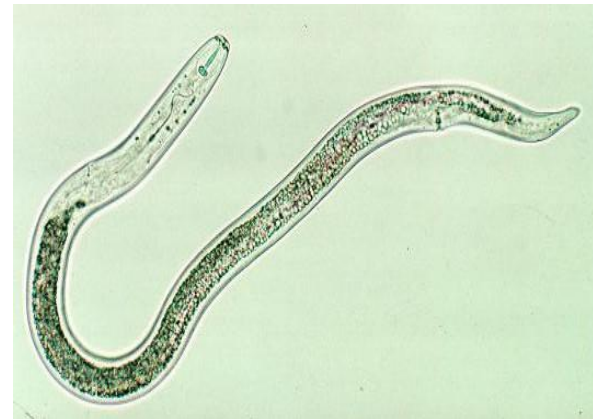
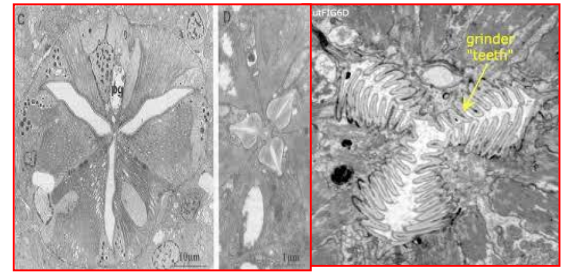


# INTRODUCTION TO NEMATODES

The Greek word **nematode** means "threadlike" **Nemat**=thread **ode**=like

- “Kingdom Animalia - Phylum Nematoda
- Vermiform
- Un-segmented roundworms
- Bilaterally symmetrical invertebrates
- A body cavity or vacuoles (**pseudocoelom?**)
- A complete digestive system (mouth, intestine, anus)
- A triradiate pharynx,
- Nerve ring and a well-developed nervous system
- **Reproduction System:** one or two tubular gonads,
- **They lack:** specialized respiratory and circulatory systems
- **Range of size:** from <100 µm (*Greeffiella minutum* - marine) to >8 m (*Placentonema gigatissima* - parasite of the spermaceti whale)
- The **emerging second-stage juvenile (J2)** is the most common infective stage.
- Length of life cycle of plant parasitic nematodes can be anywhere from 20-40 days (on average 25 days at 22°C).
- The estimated losses due to nematodes in life sustaining crops are 11%.
- The females of some species become swollen at maturity, which form pear-shaped bodies. e.g. *Meloidogyne* sp. and *Heterodera* sp.



## DEFINITION

Nematodes are generally multicellular, microscopic, worm-like, non-segmented, ell-shaped, tapering at both ends micro-organism that live saprophytically in water or soil and as parasites of plants and animals. They possess all the physiological systems like animals except respiratory and circulatory systems.

## Anatomy & Morphology

Transparent body covered by cuticle, muscular system helps in nematode movement. Body cavity contains a fluid, which responsible of circulation and respiration process.

1. **Digestive system:** The nematode digestive system is hollow tube generally divided into three parts, the stomodeum, intestine, and proctodeum.

The stomodeum consists of the mouth with six lips, buccal cavity, and the pharynx (esophagus).

2. **Reproduction system**: one or two ovaries with an oviduct and uterus terminating in a vulva in case of female and testis with seminal vesicle in males.

## LIFE CYCLE

### 5-Stages-4 Molts

Egg - J1 - M1 - J2 - (Hatch) - M2 - J3- M3 - J4 - M4 – Adult

In all plant parasitic nematodes the first molt occurs in the egg.

The emerging second-stage juvenile (J2) is the most common infective stage.

Length of life cycle of plant parasitic nematodes can be anywhere from 20-40 days (on average 25 days at 22°C).

## NEMATODE MODES OF REPRODUCTION

**Amphimixis** [syngamy] - cross fertilization (males and females).

**Parthenogenesis**- nonsexual, males not required for reproduction.

**Hermaphroditism** - male and female organs in one individual (some change sexes).

**Pseudogamy** - Reproductive mechanism where sperm penetration stimulate completion of oocyte and meiosis, but no fusion with egg.

## FEEDING HABITS (NUTRITION)

There are two types' saprophytes and parasites. As plant parasites these are divided into three groups:

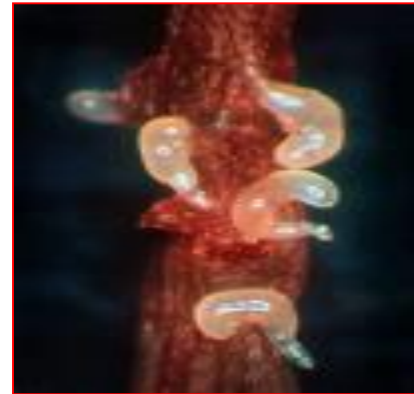
- **Ecto-parasites** (The nematodes which do not enter into the root tissues but feed only on outer surface.)  
**Migratory**: Ring nematode, *Criconemoides* spp.
- **Endo-parasites** (The nematodes which enter into the root tissues and feed within the cells.)
  1. **Sedentary**: Dagger nematode, *Xiphinema* spp.



- **Semi endo-parasites** (The nematodes which enter their some frontal body portion into the root tissues but feed outside cells.)

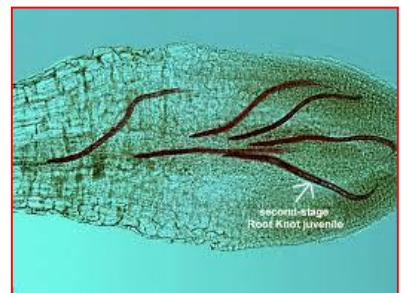
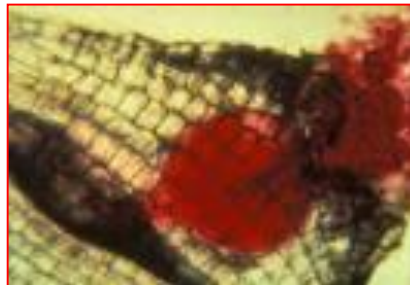
1. **Reniform nematode:** *Rotylenchulus reniformis*

2. **Citrus nematode:** *Tylenchulus semipentrans*



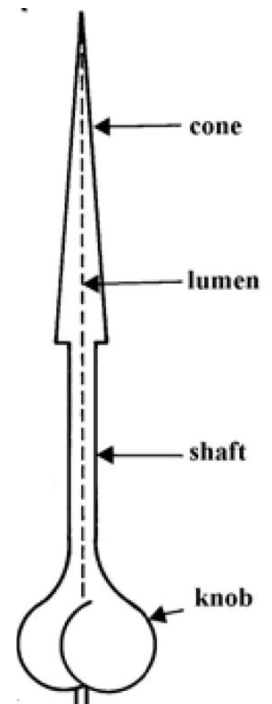
According to **feeding time span** it is divided into two groups:

- **Migratory** (The nematodes which live and move within the host tissues for feeding.)
- **Sedentary** (The nematodes which attached to the host tissues and do not move.)

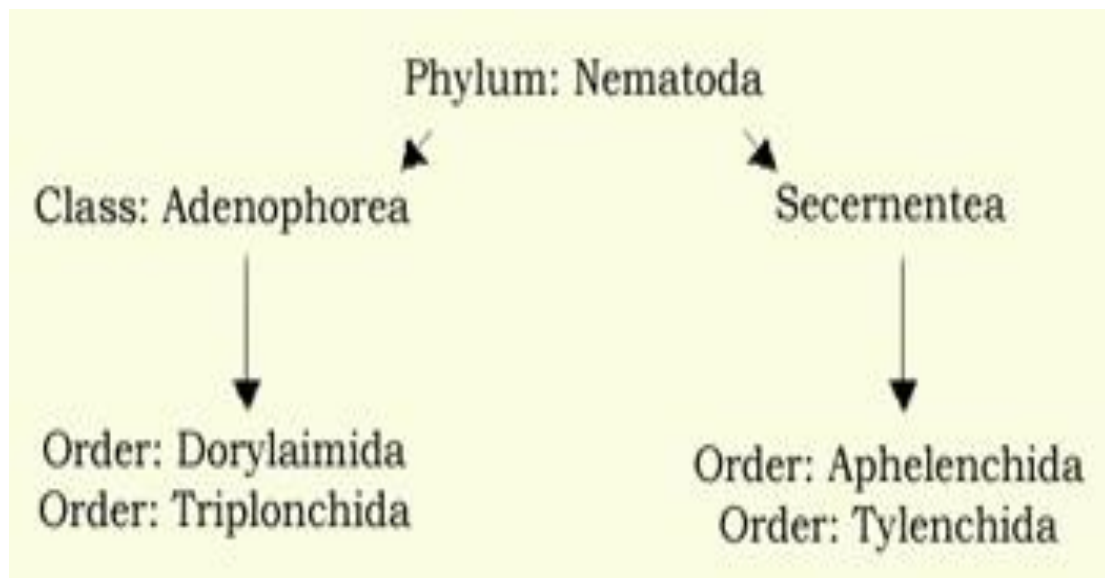


Feed organ called hypodermal needle or stylet. These have hollow stylet or spear which is used to puncture plant cells, after puncturing the cell they inject saliva into the cells then suck-part of the cell contents and move on within a few seconds. Females of some species may become permanently established in or on roots. Male nematode remains cylindrical throughout his life but the female are swollen at maturity and become pear and lemon shaped e.g. *Meloidogyne* species.

- **Juvenile:** Larva of nematode is called juvenile. All the nematodes have four juvenile stages in its life. **Only the second stage (J2) is infective stage.** After the final stage the nematode differentiated into male and female. The life cycle of nematode from egg to egg is completed within 2-4 weeks.



## CLASSIFICATION OF PLANT PATHOGENIC NEMATODES



### Animal Kingdom

CLASSIFICATION OF NEMATODES			
Taxonomic category	Genera	Species	Common name/ hosts
Order: Tylenchida Family: Heteroderidae	1. <i>Meloidogyne</i>	<i>M. incognita</i> <i>M. hapla.</i> <i>M. javanica.</i> <i>M. arenaria.</i>	Root knot of vegetable, ornamental, fruit & field crops
	2. <i>Heterodera</i>	<i>H. glycine</i> <i>H. avenae</i> <i>Globodera rostochiensis</i> <i>G. pallida</i>	Cyst Cereals Soybean Potato
Order: Tylenchida Family: Anguinidae	<i>Anguina</i>	<i>A. tritici</i>	Ear cockle of wheat
	<i>Ditylenchus</i>	<i>D. dipsaci</i>	Stem & bulb nematode of garlic

Order: Tylenchida Family: Pratylenchidae	<i>Pratylenchus</i>  <i>Radopholus</i>	<i>P. vulnus</i>  <i>R. similes</i>	Root lesion o walnut burrowing of chilies.
Order: Tylenchida Family: Tylenchulidae	<i>Tylenchulus</i>	<i>T. semipenetrans</i>	Citrus decline