Insects, their abundance and diversity

- Insects as a group are highly successful organisms.

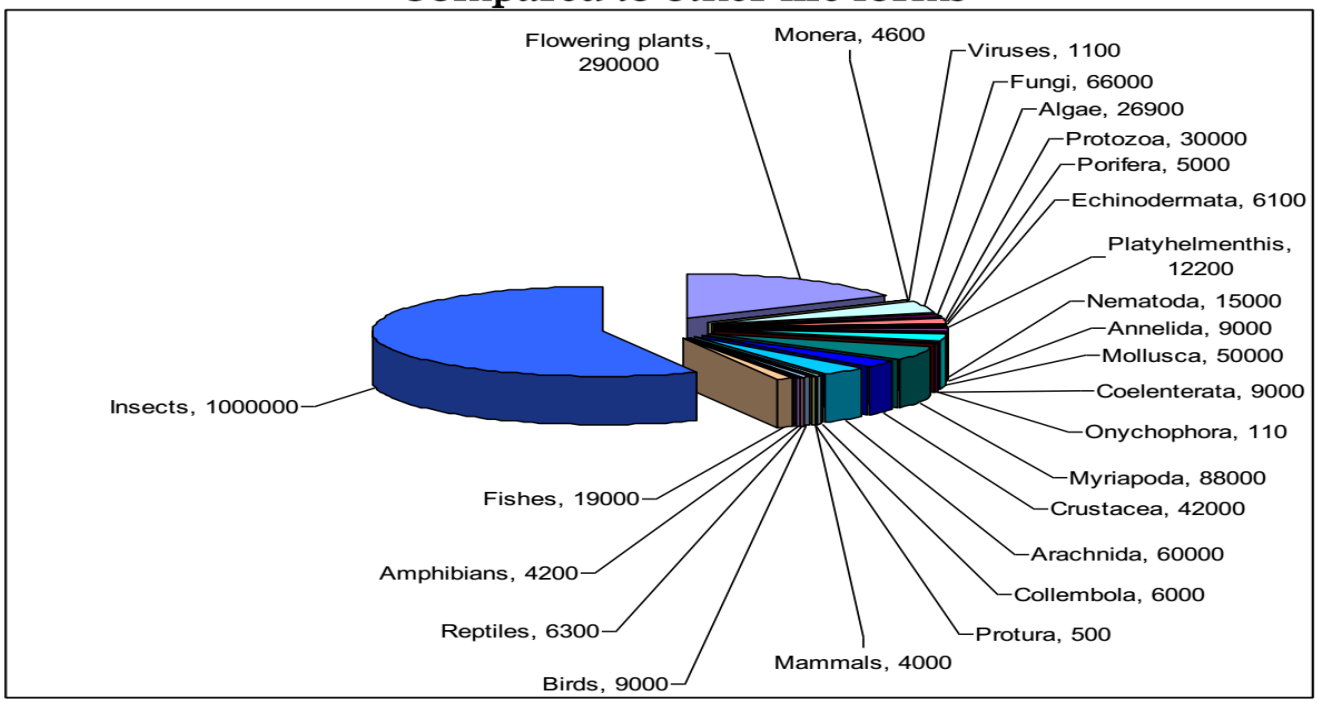
  (a) Their tremendous success relative to organisms other than human beings

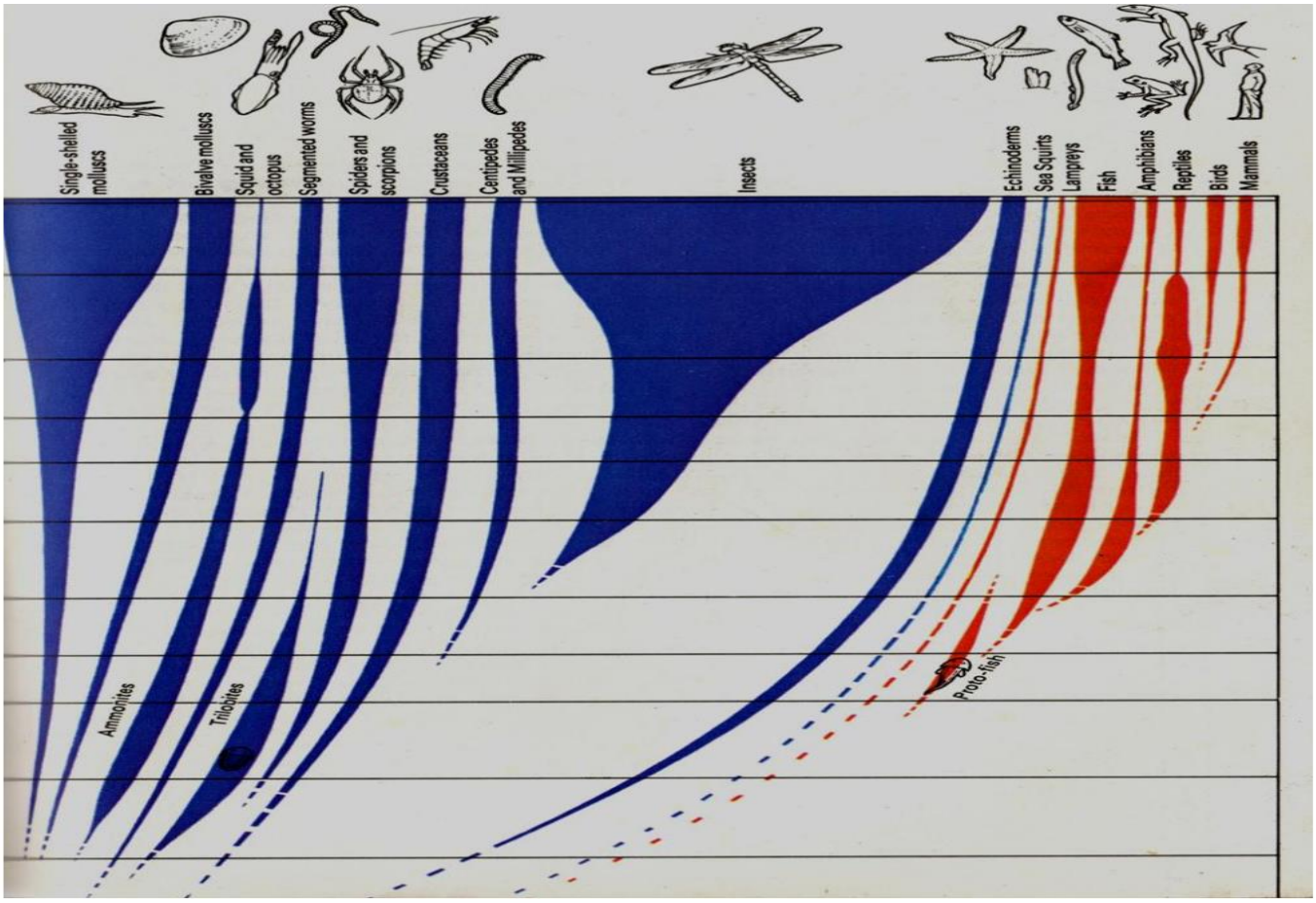
  (b) Their extreme importance from the human point of view.

Success on the universe

- One of the yard stick for their success is the number of extant species.
- Insects probably outnumber all the other species of animals and all the species of plants combined.
- It is believed that there are nearly 10 million species of insects existing on the earth and out of which we know only 1 million.
- The adaptability of the insects has been phenomenal. Insects can be found in nearly every conceivable terrestrial habit.

How many Insects ?
Compared to other life forms





CLASSIFICATION OF ANIMALS

This is the grouping together of animals with similar characteristics. Animals can be classed as either vertebrates or invertebrates.

ANIMALS

VERTEBRATES

These are animals that have a backbone.

Reptiles

Have dry scaly skin.
Lay eggs on dry land.
Are cold blooded.
(Snake, Crocodile)

Fish

Have scales on their bodies.
Have gills for breathing.
Are cold blooded.
(Shark, Tuna)

Amphibians

Have moist slimy skin.
Lay eggs in water.
Are cold blooded.
(Frog, Newt)

Birds

Have feathers and wings.
Have beaks and lay eggs.
Are warm blooded.
(Wren, Swan)

Mammals

Have fur or hair.
Feed young on milk.
Are warm blooded.
(Cow, Human)

INVERTEBRATES

These are animals that do not have a backbone.

Protozoa

Single cell organisms all microscopic.

Flatworms

Simple and soft bodied.
(Tape worm, Flukes)

Annelid Worms

Segmented bodies.
(Earthworm, Leech)

Echinoderms

Spiny sea creatures.
(Starfish, Sea urchin)

Coelenterates

Soft bodies, stinging cells.
(Jellyfish, Sea anemone)

Arthropods

Hard external skeleton and jointed limbs.

Molluscs

Soft bodied, most have shells.
(Snails, Limpet)

Arachnids

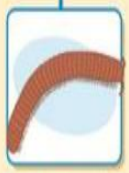
Eight legs, two body parts, no antennae.
(Spider, Scorpion)

Crustaceans

Mostly sea creatures.
Many legs and two sets of antennae.
(Crab, Lobster)

Insects

Wings, six legs, three body parts, one pair of antennae.
(Bee, Ladybird)



Myriapods

Many legs and body segments.
(Centipede, Millipede)

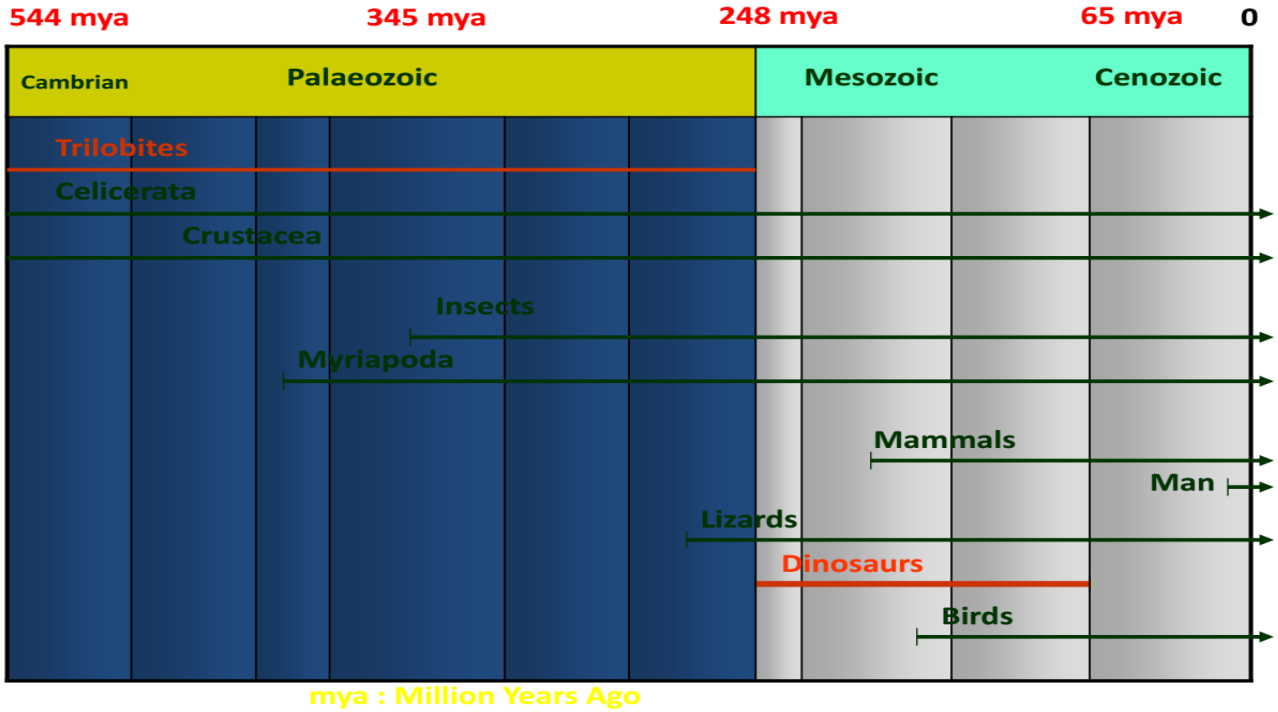
Darwin's Theory of 'Evolution by Natural Section' has five basic premises which very well fits to insects.

1. Many more individuals are born in each generation than will survive and reproduce (natality)
2. There is variation among individuals; they are not identical in all their characteristics. (variability)
3. Individuals with certain characteristics have a better chance of surviving and reproducing than individuals with other characteristics (survivorship)
4. At least some of the characteristics resulting in differential reproduction are caused by have different genes. (heritability)
5. Enormous spans of time available for slow, gradual change. (Time)

REMEMBER: Insects, as a taxon, have long inhabited this planet!!!!

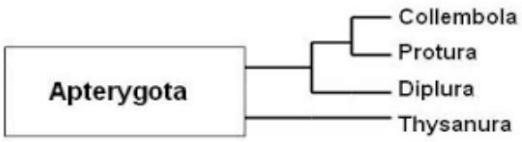
TIME EVENTS OF NOTE

- Earth 4.5 billion years old
- *Precambrian*: 3.1 billion, single celled organisms, bacteria ***et alia*** assorted prokaryotes
- *Cambrian* :600 mya (million years ago), 1st period of abundant fossils (metazoans)
- *Silurian* :425 mya, invasion of land by arthropods
- *Devonian* :405 mya, first true insects
- *Carboniferous* :345 mya, first great radiation of insects
- *Cretaceous* :135 mya, second great radiation of insects
- *Tertiary* :63 mya, dominance of the land by mammals, birds, & insects
- *Quaternary* :2 mya, first ***Homo*** sp.



INSECT MACROEVOLUTION – THE DEFINING EVENTS

1) Appearance of primitive, wingless insects!!! The **APTERYGOTES** (Devonian Period: ca. 400 million years ago)

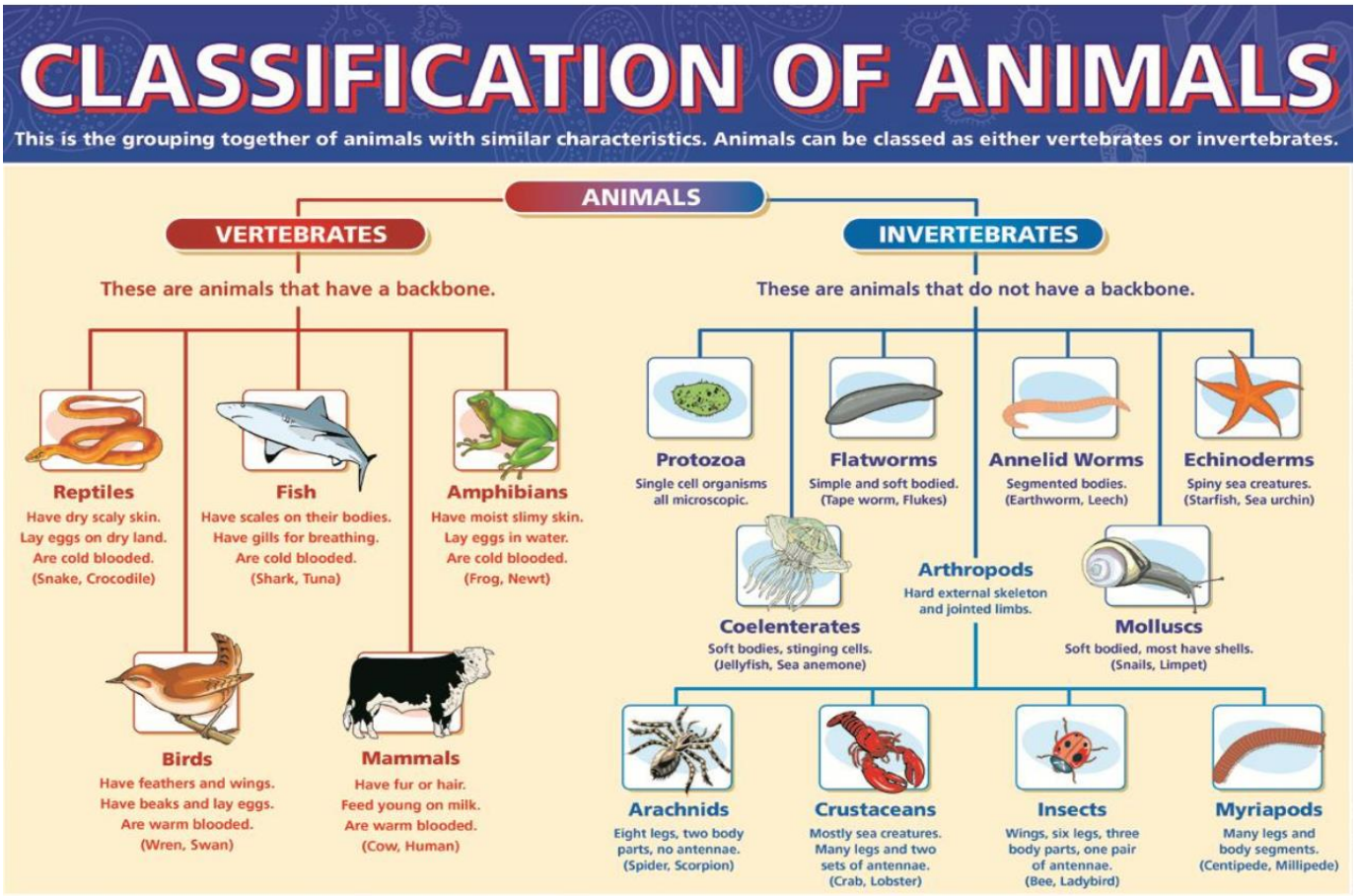


2) Development of Wings!!! The **PTERYGOTES**
(Late Devonian to Lower Carboniferous Period: 350 million years ago)

Primitive Winged Insects or PALEOPTEROUS insects with simple wing articulation – at rest held out from body (Odonata and Ephemeroptera)

3) Development of the **WING-FLEXION** mechanism!!!! – Allows exploitation of terrestrial habitats (niches) and more efficient escape from predators. **NEOPTEROUS** – (Lower Carboniferous Period: **300 million years ago).**

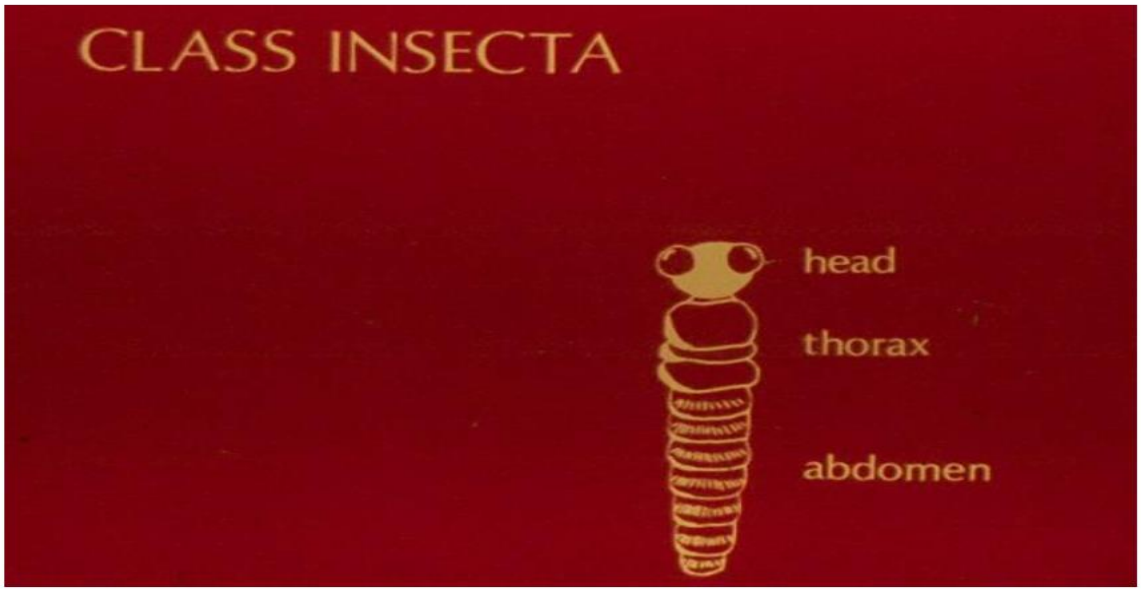
Today NEOPTEROUS insects comprise the majority of insect orders and 97% of species.



Arthropods= Insects and their relatives

- arthro = Joint or segment; poda= legs
- Segmented body
- Paired, segmented appendages
- Bilateral symmetry
- A chitinous exoskeleton (periodically sheds)
- Open circulatory system
- Pseudocoelom

Hexapoda (= Insecta)



Body divided into three regions

Insect -characters

Three sets of legs

Insect -characters

One pair of antennae

Insect -characters

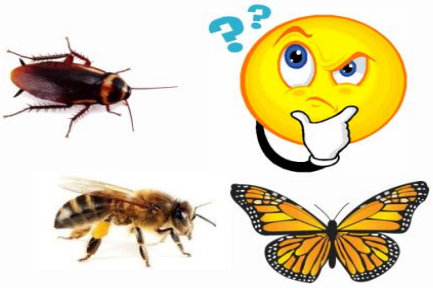
Wings

Insect classification (based on economic importance)

INSECT

- **Economically important**
  - **Injurious**
    1. **Pests of crops and Plants**
       a. Agricultural Entomology
       b. Forest Entomology
       c. Storage Entomology
    2. **Pest of human beings**
       a. Medical Entomology
    3. **Pests of Animals**
       a. Veterinary Entomology
  - **Beneficial**
    1. **Productive insects** (Honey bee, Silkworm etc.)
    2. **Insects as food**
    3. **Insects as medicines**
    4. **Insects for scientific research**
    5. **Insects for aesthetic value**
  - **Helpful**
    1. **Predators**
    2. **Parasitoids**
    3. **Pollinators**
    4. **Weed killers**
    5. **Scavengers**
- **Economically not important**

What is a pest?



"Pest is an any organism whose population increases to such an extent as to cause economic loss to crops or a nuisance and health hazards to man and his live stock"

The word pest is derived from French '***Peste***' and latin terms '***pestis***' means **plague or contagious disease** .

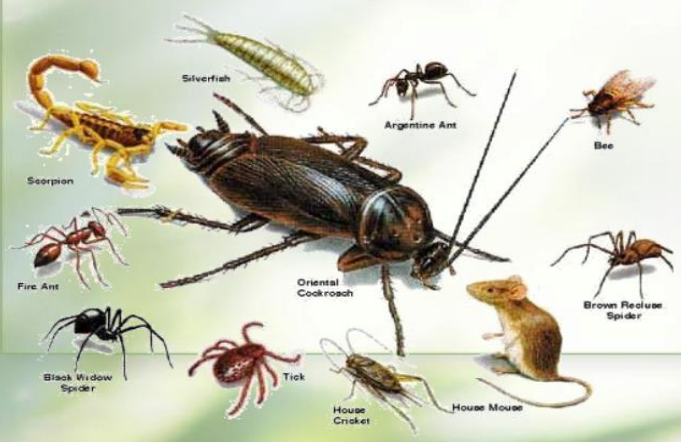
The pest status of an insect spices may be determined by numbers of ways such as

- Increase in the number of insects,
- change is the type of damage inflicted on the crop,
- change in method of cultivation or harvesting,
- fluctuation in the market value of the crop etc.

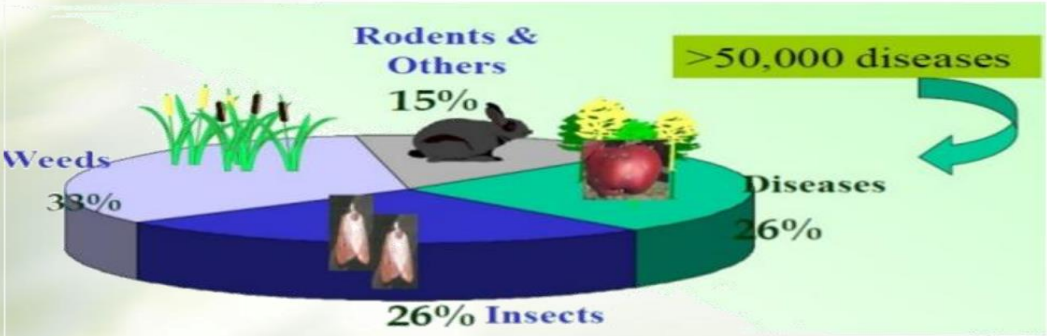
Pests are organisms which impose burdens on human population by causing

(i) Injury to crop plants, forests and ornamentals
(ii) Annoyance, injury and death to humans and domesticated animals
(iii) Destruction or value depreciation of stored products.

Pests include insects, nematodes, mites, snails, slugs, etc. and vertebrates like rats, birds, etc.



Crop losses due to pest



Average 18% of the crop yield is lost due to pests.

Annual monetary loss in India is: Rs.60,000 Crores.

Estimation of losses caused by insect pests to major agricultural crops in India

Crop	Approx. estimated loss in yield		Hypothetical production (MT)	Value of loss in million Rs
	%	Total (MT)		
Cotton	30	18.9	62.9	339660
Rice	25	32.2	128.9	240138
Maize	20	4.8	23.8	29450
Sugarcane	20	87.1	435.3	70667
Rapeseed-mustard	20	1.5	7.3	26100
Groundnut	15	1.6	10.8	25165
Other oilseeds	15	2.6	17.3	35851
Pulses	15	2.6	17.4	43551
Course cereals	10	2.0	19.9	11933
wheat	5	4.1	82.7	41368
Total/average	17.5			863884

Production and MSP fixed by GOI for 2007-08, are adopted from anonymous (2010)

HOW INSECTS BECOME PESTS? (Reasons for out break of Pest)

A. Destruction of forest or bringing forest area under cultivation

B. Destruction of natural enemies

C. Intensive and extensive cultivation of crops: Eg. Stem borers in rice and sugarcane.

D. Introduction of new crops and improved variations Introduction of new crop may some as new host for the pest Eg: Sunflower and head borer

E. Improved agronomic practices

F. Introduction of new pest in new areas

G. Accidental introduction of foreign pest