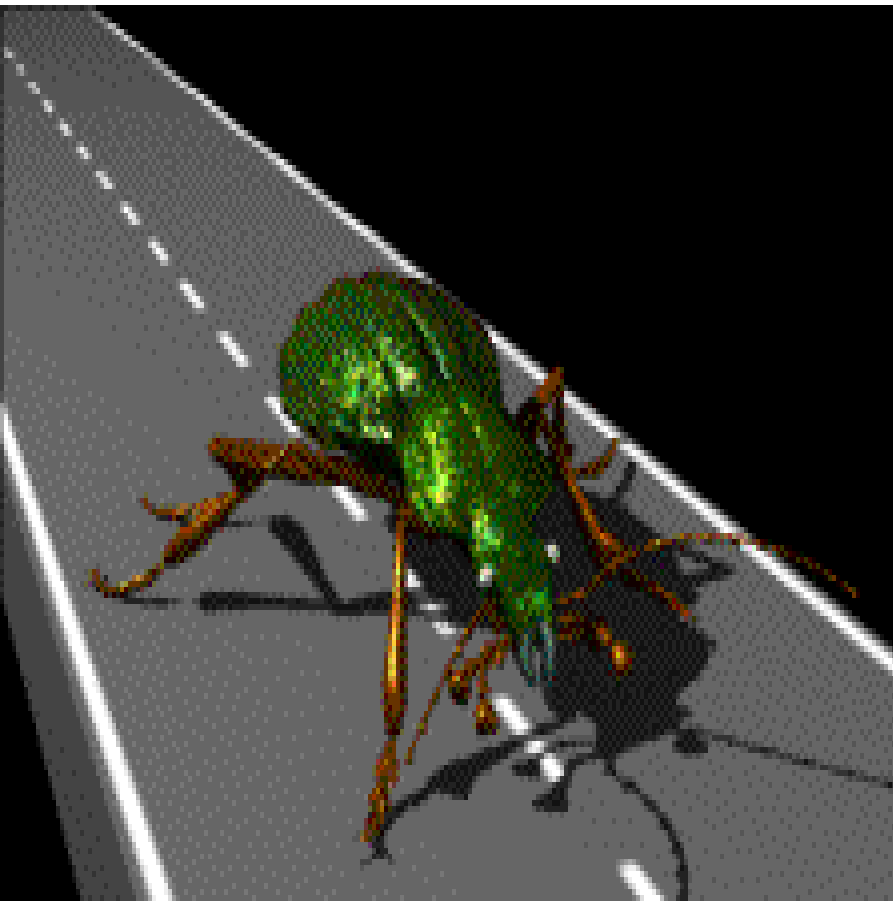


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# COURSE TITLE: Horticultural Entomology



# Section one: - Introduction.

- Definitions
- Fields of Entomology
- Relationships of insects with arthropods classes.
- Importance of class insect for horticultural crops
- Success of insects

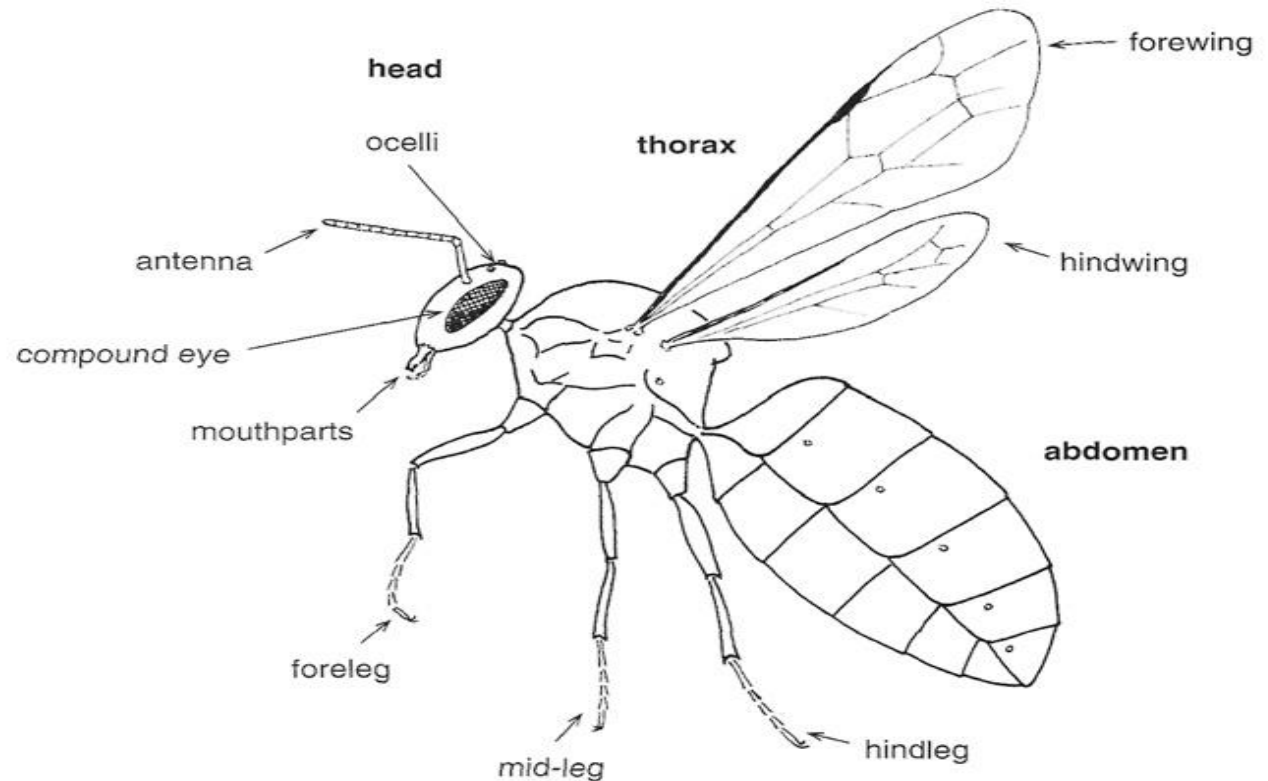
# INTRODUCTION

## 1.1. Definition

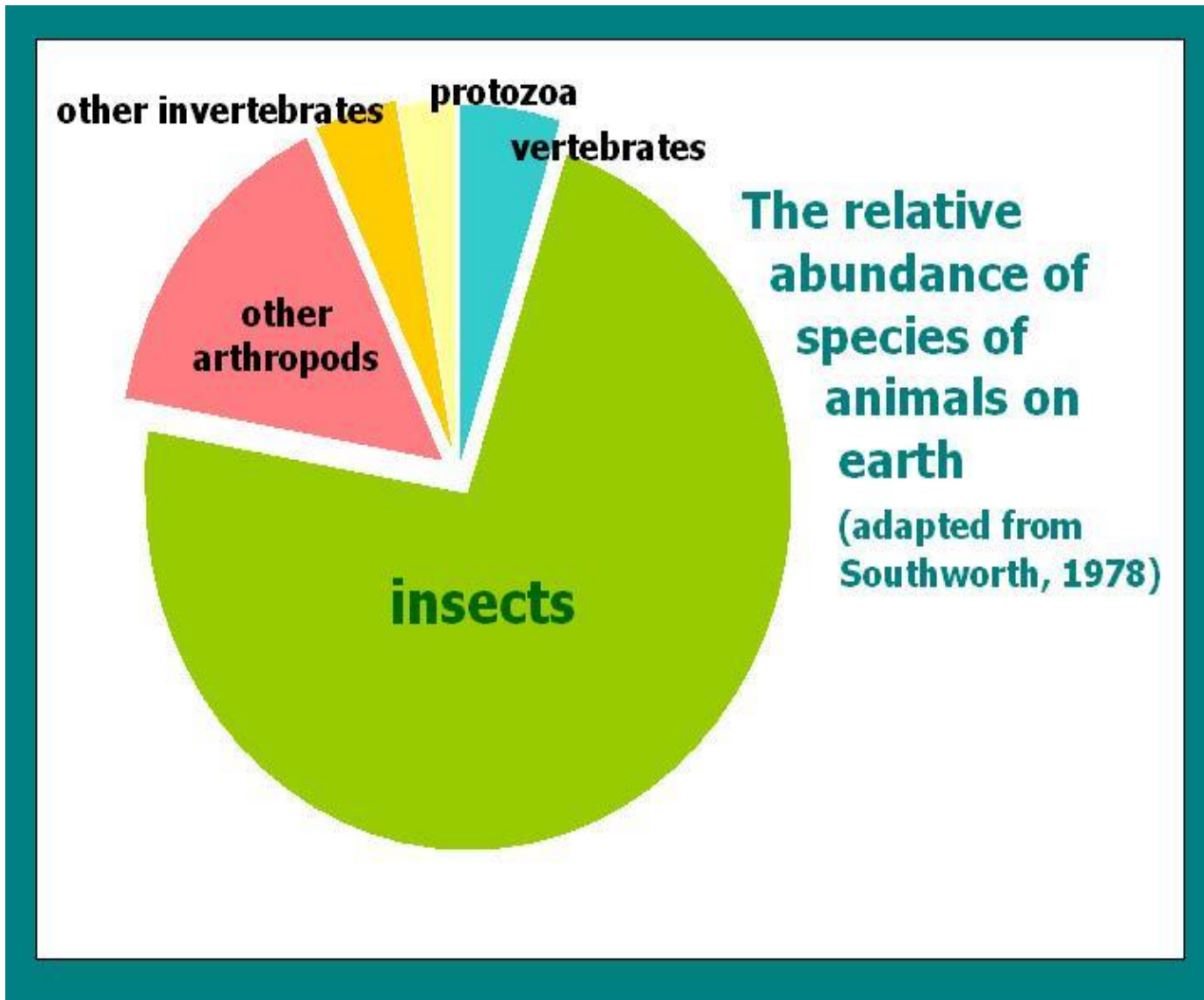
- ❖ entomology' comes from the Greek word '
  - entomos'- meaning insects and
  - logy ---meaning study    Study of insects
  
- ❖ Another word for six-legged arthropods is '**hexapoda**'
  - 'hexapoda' which comes from the Latin word meaning six legged.
  - **Arthropods** (Greek-arthros means jointed, and podos means legs).
  - **Entomologists?**

# Definitions of insects

- Insects are tracheae arthropods in which the body is divided in to **head, thorax, and abdomen.**
- The head bears a single pair of **antennae,**
- The thorax carries three **pairs of legs** and usually one or two **pairs of wings.**



- nearly 75% of the all known animal species
- Today insects colonized nearly all areas of life in the world.
- Some of them are adapted to water for their whole life (like **water beetles and water bugs**) or only for certain period of development (egg, larvae, pupae) like damselflies and mosquitoes.
- Other are terrestrial still some others are also adapted to extreme conditions of the earth like caves and deserts



Abundance of insects relative to other animals

## ❖ **Fields of Entomology**

- From the economic point of view, branches of entomology:-
  - **Agricultural entomology-** crops and the stored commodities
  - **Medical entomology-** transmitting human diseases.
  - **Veterinary entomology-** may be beneficial or harmful to the animals



- **Industrial entomology**- related with wood, wool, cloth and the other industrial materials.
- ✓ It also includes the study of beneficial insects like honey bee, and silkworm.
  
- **Forest entomology**- insects concerning with forest plantation.
  
- **Forensic Entomology** Study and use of insects in crime investigations

# **Insects and their relation to humans**

- insect species has a lot of relations
- ✓ among insects, man and his environment
- Some insects are useful to humans, some are harmful and some are indifferent

- **Benefit of insects to humans**

- **i. Insects producing commercial products**

- The larvae of silk worm produce commercial silk fibers.
- The honey bees produce honey as well as bee wax.
- The bee wax is used in medicine, cosmetics, ink, carbon paper, electrical insulators, sewing threads, and polishes for floor, furniture, shoe and leather.

- **ii. Insects which help in pollinating blossoms**
- like butterflies, beetles, flies, etc.
- Without the presence of pollinating insects some plant species may not survive or exist.
- **iii. Some insects serve as food for**
- many animals like- humans, birds, chickens, etc.
- Crickets are edible: 100 grams contain 121 calories and 13 grams of protein.
- **iv. Some insects serve as predators**

- **v. Insects are subjects of research, art, and ornament**
- For instance, for toxicological studies, genetics, physiology and so on.
- **Biologists** choose insects to work with insects for many **reasons**;
  - ✓ the ease of maintaining laboratory cultures
  - ✓ short shelf life cycle and availability of many individuals
  - ✓ the few ethical problems concerning the experimental use

- vi. **Some insects increase soil fertility** by decomposing dead plants and animals. For example, dung beetle, termites, etc.
- Entomologists also know that less than 1% of all insects are harmful to humans while others are useful or neutral groups.

- **Harmful effects of insects**
- **i. Insects damaging growing plants as food**
- such as aphids, thrips, plants bugs, stalk borers, etc.
- **ii. Insects damage growing plants by using them for breeding or for the construction of nests or shelters. E.g., cicadas, thrips, crickets, ants, etc.**
- **iii. Insects as external or internal parasites of animals. E.g. blood sucking fleas, bed bugs, lice, etc.**

- **iv. Insects as carriers of animal diseases.** E.g. mosquitoes , Tsetse fly, human louse-
- **v. Annoying** (aggravating, irritating ) insects like house flies, sting bugs, cockroaches, etc.
- **vi. Few venous insects.** For example- caterpillar with poisonous hairs causing dangerous inflammation of the skin
- **vii. Insects spoil** stored products and other materials



- **Relationships with other arthropods**
- Arthropods (Greek-arthros means jointed, and podos means legs).
- All of which are characterized by:
  - Metameric segmentation
  - Segments fused to form head, thorax, and abdomen
  - Majority of the segments possess pair of jointed appendages
  - Exoskeleton contains chitin secreted by epidermis
  - Metamorphosis takes place in the development
- ❖ **No animals, other than arthropods exhibit the above combinations of characters.**

## ❖ phylum of **arthropoda**

- **Class Crustacea**

- ✓ are a very diverse group with most members found in marine or freshwater habitats

- ❖ **their characteristic include:**

- ✓ The head and thorax are merged (**cephalothorax**) but they have distinct abdomen,

- ✓ They have a lot of appendages, mainly modified as walking legs, for swimming or as gills.

- ✓ Their Respiration system is by means of **gills**.

- ✓ They have two pairs of **antenna**.

# Sowbugs and Pillbugs - CRUSTACEA



- ***Class Myriopoda (innumerable feet)***
- These are wormlike and elongated animals.
- Their characteristics include:
  - They have no separation between thorax and abdomen, but they have clearly identified **head**.
  - They have many pairs of legs and one pair of antenna.
  - They are terrestrial and respiration by means of **tracheal** system.

They are terrestrial and respiration by means of tracheal system. e.g. centipedes ( Chilpoda), millipedes (Diplopoda)



- **Class Arachnids**
- Their characteristics include:
- They have two body regions: **cephalothorax** (head and thorax are merged) and abdomen.
- They have **four pairs of legs** and they **don't have antenna**.
- Mostly, they are terrestrial arthropods but some live in fresh water; and they respire by tracheal means. E.g. spider, scorpions, mites, tick

- **Class Insecta**

- The body is divided in head, thorax and abdomen;
- they have three pairs of legs
- single pair of antenna (some don't have);
- usually one or two pairs of wings (some don't have wing).
- They are mostly terrestrial, but some grow in fresh water.
- They live in all ecosystems (ubiquitous or cosmopolitan organisms)
- breath by means of tracheal system. Example- Insects (like house flies, grasshoppers, etc.)

# Adaptive features for the success of insects

- ❖ both abundance and distribution
- ❖ most successful group of living organisms on earth.
  - Approximately over 70 to 75 percent of the known animals are classified as insects,
  - The total number of insect species is more than all other animals put together,
  - i.e. there are about 1.35 million living animal species, and from this the insect carries greater than 900,000 species.



# The reasons for their success

- **Highly adapted to wide range of habitats:**
  - ❖ They exploit most of the habitable environments.
  - Some of them are resistant to adverse environmental conditions, e.g. arctic snow (- 20C<sup>0</sup>),
  - high mountain peaks,
  - certain fly larvae live in hot springs in hot springs (up to 80 C<sup>0</sup>),
  - others in lakes with a high salt content;

- **Functional wings:**

- Flight generally increases the insect's chances of survival and dispersal.
- It allows the insect to increase its feeding and breeding ranges
- It is effective mode of escape from predators
- It is also an efficient means of transportation
- to expand more quickly into new habitats and exploit new resources.

❖ to migrate over long distances by air

E.g. migratory locust, *Schistocerca gregaria*, can fly for up to 9 hours without stopping.

❖ wings of a large insect can generate a considerable amount of lift.

e.g. Green darner dragonflies (*Anax junius*) are able to fly carrying a load up to 15 times their body weight.

# Small size:

- small places in which to live.
- insects need small food or energy to complete development and sustain life
- Increases the available habitats and shelters
- Permits to escape from enemies

# Possession of exoskeleton:

- insects have a very hard outer covering called exoskeleton.
- Insects possess an exoskeleton made of **chitin**.
- This provides protection from predators and from desiccation
- reduced **evaporation**(**Minimizing of Waste Loss**)

# Diverse feeding:

- Modified mouthparts have evolved in insects that prepare them for survival on diverse food substances
- herbivores (e.g. grasshopper), scavengers (most soil living insects), omnivores, predators (preying mantids), parasites (some wasps)
- ❖ Extensive development of complete metamorphosis
- ❖ the immature and adults have evolved to feed on different food source
- ❖ They are not in competition.

# Quiescence and Diapause:

- insects survive adverse conditions such as low or high temp and water and food shortage by entering **dormancy**.
- **Quiescence** is the simplest type of dormancy.
- It is simply an immediate adverse condition (i.e., low temperatures).
- Diapause is arrested development induced by certain factors in advance of adverse conditions

- There are two types of diapause:
- **Obligatory** diapause is genetically controlled and affects every individual of every generation within a species regardless of environmental conditions.
- most insects living in temperate regions have developed obligatory diapause.
  
- **Facultative** diapause may or may not occur within a given individual or population of a species and depends entirely on the environmental conditions
  
- The most common factors inducing diapause in insects are photoperiod, temperature, maternal physiology, and the quality of host food.



# Reproductive Potential

- Reproductive success is one of the most significant measures of an organism's fitness.
- In insect populations, females often produce large numbers of eggs (high **fecundity**),
- most of the eggs hatch (high **fertility**),
- the life cycle is relatively short (often as little as 2-4 weeks).
- these three characteristics enable insects to produce large numbers of offspring.
- A typical female lays 100-500 eggs in her lifetime,

# Defense mechanism:

- insects use different defense mechanism, such as
- **Behavioral** defense: Insects will escape from natural enemies by crawling (e.g. leaf hoppers), flying (mosquito, housefly), jumping (grasshopper), dropping, etc.
- **Morphological** defense: Many structures used for defense. E.g. having exoskeleton, grasping leg of preying mantids, stingers of bees and wasps, etc.
- **Chemical** defense: chemical defenses are often grouped into nonvenomous repellent secretions and venoms injected into the attacker.

- **Protective color pattern:**
- Protective color patterns of insects are often grouped into cryptic coloration, warning coloration, deceptive coloration, and mimicry.
- Insects with cryptic coloration are called concealing or camouflage,
- Insects with warning coloration are often brightly colored and distasteful or poisonous to natural enemies.
- These insects, such as bees and distasteful caterpillars, are normally diurnal, and found in exposed places, and frequently occur in gregarious forms.
- **Mimicry:** it is superficial resemblance between two organisms e.g. some moths, flies and bugs mimic certain wasps to avoid predation.

# Adaptability

❖ Adapting quickly in the face of a changing environment.

(high reproductive potential, short life cycles, large and diverse populations)

❖ continually change as new resources appear and old ones disappear

(taste for new products that would never be a part of their "natural" environment)

❖ Pests developed resistance to chemical and biological insecticides

(e.g. In New York, Colorado potato beetle (*Leptinotarsa decemlineata*) is resistant to **organophosphates**, carbamates, **synthetic pyrethroids**, and to some of insect growth regulators and microbial insecticides).