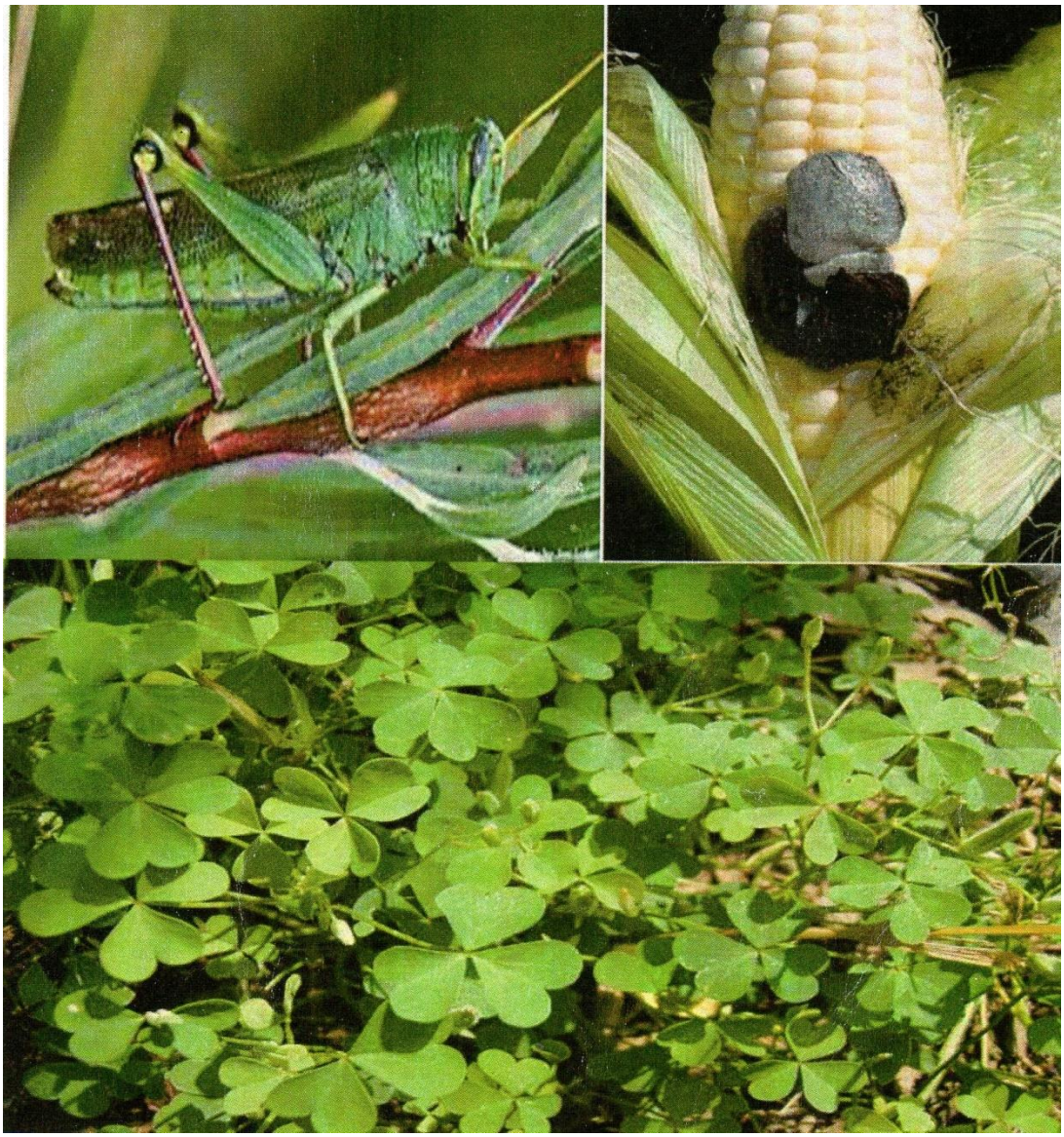
LABORATORY MANUAL



PRINCIPLES OF CROP PROTECTION
(Crop Protection 21)

Southern Luzon State University
College of Agriculture
Lucban, Quezon

LABORATORY EXERCISES

IN

PRINCIPLES OF CROP PROTECTION
(CROP PROTECTION 21)

WENCESLAO S. DURANTE

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Laboratory Manual Crop Protection 21 (Principles of Crop Protection)

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PREFACE

This laboratory manual is prepared in order to guide the students to learn the fundamentals of crop protection with emphasis on pests, diseases and weeds. This is intended for a one-semester course.

The manual is composed of eight (8) exercises to introduce the most important aspects of crop protection.

Students will work individually or in groups to maximize the use of materials, equipment and instruments. In every exercise questions are given to help the students better understand what the exercise is all about.

The author would like to extend his profound gratitude to the LORD ALMIGHTY for the strength and power to pursue this kind of job.

WENCESLAO S. DURANTE

FOREWORD TO THE STUDENT

American naturalists, Louis Agassiz once said to his students, “study Nature, not Books”. Any laboratory manual aims to provide opportunity to obtain a firsthand observation and knowledge which cannot be found merely by reading about them or looking at their pictures.

A student learns to report only that which he sees even though it may not agree with written descriptions and pictures. The student should remember that the specimen is always right. Thus, a student becomes saturated with the spirit of the scientific method and has an opportunity to go through the process. Briefly stated, this method involves observation, experimentation, analysis and conclusions. The conclusion reached must square with the facts. Science does not recognize rumor or mere guess work. If the true scientific attitude is maintained, objective, factual evidence always supplants authority.

This laboratory manual should not be treated as a handbook of direction that is to be followed. This is designed merely as an aid to the student. This manual points out important structures or topics to be seen. This manual provides illustrations that are designed to be helpful in recording facts observed. The curious student will see more things and may come up with many more inquiries than those suggested in this manual.

The student is encouraged to approach his laboratory studies with curious mind of the scientific investigator. The laboratory exercises should not be considered as a work but as an opportunity to find out more about the various areas of crop protection. In laboratory work innocence and superstition are replaced by dependable knowledge. The laboratory is the place to develop the investigative spirit, and cultivate an open and tolerant mind.

WSD

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Laboratory Exercise No. 1

PEST IDENTIFICATION

Introduction

Pest refers to any organism judged as threat to human beings or to their interest. When early man hunted animals and foraged for food, he shared the natural resources with other organisms in the community. As human culture developed and population rose, people made ever-increasing demands on these resources. One result of changing the environment has been a great increase in the number of species that are now recognized as competitors of humans. These competitors are usually referred to as pests. The definition of pest is, of course, subjective. An ecologist would not necessarily consider several leaf-eating caterpillars on a plant as pests, whereas a gardener who cultivated the plant might very well do so. And only one bat, rat, or mouse is enough to qualify as a household pest.

Natural communities have always contained organisms that were economically significant; locusts, for example, have plagued humans throughout history, and grain from Stone Age locations has been found infected with bunt and ergot diseases. Most species that became pests, however, did so because of environmental modifications, occasionally from natural causes but usually from human activities.

In order to appreciate some of the methods devised to combat pests, one should consider how advancing technology has increased the number of harmful insect species. The change from natural vegetation to large areas of single-crop (monoculture) agriculture has three consequences. First, given a more uniform food source, some plant-eating species increase to large populations. Second, the uniform plant cover is easily invaded by attacking pests. Third, the introduction of new crops over large areas results in the transfer of previously harmless insects from scattered native plants to the new and abundant sources of food. Cultural practices such as fertilization, irrigation, and the use of modern harvesting equipment (which often leaves large amounts of plant litter in the field) enhance still further the ability of pest species to increase rapidly. In addition, the elimination of species that compete with or prey upon pests—an unintended effect in some pest control programs—has also exacerbated certain pest problems. Also, the ease with which people and goods can be transported around the world has resulted in the introduction of exotic pests in many places.

Pests are found throughout the animal kingdom. Microorganisms such as fungi, bacteria and viruses are here considered pests even though they are usually thought of as agents of disease. Most animal pests are invertebrates, among them protozoa,

flatworms, nematodes, snails, slugs, insects, and mites. Among the vertebrates, rabbit, elk, deer, and many kinds of rodents are sometimes injurious to crops.

Insects are also serious pests because some of them play an essential role in the transmission of disease. Each year millions of lives, particularly in the tropics, are threatened by insect-borne diseases. Malaria and yellow fever are transmitted by mosquitoes, plague by fleas, typhus by human louse, sleeping sickness by tsetse flies. Other diseases may be spread by insects accidentally as a result of their habits.

Objective

At the end of this laboratory exercise, the students should be able to:

1. familiarize themselves with various pests, and

2. differentiate a pest from a beneficial insect.

Methodology

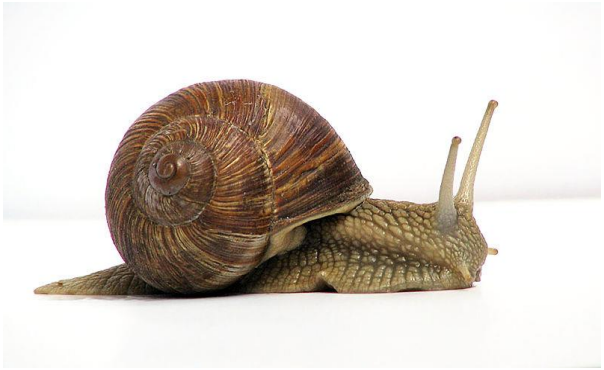
The laboratory instructor will accompany the students in College of Agriculture projects and will examine the different plants infested by pests. Students have to identify whether the damage is caused by insect, pathogen, rodent, etc.

If possible, students will provide an illustration of the different insect pests with the following information (Common name and Scientific name).

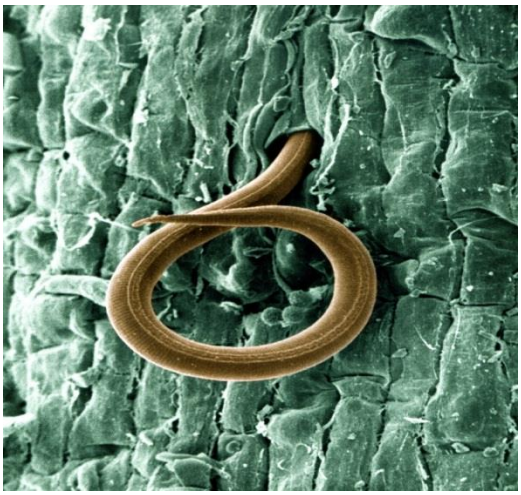
Common examples of Pests

Larva

Termites



Snail



Root-knot nematode

Migratory locust

Aphids

Microscopic mite

Rodent/Mouse

Banana bunchy top

Coffee bird

Questions

Students have to answer the following questions below using different references available in the library.

1. How will you consider an insect a pest?
2. What is a predator? Give an example.
3. What is a parasitoid? Give an example.
4. What is the most destructive phase in the life cycle of insect with complete type of metamorphosis? Why?

References

Baltazar, C. R. and N. P. Salazar. 1979. Philippine Insects. An Introduction. University of the Philippines Press. Quezon City. 130 p.

Calilung, V. C. J. 1990. Manual for General Entomology. College of Agriculture, University of the Philippines at Los Baños, College, Laguna, Philippines. 198 p.

Laboratory Exercise No. 2

IDENTIFYING THE DISTINGUISHING FEATURES OF INSECTS AND OTHER ARTHROPODS

Introduction

Arthropods (from the Greek words arthros = joints; podos = feet) characteristically possess segmented, bilaterally symmetrical bodies equipped with several pairs of jointed appendages. The animals have hard external covering (exoskeleton) which is periodically shed and removed to allow growth. The basic structural or body plan of insects were laid down long before insects became a specialized group with the Phylum Arthropoda.

There are about a million species of insect and many more yet to be discovered. They include, for example, ants, bees, wasps, beetles, butterflies, dragonflies and fleas. They range in size from microscopic soil-dwelling insects to large beetles and butterflies but they all share certain common features.

Their bodies are divided into about 20 segments which are grouped into the head (6 fused segments), the thorax (3 segments) and the abdomen (11 segments). All insects have an exoskeleton consisting of a firm cuticle.

The head bears sensory organs and mouthparts. There is a pair of antennae which are sensitive to touch and to smell. There is also a pair of compound eyes made up of hundreds of separate lenses and sensory cells. These can detect light, movement and color and can form crude images of shapes. In bees and butterflies, these senses allow the insect to find sources of nectar in flowers by their color, shape and smell.

There are three sets of mouthparts carried externally on the head. A pair of mandibles (jaws) bites off portions of food and passes them into the mount. A pair of maxillae helps taste and manipulates the food and the labium (lower “lip”) has a variety of functions depending on the species of insect.

All insects have three pairs of legs, one pair on each thoracic segment. There are five sections on each leg with joints between each section which give the leg the ability to move in different directions. The exoskeleton at the joints consists of a flexible cuticle which allows freedom of movement.

Also, each of the second and third segments of the thorax there is, typically a pair of wings though in some insect (e.g. flies and mosquitoes), these may be reduced to one pair and a number of species have no wings at all.

In the mature insect, the abdomen carries no appendages other than some apparatus on the final segment to assist with egg-laying.

The firm exoskeleton supports the insect, maintains its shape and protects it from damage and from evaporation. The rigid exoskeleton prevents insects from growing in a continuous manner and growth takes place in spurts. The outer layer of cuticle is

shed and the insect expands its body until the new layer of cuticle forms and hardens. This molting process (ecdysis) takes place 5 times or more until the mature insect appears, after which there is no further growth or ecdysis.

The intermittent growth takes place in the larval or nymphal stages of an insect's life cycle. Insects such as butterflies or bees, which exhibit complete metamorphosis, have larval stages quite unlike the adult e.g. fly maggots or butterfly caterpillars. The penultimate molt results in a quiescent stage, the pupa, in which the adult features are formed. The final molt reveals the mature insect.

In insect such as the cockroach or grasshopper, which have incomplete metamorphosis, the early stages are called nymphs and they closely resemble the adult except that their wings have not formed. Small changes of form take place at each ecdysis until the mature winged insect emerges.

Arachnids belong to class Arachnida. They are characterized as invertebrate animals with jointed-legs. They belong to the subphylum Chelicerata. All arachnids have eight legs, although the front pair of legs in some species has converted to a sensory function, while in other species, different appendages can grow large enough to take on the appearance of extra pairs of legs. The term is derived from the Greek word ἀράχνη (*arachnē*), meaning "spider".

Almost all extant arachnids are terrestrial. However, some inhabit freshwater environments and, with the exception of the pelagic zone, marine environments as well. They comprise over 100,000 named species, including spiders, scorpions, harvestmen, ticks, mites and Solifugae.

Almost all adult arachnids have eight legs, and arachnids may be easily distinguished from insects by this fact, since insects have six legs. However, arachnids also have two further pairs of appendages that have become adapted for feeding, defense, and sensory perception. The first pair, the chelicerae, serves in feeding and defense. The next pair of appendages, the pedipalps has been adapted for feeding, locomotion, and/or reproductive functions. In Solifugae, the palps are quite leg-like, so that these animals appear to have ten legs. The larvae of mites and Ricinulei have only six legs; a fourth pair usually appears when they moult into nymphs. However, mites are variable: as well as eight, there are adult mites with six or even four legs.

Arachnids are further distinguished from insects by the fact they do not have antennae or wings. Their body is organized into two tagmata called the prosoma, or cephalothorax, and the opisthosoma, or abdomen. The cephalothorax is derived from the fusion of the cephalon (head) and the thorax, and is usually covered by a single, unsegmented carapace. The abdomen is segmented in the more primitive forms, but varying degrees of fusion between the segments occur in many groups. It is typically divided into a preabdomen and post abdomen, although this is only clearly visible in scorpions, and in some orders, such as the Acari, the abdominal sections are completely fused.

Like all arthropods, arachnids have an exoskeleton, and they also have an internal structure of cartilage-like tissue called the endosternite, to which certain muscle groups are attached. The endosternite is even calcified in some Opiliones.

Objectives

At the end of this laboratory exercise, the students should be able to:

1. study the external anatomy of a typical insect.
2. study the external anatomy of arachnids.
3. distinguish the varied types of antenna, mouthparts, legs and wings of insects.

Materials

Students are expected to bring the following materials:

1. Adult grasshopper (e. g. citrus green locust)
2. Alive and/or mounted arachnid specimens (mites and spiders)
3. Samples of insects representing different types of antenna, mouthparts, legs and wings
4. Dissecting and compound microscopes
5. Dissecting sets

Procedure

1. Place grasshopper on a dissecting dish and study the body regions and parts.
2. Identify all pertinent parts. Draw and label accordingly (Figure 1).
3. Examine specimens of arachnids. Study the different body regions and parts. Label drawings accordingly (Figure 2).
4. Examine the specimens provided by the instructor for the insects' different types of antenna, mouthparts, legs and wings. Label the drawings properly. Identify the different segments of each type. (Figures 3 and 4)
5. Label the drawings of the different types of insect wings (Figure 5).
6. Label the drawings of insect mouthparts (Figures 6 and 7).
7. Submit on the following laboratory period properly labeled drawings (Figures 1 to 7)

Name: _____

Course/Year/Section: _____

Laboratory Schedule: _____

Results/Discussion

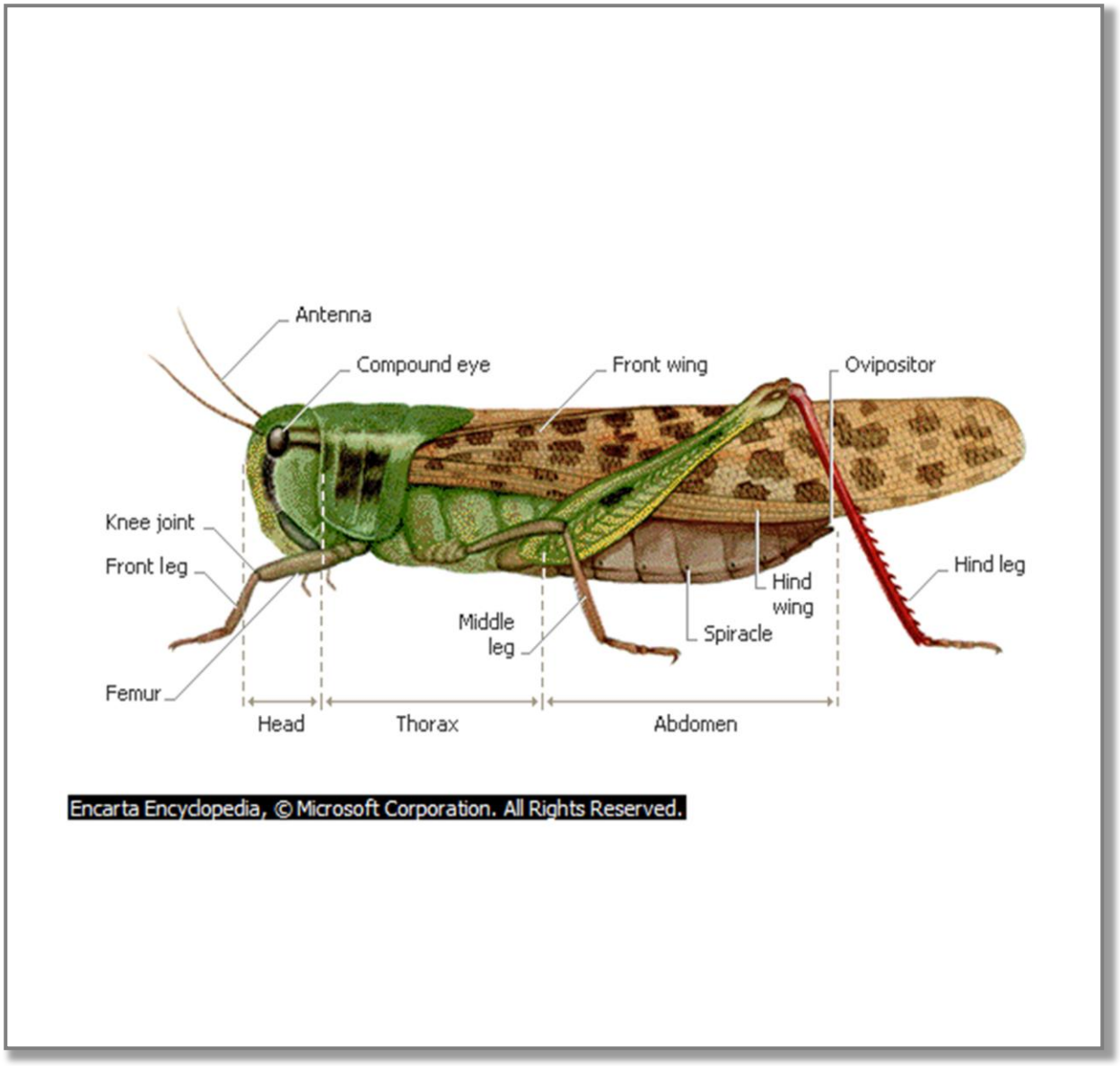
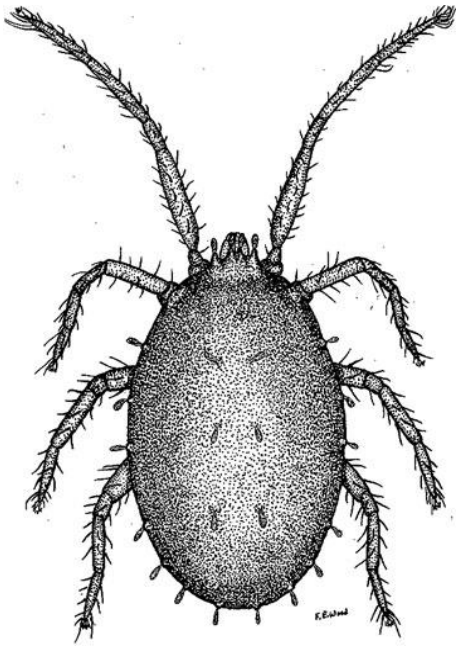


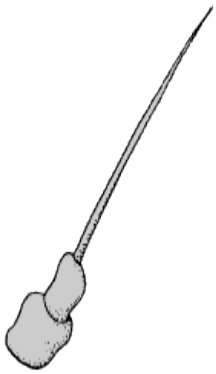
Figure 1. The grasshopper as a generalized insect

A

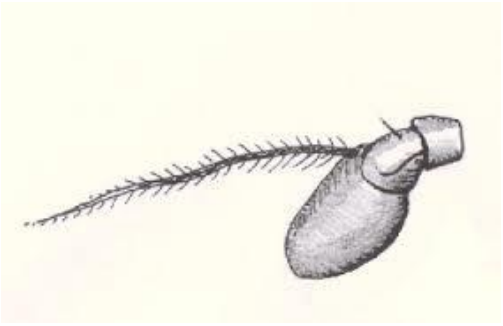


B

Figure 2. Class Arachnida: (A) Spider, (B) Mite



1. _____



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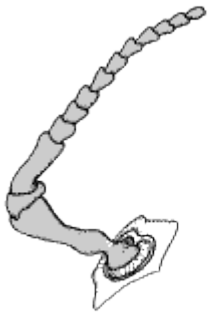

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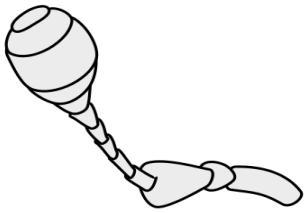
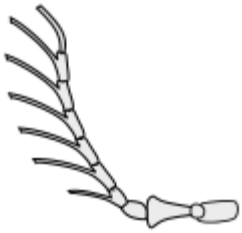


4. _____



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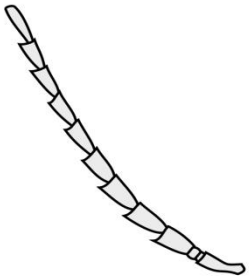
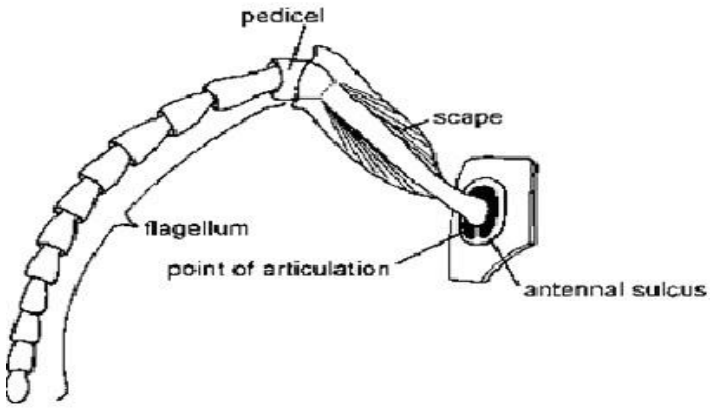


6. _____.

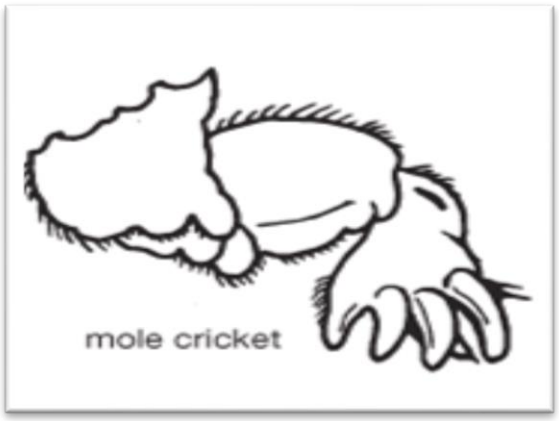
7._____ 8. _____

9._____ 10. _____

Figure 3. Types of Insect Antenna



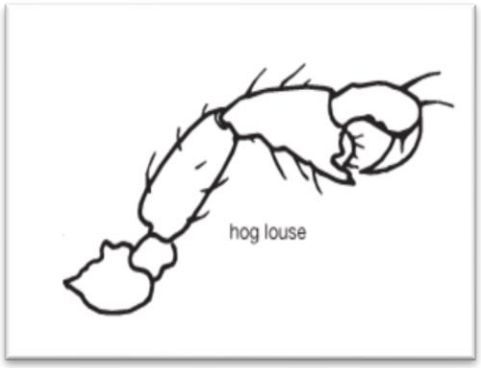
Parts of an Insect Antenna

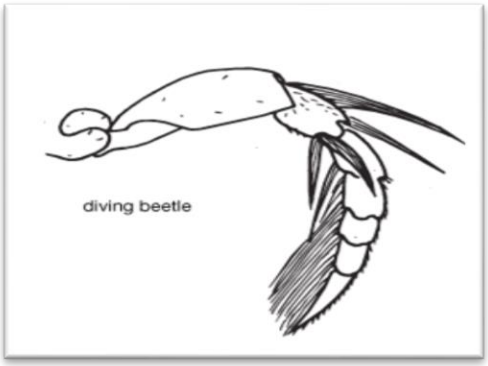


1. _____ 4. _____

2. _____

5. _____





3. _____

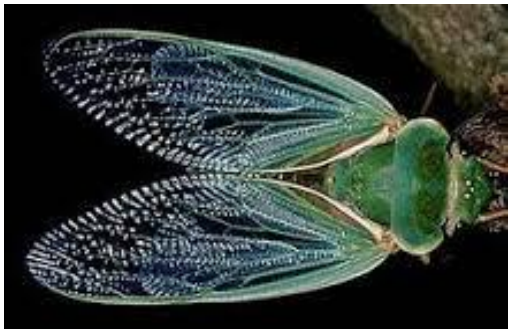
6. _____

Figure 4. Types of Insect's legs

1. _____

4. _____

2. _____



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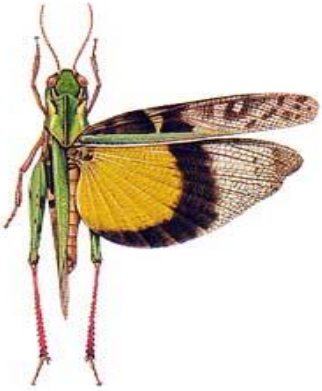


3. _____

6. _____

Figure 5. Types of Insect's Wings

Question

Students are expected to answer this questions critically using the available references in the library.

1. Students should compare and contrast the external anatomy of an insect from an arachnid.

2. Describe the different types of insect mouthparts. What are the specific modifications of the different parts for each type?

Type of Mouthparts	Description/Modifications
Chewing Type (Grasshopper)	
Piercing-sucking Type (Aphids)	
Rasping-sucking Type (Thrips)	
Sponging Type (Housefly)	

Siphoning Type (Butterfly)	
Chewing-lapping Type (Bees, wasps)	

References

Baltazar, C. R. and N. P. Salazar. 1979. Philippine Insects. An Introduction. UP Press. Quezon City, Philippines. 130 p.

Calilung, V. C. J. 1990. Manual for General Entomology. College of Agriculture, University of the Philippines at Los Baños, College, Laguna, Philippines. 198 p.

Laboratory Exercise No. 3

IDENTIFYING DIFFERENT ORDERS OF INSECTS

Introduction

Class Insecta is composed of so many species with diverse morphological features and behaviors. The class is divided into two subclasses based on the absence or presence of wings. Thus, the wingless ones are classified as Apterygota and the winged are classified as Pterygota. Although some orders of Pterygota lack wings, their wingless condition is a secondary one.

The 2 subclasses are further divided into orders. The orders are differentiated based on the forms; venation and structure of wings; type of mouthparts; type of metamorphosis and other special characteristics and peculiarities.

The more common orders, which include majority of known species of importance to man and agriculture, are summarized below with their important distinguishing morphological features.

Description of Common Insect Orders

A. Order Orthoptera (grasshoppers, crickets, cockroaches, walking sticks, mantids)

1. Chewing mouthparts; body elongated; many species have –developed cerci and long ovipositor.

2. If winged, front wings are long, narrow and many veined, somewhat thickened and leathery, hindwings, membranous, triangular in shape like a fan under forewings when at rest.

3. Grasshoppers and crickets have jumping hindlegs; mantids have well-developed spiny forelegs for grasping preys; mole crickets have rake-like forelegs for digging.

4. Young and adult are similar in general appearance but the former have less developed wings.

a.

c.

b.

d.

Figure 6. Representative Insects: (a) cricket – Orthoptera, (b) cicada – Homoptera, (c) bug - Hemiptera, (d) thrips - Thysanoptera

B. Order Hemiptera (true bugs, bed bugs, rice bugs, citrus green bug, cotton stainer) Figure 5c.

1. Piercing-sucking mouthparts with base attached to more anterior portion of head.

2. Winged members have 2 pairs; front wings thickened at the base and membranous distally or hemelytron type; hindwings membranous.

3. Young and adult are similar in general appearance except that the former has less developed wings.

C. Order Homoptera (cicada, leafhoppers, treehoppers, aphids, scale insects, mealybugs, whiteflies), Figure 5b.

1. Piercing-sucking mouthparts with base attached to head near its hind part, often seeming to arise between the legs.

2. If winged, there are 2 parts, which are uniformly membranous or leathery.

D. Order Thysanoptera (thrips), Figure 5d.

1. Mouthparts rasping-sucking

2. If wings are present, they are fringed with long hairs.

3. Minute, slender-bodies

E. Order Lepidoptera (butterflies, moths, skippers), Figure 6 a.

1. Coiled siphoning mouthparts called proboscis (some have no functional mouthparts)

2. Winged members have 4 wings covered with overlapping scales.

3. Actively feeding immatures are caterpillar-like

F. Order Coleoptera (beetles, weevils), Figure 6 b.

1. Chewing mouthparts

2. Forewings thick and hard called elytra; hindwings membranous, folded beneath elytra

3. Immature grub-like, worm-like or legless (weevils)

G. Order Isoptera (termites), Figure 6c.

1. Chewing mouthparts and head-like antennae

2. Two pairs of very similar, long and narrow wings laid flat on the back when not in use that easily detach from thorax.

a.

b.

c.

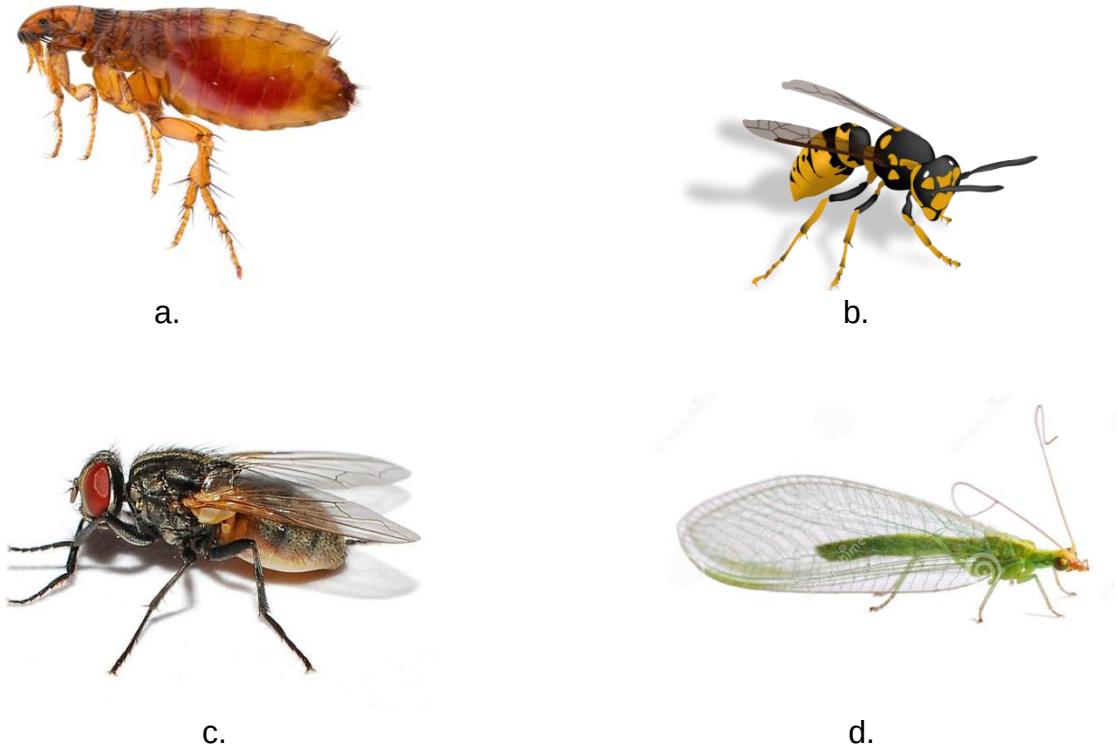
d. e.

Figure 7. Representative Insects: (a) butterfly – Lepidoptera, (b) beetle – Coleoptera, (c) termites – Isoptera, (d) human louse – Anoplura, (e) bird louse - Mallophaga

H. Order Phthiraptera (true lice or sucking lice, biting lice and bird lice), Figure 7d and Figure 7e.

1. The true lice or sucking lice have piercing-sucking mouthparts while the biting and bird lice have chewing mouthparts.

2. True lice or sucking lice are small, flat, wingless with well-developed tarsal claws (found on warm-blooded animals except fowls) while the biting and bird lice are likewise small, flat and wingless (found on feathers of brids or hairs/scales of animals).



a. b. c. d.

Figure 8. Representative Insects: (a) flea – Siphonaptera, (b) wasp – Hymenoptera, (c) fly – Diptera, (d) lacewing – Neuroptera

I. Order Siphonaptera (fleas), Figure 7a.

1. Piercing-sucking mouthparts.

2. Wingless; legs comparatively long.

3. Body laterally compresses with numerous short bristles directed backward.

J. Order Hymenoptera (ants, bees, wasps, sawflies, ichneumons), Figure 7 b

1. Mouthparts chewing-lapping or sucking.

2. Winged forms have 2 pairs; membranous hindwings smaller than forewings and have a row of tiny hooks for coupling with forewing to synchronize movement.

3. Antennae long, often bent at the base like a knee (geniculate).

4. Ovipositor modified into a sting.

K. Order Diptera (flies, mosquitoes, gnats), Figure 7 c

1. Mouthparts sponging, piercing-sucking or lapping.

2. Forewings well-developed but with few veins; hindwings called halters, slender and knobbed at tip.

3. Immatures mostly worm-like and called maggots.

L. Order Neuroptera (antlions, lacewings, snakeflies, fishflies, dobsonflies, alderflies and owlflies), Figure 7 d

1. Mouthparts chewing; mostly soft-bodied.

2. With 2 pairs membranous wings that usually have many cross veins and extra branches of longitudinal veins.

M. Order Odonata (dragonflies and damselflies), Figure 8 a

1. Mouthparts chewing.

2. Wings elongate and membranous; abdomen long and slender.

3. Compound eyes large, many-faceted and often occupy most of the head.

N. Order Dermaptera (earwigs), Figure 8 b

1. Chewing mouthparts

2. A pair of large forceps-like cerci

3. Forewings short, leathery and veinless; hindwings, membranous

a.

b.

Figure 9. Representative Insects: (a) dragonfly – Odonata, (b) earwig - Dermaptera

Objective

At the end of this laboratory exercise, the students should be able to classify and identify different insects into order level.

Materials

The following materials are needed:

1. Specimens representing different orders
   a. Pinned specimens
   b. Specimens preserved in alcohol
   c. Specimens mounted on glass slides

2. Compound and dissecting microscopes/hand lens

Procedure

1. Using the key provided, identify the specimens up to order level. Run through the key in steps and start with number 1. Each number has two choices, one of which should apply to the specimen. There is either a number or name at the end of the line.

   If the description fits the specimen and the identification name is stated at the end of the line, then there is no need to go through the rest of the key.

   Continue running through the key if the next number is indicated as the second alternative.

2. In a tabular form, indicate the common name, type of mouthparts, antennae, wings and legs of each specimen examined and identified.

KEY TO ORDERS OF THE PHILIPPINE INSECTS

1. Wings present (1 or 2 pairs) ……..…….. 2
   Wings absent …… 17

2. Abdomen with 2 or 3 terminal filaments; body soft; hindwing small or absent …… Order EPHEMEROPTERA (mayflies)

   Abdomen without terminal filaments, body soft; hard hindwings usually present ……. 3

3. One pair of membranous wings present; hindwings reduced to a pair of halteres…… Order DIPTERA (mosquitoes and flies)

   Two pairs of wings present; hindwings membranous …….. 4

4. Front wings hard, not transparent, without veins and meeting at midline, hindwing membranous and hidden under front wings …….. 5

   Front wings usually membranous with distinct veins, sometimes covered with scales or hairs; if partly leathery, veins distinct and wings not meeting at midline …….. 6

5. Abdominal tip with a pair of forceps-like appendages; front wings very short……. Order DERMAPTERA (earwig)

   Abdominal tip without forcep-like appendages; front wings usually covering entire abdomen ……. Order COLEOPTERA (beetles)

6. Mouthparts beak-like for sucking; mandibles modified into threadlike stylets and enclosed in beak …….. 7

   Mouthparts adapted for chewing; mandibles usually large for masticating …….. 10

7. Wings long and narrow, fringed with long hairs; tarsus with one or two segments, the last segment bladderlike; minute elongate insects; usually less than 5 mm long …… Order THYSANOPTERA (thrips)

   Wings not a above; the last segment not bladderlike; size variable ……. 8

8. Wings covered with scales; proboscis elongate and coiled when not in use, mouthparts sometimes lacking …….Order LEPIDOPTERA (butterflies/moths/skippers)

   Wings not covered with scales, proboscis straight or curved but not coiled …… 9

9. Front wings membranous apically and overlapping, basally somewhat leathery except in lacebug, beak arising anterior part of head …….. Order HEMIPTERA (true bugs)

   Front wings of even thickness throughout and usually held rooflike over body; beak arising from posteroventral part of head, usually near base of front legs ……..…… Order HOMOPTERA (cicada, hoppers, plant lice, whiteflies)

10. Front wings somewhat leathery or thickened …… ……. Order ORTHOPTERA (grasshopper, crickets)

    Front and hindwings membranous throughout …… 11

11. Front wings with many crossweins and cells ……. 12

    Front wings with few crossveins and cells ……. 15

12. Antennae inconspicuous, bristlelike and with a few segments …… …… Order ODONATA (dragonflies, damselflies)

    Antennae conspicuous and with many segments …… 13

13. Wing veins not well developed; tarsi with 4 segments …….. ……... Order ISOPTERA (termites)

    Wing veins well-developed; tarsi with 2, 3 or 5 segments ……. 14

14. Wings held flat above abdomen; cerci present and usually elongated; tarsi with two or three segments …….. Order PLECOPTERA (stoneflies)

    Wings held rooflike over abdomen; cerci absent; tarsi with five segments …….. …….. Order NEUROPTERA (antlion, lacewings, owlflies)

15. Tarsi with 2 or 3 segments; minute, soft-bodies insects, usually less than 5 mm long ……..…… Order PSOCOPTERA (psocids or booklice and barklice)

    Tarsi with 5 segments; size variable …… 16

16. Wings covered with fine long hairs and held rooflike over body when at rest; females without sting …… Order TRICHOPTERA (caddis flies)

    Wing without long hairs, held in a vertical position or horizontal overy body when at rest; females with a sting ……..…. ……..Order HYMENOPTERA (sawflies, ichneumon, ants, wasps, bees)

17. Insects fixed to host plant and not capable of locomotion; head and jointed legs not distinct; body covering waxy or scaly ….. Order HOMOPTERA (scale insects)

    Insect capable of locomotion; head and legs distinct …… 18

18. Antennae very short, inconspicuous and not projecting in front of head ectoparasites of birds and mammals …… 9

    Antennae long and projecting in front of head; free-living, not ectoparasites except in family Cimicidae or bedbugs …… 21

19. Body compressed or flattened laterally; legs fitted for jumping ……. …….. Order SIPHONAPTERA (fleas)

    Body depressed or flattened dorsoventrally; legs not fitted for jumping …… 20

20. Mouthparts for piercing and sucking ……. Order PHTHIRAPTERA (Anoplura) (sucking lice)

    Mouthpart for chewing …… Order PHTHIRA[TERA Mallophaga) (biting lice)

21. Body covered with scales …… 22

    Body not covered with scales …….. 23

22. Abdomen with threadlike tails and stylelike appendages on some segments; mouthparts for chewing …….. Order THYSANURA (silverfish)

    Abdomen without tails and appendages; mouthparts for sucking, proboscis coiled when not in used …….. Order LEPIDOPTERA (wingless moth)

23. Abdominal tip forceps-like …….. Order DERMAPTERA (earwigs)

    Abdominal tip modified …….. 24

24. Cerci present as tubby or long appendages; insects with tough exoskeleton…… Order ORTHOPTERA (grasshopper)

Cerci absent; insects soft or hard bodies …… 25

25. Tarsi with 4 to 5 segments …… 26

    Tarsi with 1 to 3 segments …… 27

26. Abdomen distinctly constricted at the base; antennae usually elbowed; hard bodied insects …….. Order HYMENOPTERA (wasp)

    Abdomen not constricted at the base; antennae not elbowed, soft-bodies insects…… Order ISOPTERA (termites)

27. Tarsi with last segment bladderlike; proboscis cone shaped …… …….. Order THYSANOPTERA (thrips)

    Tarsi with last segment not modified; proboscis beaklike or mouthparts for chewing …… 26

28. Antennae with more than 6 segments; small louse like insects, less than 5 mm long ……. Order PSOCOPTERA (psocids or booklice

    Antennae with 3 to 6 segments; size variable …… 29

29. Mouthparts concealed with head; abdomen on ventral side usually with forked appendages for jumping; minute insects, about 5 mm long; usually soil inhabiting…… Order COLLEMBOLA (springtails)

    Mouthparts beaklike for sucking; abdomen not modified as above, small to medium sized insects; habitat variable …… 30

30. Beak arising from anterior parts of head …….. …….. Order HEMIPTERA (bedbugs, wingless bugs)

    Beak arising from posteroventral part of head, soft-bodied insects …… ……. Order HOMOPTERA (aphids and mealy bugs)

Name: _____

Coure/Year/Section:_____

Laboratory Schedule: _____

Results/Discussion

Table 1. Specimens classified into orders including their common names, type of mouthparts, antenna, wings and legs.

ORDER	COMMON NAME	TYPE OF MOUTHPARTS	TYPE OF ANTENNAE	TYPE OF WINGS	TYPE OF LEGS

Question to answer

In tabular form, enumerate the different insect orders and indicate their economic importance and type of metamorphosis.

Table 2. The orders of insects including their economic importance and type of metamorphosis

ORDER + ETYMOLOGY	ECONOMIC IMPORTANCE	TYPE OF METAMORPHOSIS

References

Baltazar, C. R. and N. P. Salazar. 1979. Philippine Insects. An Introduction. UP Press. Quezon City, Philippines. 130 p.

Boror, D. J., D., M. De Long and C. C. Triplehorn. 1970. An Introduction to the Study of Insects.

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Laboratory Exercise No. 4

ASSOCIATING MICROORGANISM WITH DISEASED PLANTS

Introduction

Diseases in plants are caused by abiotic (non-living; non-parasitic) and biotic (living; parasitic) (Figure 1). The abiotic agents are usually the environmental factors, while the biotic agents are organisms, among which are bacteria, fungi, prokaryotes (bacteria and mollicutes phytoplasma and spiroplasmas, viruses, nematocytes, protozoa and parasitic higher plants. All of these depend on the host plant for food and survival. When a biotic agent is the cause of a disease, it is always associated with the diseased plants. The presence of an organism on or in a plant indicates that it is probably the cause of the disease. However, not all microorganisms associated with the diseased plants are causal agents of plant disease.

Objective

At the end of this laboratory exercise, the students should be able to:

1. become familiar with various microorganisms associated with diseased plants.

Materials

The following are the materials that should be used in this laboratory exercise:

1. Bacterial diseases such as:
   - Bacterial leaf blight of rice
   - Bacterial spot of tomato
   - Bacterial leaf streak of rice
   - Soft rot of vegetables

2. Fungal diseases such as:
   - Anthracnose of mango
   - Leaf blight of corn
   - Leaf spot of corn
   - Corn smut
   - Corn rust
   - Downy mildew of plants
   - Powdery mildew of plants
   - Leaf mold of okra or tomato
   - Orange gall of calamismis/winged bean
   - Rice blast

3. Nematode diseases
   - Root knot of vegetables (okra, pepper, tomato, eggplant)

4. Glass slides and cover slips

5. Razor blades/Dissecting needles

6. Dropping bottles with distilled water

7. Compound microscope

8. Dissecting microscope

Procedure

A. On bacterial diseases:

1. Cut small pieces of the advancing portion of the diseased tissue with a sharp blade.
2. Mount in water on a clean glass slide, put cover slip and examine under the low power objective. Bacterial ooze should come out from the tissues.
3. Draw the signs microscopically observed on/in the diseased tissues.

B. On fungal diseases:

1. Scrape surface of diseased parts of plants using a sharp razor blade.
2. Mount in water, put cover slip and examine microscopically.
3. In addition, mount thin section of advancing portion of the lesion or diseased area, mount in water on a clean glass slide, put cover slip and examine under the microscope.
4. Note the different fruiting structures of the different fungi. Draw. Label accordingly.

C. On nematode diseases:

1. Examine the enlarged portion (galls) of roots of nematodes-infested plants.
2. Compare root-knot galls with Rhizobium nodules (N-fixing root nodules) on the roots of leguminous plants. Draw.
3. Place root-knot infected roots in a watch glass or Petri dish containing water.
4. With the use of dissecting needles, tease the tissue apart. Examine the material under the dissecting microscope for the presence of the nematodes.
5. Look for the enlarged, lemon-shaped (female) and the needle-shaped (male) nematodes. Draw and label accordingly.

Results/Observations

1. Bacteria

Bacterial ooze	Bacterial cells

2. Fruiting structures of different fungi.

3. A. Root nodules vs Root-knot galls

Root nodules	Root galls

B. Female and male root-knot nematodes (RKN)

Female RKN	Male RKN

Question to answer

1. Are all microorganisms associated with a diseased plant pathogenic? Why?

References

Agrios, G. N. 1997. Plant Pathology 4th ed. Academic Press. New York. 635 p.

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Laboratory Exercise No. 5

RECOGNIZING SYMPTOM AND SIGNS

Introduction

Disease is a harmful alteration of the normal physiological and biochemical development of the plant. To be able to diagnose or identify specific plant diseases, it is important to know the characteristic symptom and signs including other factors that may be related to the disease process. Correct diagnosis of the plant disease is necessary for recommending the appropriate control measures and in plant disease survey.

Symptoms are expression by the suscept or host of a pathologic condition by which a particular plant disease may be distinguished from other diseases. It also includes any measurable host response to infection such as increased respiration and increase leaf temperature. Symptoms usually change as the disease progresses since disease is often dynamic process. Symptoms may also vary according to the environment, the host variety and race of the pathogen involved. On the other hand, different pathogens may cause formation of identical symptom. It has been variously described as primary or secondary, localized or systemic and histological or morphological.

Signs of plant disease refer to the structure of the pathogens that are found associated with the infected plant part. Some of these structures may not always be present in diseased plant because their formation depends on environmental conditions. Most of these signs are best seen and distinguished under a microscope. Examples of signs are fungal mycelia, spores and fruiting bodies, bacterial ooze, nematodes at various growth stage and plant parts of phanerogams.

Objective

At the end of this laboratory exercise, students are expected to be acquainted with different signs and symptoms of plant diseases.

Methodology

Student should only focus on a particular plant disease whether it is due to fungi, bacteria, virus, viroids, etc.

1. Examine a disease plant and describe the symptoms observed. Make an illustration of the symptom seen.

Questions

1. Why is the use of symptom alone not a reliable basis in the identification of a plant disease?
2. What are the symptoms manifested in the following diseases of plants?
   a. Banana bunchy top disease
   b. Ring spot of papaya
   c. Tungro disease of rice
   d. Bacterial wilt of tomato
   e. Soft rot of vegetables
   f. Powdery mildew of tomato
   g. Cadang cadang disease of coconut
   h. Peanut rust
   i. False smut of rice
   j. Wilting of tomato due to root knot nematode

3. Define the following terms:
   a. Sclerotial bodies
   b. Phanerogams
   c. Mycelia
   d. Parasite
   e. Saprophyte
   f. Host
   g. Pathogen
   h. Infection court

4. What signs could be found in the following diseases of plants:
   a. Orange gall of winged bean
   b. Soft rot of carrot due to bacteria
   c. Galling of tomato due to root knot nematode

References

Agrios, G. N. 1997. Plant Pathology. 4th ed. Academic Press. New York. 635 p.

Compilation of Hands-outs in Plant Pathology 11 (Diagnosis of Plant Diseases), Department of Plant Pathology, University of the Philippines, Los Baños, College, Laguna.

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Laboratory Exercise No. 6

DIAGNOSING PLANT DISEASE

Introduction

Diagnosis of plant diseases is the identification after an examination of their symptom and signs as well as other factors involved in or related to the disease production. Correct diagnosis is important in plant pathology as is animal or human medicine because it is obvious that one must know first what the disease is before one can suggest control measure. In plant pathology, it is also important in such activities as plant disease survey and in extension work.

In plant disease diagnosis, the symptoms and signs of the disease as exhibited by the plant and causal organisms or agents, respectively are heavily relied upon. Hence, in order to diagnose disease correctly one must know and familiar with the different types of symptoms and the identity of the causal agent. In addition to symptoms and signs, it is also important to consider other factors such as the previous crops, location of the land, the pesticide and the fertilizer applied, the type of irrigation used and others. In some cases, these factors will help much in the correct diagnosis of a plant disease.

Objectives

At the end of this laboratory exercise, students should be able to:

1. learn the rudiments of plant disease diagnosis.
2. know some of the types of symptoms of disease plants.
3. become familiar with signs of disease.
4. Identify common diseases based on their symptoms and signs.

Procedure

Students should collect first the different plant diseases mentioned in each category.

1. Vascular wilt

   Vascular wilt of solanaceous plant – *Pseudomonas solanacearum*

   Examine infected plants of tomato, eggplant and pepper. Note the general appearance of the affected plants. Cut cross and longitudinal section of stem and roots of infected plants. Note the browning of the vascular area. Place the cut stem and roots in a Petri dish lines with moist tissue paper. Set aside for

several minutes. A slimy white to brownish ooze will flow from the vascular area. These are mostly bacteria. The ooze is a sign of the disease.

2. Rust

   Coffee rust – *Hemeilia vastatrix*

   Examine infected plant and compare its general appearance with the non-infected ones. Gather infected leaves and note the orange powdery like structure on the lower surface. Note the symptoms on the upper leaf surface (curling of the margin). Mount some of the orange powdery growth and examine closely the color, shape and ornamentation of the spores. This spore is called uridospores.

3. Powdery Mildew of Roses - *Erysiphe sp.*

   Examine the infected plant and note the white powder-like structure usually located on the surface of the leaves. Mount some of the whitish growth and examine microscopically. Note the conidiophore and conidia in chain. Many of the conidia you will find are separated from the chain.

4. Rot

   Bacterial soft rot of fleshy tissues – *Erwinia carotovora*
   Diplodia rot of mango – *Diplodia natalensis*

   Examine disease specimens of the above disease and note the color and consistency of the lesion (disease area). Look for signs of the disease. Mount portion of the lesions and observed microscopically the appearance and arrangement of host cell as well as the presence of any structure of the pathogen.

5. Knot

   Root knot of tomato, pepper and other plants – *Melaidogyne incognita*

   Examine plant infected by root knot nematode. Note the general appearance of the plant. Look for infected root which are irregularly swollen. Inside this swollen root, one may find nematode. Tease this part or make a smash, mount and examine under the microscope.

A. Fungal Plant Diseases

1. Disease:
   Pathogen:

Symptom	Sign

2. Disease:
   Pathogen:

Symptom	Sign

3. Disease:
   Pathogen:

Symptom	Sign

4. Disease:
   Pathogen:

Symptom	Sign

B. Bacterial Plant Disease
   1. Disease:
      Pathogen:

Symptom	Sign

   2. Disease:
      Pathogen:

Symptom	Sign

C. Nematode

1. Disease:
   Pathogen:

Symptom	Sign

D. Viral Diseases

1. Disease:
   Pathogen:

Symptom	Sign

2. Disease:
   Pathogen:

Symptom	Sign

Questions to Answer

1. Define the following symptoms:
    a. Anthracnose –
    b. Blight –
    c. Blotch –
    d. Canker –
    e. Chlorosis –
    f. Damping-off –
    g. Die-back –
    h. Gall –
    i. Hyperplasia –
    j. Hypertrophy –
    k. Mildew –
    l. Mosaic –
    m. Mottle –
    n. Mummification –

o. Rosette –

p. Rot –

q. Rust –

r. Scab –

s. Shot-hole –

2. Compare downy mildew from powdery mildew of crops based on symptoms and time of occurrence.

3. What are the three major factors involved in the development of disease in

References

Agrios, G. N. 1997. Plant Pathology. 4th ed. Academic Press. New York. 635 p.

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SOME IMPORTANT PLANT DISEASES COMMON IN THE PHILIPPINES AND THEIR CAUSAL AGENTS

Plant Disease	Causal Agent
A. Fungal Disease	
Downy mildew of corn	*Peronosclerospora philippinensis*
Downy mildew of Cucurbit	*Pseudoperonospora cubensis*
Downy mildew of grapes	*Plasmopara viticola*
Powdery mildew of Beans	*Erysiphe polygoni*
Corn rust	*Puccinia polysora*
Sorghum rust	*Phakopsora sorghi*
Soybean rust	*Puccinia phaseoli*
Coffee rust	*Hemeleia vastatrix*
Bean rust	*Uromyces phaseoli*
Peanut rust	*Phakopsora arachidis*
White rust of mustard	*Albugo candida*
White rust of kangkong	*Albugo ipomoea panduranae* *Albugo ipomoea-aquatica*
Smut of corn	*Ustilago maydis*
Damping-off of vegetables	*Pythium debaryanum*
Late blight of eggplant	*Phytophthora parasitica*
Late blight of potato & tomato	*Phytophthora infestans*
Leaf blight of gabi	*Phytophthora colocasiae*
Clubroot of crucifers	*Plasmodiophora brassicae*
Powdery scab of white potato	*Spongospora subterranea*
Orange gall of winged bean	*Synchytrium psophocarpi*
Brown spot of corn	*Physoderma maydis*
Leaf spot or Blotch of banana	*Cordana musae*
Aspergillus rot of onion (green)	*Aspergillus niger*
Mold of citrus	*Penicillium digitatum*
Narrow brown spot of rice	*Cercospora oryzae*
Leaf mold of okra	*Cercospora belmoschi*
Leaf spot of mungbean	*Cercospora cruenta*
Leaf spot of corn	*Bipolaris maydis*
Brown spot of rice	*Helmintosporium oryzae*
Early blight of tomato	*Fusarium moniliforme*
Late blight of tomato	*Alternaria solani*
Rhizoctonia stalk & stem rot of plant (sunflower, sorghum, sugar cane etc)	*Fusarium solani*
Sheath blight of rice and corn	*Sclerotium rolfsii*
Phomopsis blight of eggplant	*Phomopsis vexans*
Jackfruit bud rot	*Rhizopus nigricans*
Anthracnose of pepper	*Collectotrichum capsici*
Citrus scab	*Elsinoe fawcetti*
Black spot of rose	*Marsoninna rosae*
B. Bacterial diseases	

Bacterial leaf streak of rice	*Xynthomonas oryzae pv. oryzicola*
Bacterial leaf blight of rice	*Xynthomonas oryzae pv. oryzae*
Citrus canker	*Xanthomonas axonopodis pv. citri*
Bacterial wilt of crops (Solanaceous crops, Abaca, Banana, peanut, ginger, cowpea, ampalaya etc)	*Ralstonia solanacearum*
Red stripe of sugarcane	*Xanthomonas albidineans*
Bulbrot of onion	*Burkholderea gladioli pv. aliicola*
Black rot of Broccoli, cabbage, caluliflower and radish	*Xanthomonas campestris pv. campestris*
Bacterial blight of soybean	*Pseudomonas savatonoi subsp. glycinea*
Cassava leaf blight	*Xathomonas axonopodis pv. manihotis*
Common blight of cowpea/bean	*Xathomonas axonopodis pv phaseoli*
Soft rot of vegetables and orchids	*Pectobacterium carotovorum subsp. carotovorum*
Bacterial wilt of cucurbits	*Erwinia tracheiphlia*
Crown gall	*Agrobacterium tumefaciens*
Canker of tomato	*Corynebacterium michiganense*
Potato scab	*Streptomyces scabies*
Sweet potato scab	*Streptomyces ipomeae*
C. Viral diseases	
Cucumber mosaic	Cucumber mosaic virus (CMV)
Tobacco mosaic	Tobacco Mosaic Virus (TMV)
Tomato mosaic	Tomato Mosaic Virus (TMV)
Bunchy top of banana/abaca	Abaca/Banana Bunchy Top Virus
Abaca mosaic	Abaca Mosaic Virus (AMV)
Tungro of rice	Rice Tungro Virus
Papaya Ringspot	Papaya Ringspot Virus (PRSV)
Tomato Leaf Curl	Tomato Leaf Curl Virus (TLCV)
Tristeza of citrus	Citrus Tristeza Virus (CTV)
D. Diseases caused by Nematodes	
Root knot of tomato	*Meloidogyne incognita*
Slow decline of citrus	*Tylenchulus semipenetrans*
Root rot, blackheads, or toppfing	*Radopholus similes*
Yellow dwarf of black pepper	*Radopholus similes*
Root knot disease	*Meloidogyne* spp.
Root decay of papaya	*Rotylenchus reniformis*

Laboratory Exercise No. 7

WEED CLASSIFICATION

Introduction

A weed is any plant, native or non-native, that interferes with crop production by doing more harm than good and has a habit of encroaching where it is not wanted (California Weed Science Society, 2004). It competes with crops in terms of nutrient, light, water and space, and thus affects crop yield and quality. It may interfere with harvesting operation. Weeds are also known to have allelopathic effect on crop germination and growth. Although it can provide shelter for natural enemies against other pests, it is also possible that it harbors diseases and other pests. The quality of the role of weeds in the ecosystem is evidenced by its having both harmful and beneficial impacts.

The weed's greatest effect is on agriculture. There is no reliable study of worldwide damage due to weeds, but it is widely known that losses caused by weeds exceed the losses from any other category of agricultural pests like insects, nematodes, diseases, rodents, etc (Rao, 1983). Yield reductions caused by uncontrolled weed growth in a crop season can range from 44 to 96^{o}m (Ampong-Nyarko and De Datata, 1991).

In determining the methods needed for control or eradication of weeds, it is important to know its life habit, habitat, body texture, growth habit and gross morphology; which are the bases or categories for classifying weeds. Weed classification aims to group together weeds whose similarities are greater than their differences. Although, this type of classification is relatively artificial compared to the botanical classification by families, genera, species and varieties, the knowledge would impart initial characterization of weeds critical to its identification; which is the information needed for a weed control program.

The five categories of weed classification are as follows:

A. Life-habit Classification
   a. Annual
   b. Perennial
      b1. Simple
      b2. Creeping

B. Habitat-based Classification
   a. Terrestial
      a1. Wetland
      a2. Dryland

b. Aquatic
   b1. Floating
   b2. Submerged
   b3. Emergent

C. Body Texture-based Classification
   a. Woody
   b. Herbaceous

D. Growth Habit-based Classification
   a. Shrubs or Bushes
   b. Vines

E. Gross Morphology-based Classification
   a. Grasses
   b. Sedges
   c. Broadleaves

Objectives

At the end of this laboratory exercise, students should be able to:

1. differentiate a weed from a crop;
2. group weeds based on the different categories of weed classification;
3. discuss the significance of classifying weeds; and
4. prepare a scrapbook of carefully curated weed specimens representing each type within a category of weed classification.

Procedure

1. The class will be provided with fresh or dried weed specimens representing the types of weeds based on the 5 categories of weed classification. Each student must examine each weed species and accomplish attached worksheet.
2. The student is expected to collect and submit to the laboratory instructor properly dried specimens of weeds representing each type of the 5 categories of classification.
   2.1. Each weed specimen submitted must contain the following information:
      - Scientific name
      - English common name
      - Local name(s)
      - Family (where classified, botanically)
      - Weed classification category
      - Known control measures for the weed
      - Date of collection
      - Location where collected
      - Collector's name

2.2. Herbarium Specimen Preparation

- Collection. The best time to collect weeds is in the afternoon of a sunny day. The desired size of a weed sample is about 30 to 40 cm. Two or three samples for every species can be collected, the best one selected after drying. Samples collected may be placed in plastic bags to prevent rapid wilting. A collection number (which is the field number) must be attached to the sample and descriptions in the field notebook must be recorded for future reference. Notes may include plant characters and as specified in 2.1, and also the conditions during the collection time.
- Pressing. While specimens are fresh, these must be arranged between sheets of newspaper, keeping in mind that the tag (with the number) must be intact. Corrugated board inserted between each pressed weed will absorb extra moisture. Place a heavy weight on top to ensure it is tightly packed.
- Drying. This aims to extract extra moisture from the specimen, and can be done by placing the setup under the sun. Duration for drying depends on the moisture content of the specimen.

2.3 Submission of Weed Collection

Dried specimens must be mounted on boards (black Bristol board, measuring 12 x 17.5 inches) and complied to make a scrapbook.

Important Cropland Weeds in the Philippines ((Moody, et al., 1984)

1. Wetland

English name	Scientific name
Barnyard grass	*Echinochloa glabrescens* *Echinochloa crusgali spp. hispidula*
Bulrush	*Scirpus maritimus*
Fimbristylis	*Fimbristylis littoralis*
Gooseweed	*Sphenoclea zeylanica*
Jungle rice	*Echinochloa colona*
Knotgrass	*Paspalum distichum*
Pickerel weed	*Monochoria vaginalis*
Rice flat sedge	*Cyperus iria*
Small flower umbrella plant	*Cyperus difformis*
Sprangle top	*Leptochloa chinensis*
Water lettuce	*Pistia stratiotes*
Water purslane	*Ludwigia octovalvis*

2. Dry land fields

Beggarticks	*Bidens pilosa*
Bermuda grass	*Cynodon dactylon*

Celosia	*Celosia argentea*
Cogon	*Imperata cylindrica*
Common purslane	*Portulaca oleracea*
Crowfoot grass	*Dactyloctenium aegyptium*
Day flower	*Commelina benghalensis*
Eclipta	*Eclipta prostrata*
Garden spurge	*Euphorbia hirta*
Goose grass	*Eleusine indica*
Horse purslane	*Triantheme portulacastrum*
Itch grass	*Rouboelila cochinchinensis*
Indian heliotrope	*Hellotropium indicum*
Jungle rice	*Echinochloa colona*
Lantana	*Lantana camara*
Large crabgrass	*Digitaria sanguinalis*
Little iron weed	*Vernonia cinerea*
Paspalidium	*Paspalidium flavidum*
Purple nutsedge	*Cyperus rotondus*
Slender amaranth	*Amaranthus viridis*
Sensitive plant	*Mimosa pudica*
Southern sandbur	*Cenchrus echinatus*
Spindle top	*Cleoma rutidosperma*
Spiny amaranth	*Amaranthus spinosus*
Spreading dayflower	*Commelina diffusa*
Synedrella	*Synedrella nodiflora*
Three-lobe morning glory	*Ipomea triloba*
Tridax	*Tridax procumbens*
Tropic ageratum	*Ageratum conyzoides*

References

Ampong-Nyarko A. and S. K. De data. 1991. A Handbook of Weed Control in Rice. International Rice Research Institute. 113pp.

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Muzik T. J. 1978. Weed Biology and Control. McGraw-Hill, Inc.

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WORKSHEET FOR WEED CLASSIFICATION

CPT 21 Form 1
Name: ___________________________
Lab Schedule: _____________________

Scientific Name	English Name	Local Name(s)	Life Habit	Habitat	Body Texture	Growth Habitat	Gross Morphology	Distinguishing Character

References

Ampong-Nyarko A. and S. K. De data. 1991. A Handbook of Weed Control in Rice. International Rice Research Institute. 113pp.

Moody, K., C. E. Munroe, R. T. Lubigan and E. C. Paller, Jr. 1984. Major Weeds in the Philippines. Weed Science Society of the Philippines, University of the Philippines at Los Baños, College Laguna, Philippines.

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Laboratory Exercise No. 8

WEED SURVEY IN CROPPED LANDS

Introduction

Weeds pose threats to crops and humans. They are important factors in eliciting crop losses as other pests. In non-agricultural area, they are potentials human hazard. Pollen of weeds may cause hay fever or allergies and toxic chemicals present in them may cause skin irritations and rashes.

Losses due to weeds may be manifested in a variety of ways. Weeds reduce crop yield by competing directly with the crop plant for the essentials for growth. Some of them serve as hosts of other crop pests. They impair the quality of the produce, make land preparation more expensive and time consuming and increase the cost of other farm operations. The number of weed propagules in the soil, the species of weeds present and the time of weed competition largely determine the extent of damage that weeds will cause to the crop.

Crop production is oftentimes regarded as a struggle against pests including weeds. Field activities like land preparation and flooding which are aimed at producing a profitable crop are undertaken primarily to suppress the growth of these undesirable plants. In rice production, the following are some of the pernicious effects of weeds which in the majority of instances result in monetary losses: (1) Yield reduction; (2) Increased competition for light, water and nutrients; (3) Increased cost and time of land preparation; (4) Acting as alternate hosts for insect pests and diseases; (5) Contamination of harvested grains with weed seeds; and (6) Clogging of water channels which makes water management inefficient.

Weed possesses survival mechanisms and adaptations that enable them to exploit the ecological niches left open in those environments altered by man for his use. The primary organs responsible for survival are adequate reserve supplies of seeds and vegetative propagules. Characteristics of adaptation are their morphology and physiology that are expressions of very high degree of specialization.

Weeds can be disseminated by natural forces as well as man and animals. Many seeds of lowland rice weeds may be found in clean rice sold in the market.

There are two categories by which one can assess weed communities; quantitative and qualitative. Quantitative assessment tells us the number of individual species, measurements of height, size and spaces occupied, while qualitative assessment gives us a description of what species are grouped with a certain weed.

Objectives

At the end of this laboratory exercise, students should be able to:

1. know the kind of weeds associated with different crops;
2. discuss the reasons for the predominance and the absence of each species in each crop culture; and,
3. understand the factors that affect the occurrence of weeds in field areas.

Procedures

1. The class will visit cropped lands planted to rice and other available vegetable-planted areas in the vicinity of the college.

2. Students must identify the different weed species in each crop or agro-ecological area, classify the weeds based on gross morphology, habitat and life habit, and rate the abundance of each weed using the 5-point scale developed by Tansely and Chipp:

Rating Scale	Description
1	Rare
2	Occasional
3	Frequent
4	Abundant
4	Vary abundant

Questions to Answer

1. What are the common weeds associated with the cropped-land surveyed?

2. What factors influence the predominance of a weed in a given area, and what factors influence its absence?

References

Anderson, W. P. 1983. Weed Science and Principles. West Publishing Co. U. S. A. 598 pp.

Ashton, F. M. and T. J. Monaco. 1991. Weed Science Principles and Practices. 3rd ed. John Wiley and Sons, Inc. U. S. A. 466 pp.

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Pancho J. V. and S. R. Obien. 1995. Manual of Ricefield Weeds in the Philippines. Philippine Rice Research Institute, Nueva Ecija, Philippines.

BIOGRAPHICAL SKETCH

The author was born in Kalumpang, Tayabas, Quezon on September 28, 1961. He is the third child of the nine children of Leonardo L. Durante (deceased) and the former Iluminada L. Sayas.

He completed his elementary education at the Kalumpang Elementary School (1974) where he graduated with honors. He finished his secondary education at the Quezon Provincial High School now Quezon National High School in Lucena City (1978) and then pursued and finished his Bachelor of Science in Agriculture, major in Crop Protection at the Central Luzon State University, Muñoz, Nueva Ecija (1983) as a recipient of the COCOFED Scholarship Program.

After graduation, he was employed as assistant instructor at the Southern Luzon Polytechnic College (SLPC) now Southern Luzon State University (SLSU), Lucban, Quezon in June 1983 where he taught Biology, Zoology, Entomology and Plant Pathology. In SLPC, he got promoted to the position of instructor, assistant professor, associate professor and professor. While serving the university, he was awarded a scholarship by the Southeast Asian Regional Center for Graduate Studies and Research in Agriculture (SEARCA) which helped him to obtain his Masters' degree in Crop Protection (Plant Pathology) at the Central Luzon State University in 1993. In June 1995, he was awarded a fellowship sponsored by the Cavite State University Faculty and Staff Development Program and SLPC to pursue a Doctor of Philosophy degree in Horticulture.

The author had the opportunity of attending international trainings such as the 10th Regional Training on Development Strategies for Farmers Communities held at SEARCA Headquarter, Los Baños, Laguna from September 15 to October 24, 1986. He was a recipient of the Asian Farm Youth Exchange Program (AFYE) to Taiwan, Republic of China from December 8, 1987 to February 7, 1988.

He has held several positions while serving the University. Among them are: Officer In-charge, School of Agriculture in 1988; Chairman, Agriculture Department in 1990; Assistant Dean of the School of Agriculture, Dean of the College of Agriculture, Campus Director, SLSU – Tiaong Campus from 2005 to 2013 and Director of Research Services from December 2013 to July 2016. At present he holds an item position of Professor II.

The author is married to former Maria Encarnacion S. Cajigal of Lucban, Quezon with whom he is blessed with two inspiring and sprightly sons and daughter, Ajerico, Emmnuel and Maria Ana.

VISION STATEMENT

Southern Luzon State University as an excellent academic Hub in its curricular programs transdisciplinary researches and responsive extension services.

MISSION STATEMENT

The University commits to develop a sustained culture of delivering quality service and undertaking continuous innovations in instruction, research and extension in its relevant curricular programs supportive of national and global development goals.

CORE VALUES

GO	**God-loving**
S	**Service-Oriented**
L	**Leadership by Example**
S	**Sustained Passion for Excellence**
U	**Undiminished Commitment to Peace and Environmental Advocacy**