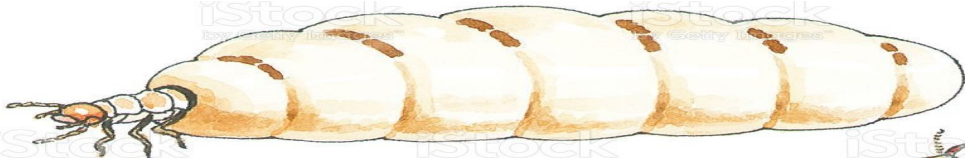
TERMITES

NOTES BY ANUPAM SIR

- The **termites** belong to the order **Isoptera** as **fore- and hindwings** of the most of the species are similar in shape and size.
- They are small to medium sized, soft bodied, social and polymorphic insects that live in social groups or communities having a highly developed caste system.
- The colony is composed of reproductive forms together with numerous apterous, sterile soldiers and workers.
- Termites are mostly tropical or subtropical, live in large communities in underground nests or termitaria or in dry wood (used in the construction of building and furniture).
- The subterranean termites are ground-inhabiting and a colony or nest may be up to 18-20 feet below the soil surface to protect it from extreme weather conditions.
- These termites travel through mud tubes to reach food sources above the soil surface.
- These forms probably play an ecological role similar to earthworms in that they aerate and add nutriment to the soil.
- In addition to wood, termites feed on a variety of cellulose-containing materials, fungi and dried animal remains.
- The digestion of cellulose is carried out by flagellate protozoans or bacteria, which are **mutualistic** inhabitants of the **gut.**

Bionomics of Termites -Termites are very significant pests,

- Damaging wooden structures
- Furniture,
- Building materials,
- Wooden floors



- Railway sleepers,
- Wooden bridges,
- Boats,
- Books,
- Large orchard trees like mango,Apple, Coconut,Guava etc.
- There are two distinct categories of termites :
  - Those forming mounds above the ground.
  - Those living underground.
  - **Ground termites** randomly and constantly forage for new food sources; and may travel up to 100 metres from their primary nest.
  - A very common mould forming species are Odontotermes spp.
  - Colonies of **Kalotermes** (dry wood termites) and **Zootermopsis** (damp-wood termites) exist entirely on wood.
  - Several species destroy **standing crops like-**
    - sugarcane, maize,sorghum, ground nut ,tea ,cotton,potato etc.
  - **Reticulitermes** construct earthen tubes on concrete and are thus able to invade a structure even though it is not in direct contact with the soil.
  - The presence of earthen tubes is one of the characteristics used to diagnose a termite

infestation.

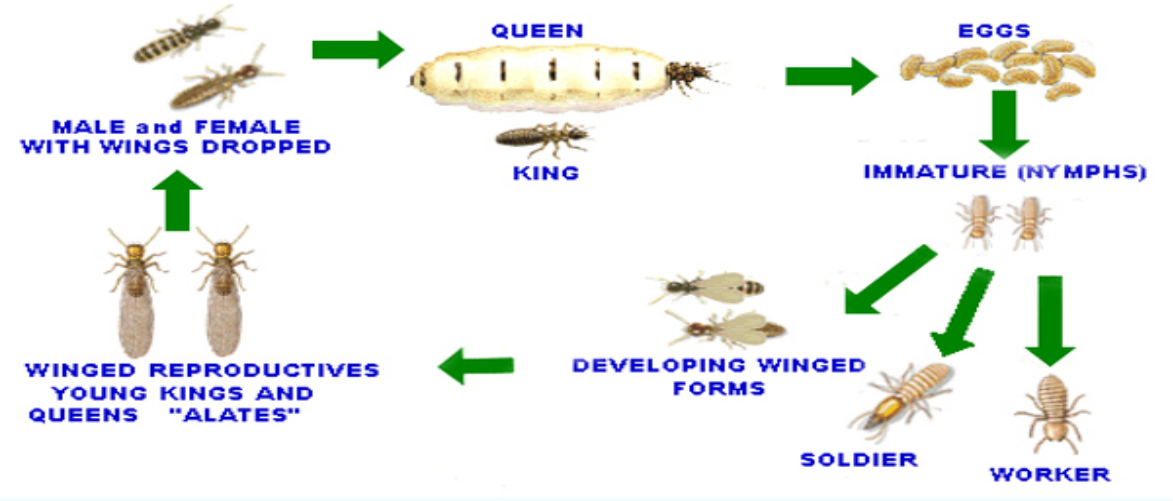
- Ecologically, termites are **good decomposer** of **dead wood** and vegetable products, they aid in agriculture by enriching the soil with their **faecal matter** and by making the soil permeable to air and moisture like **earthworms**.
- In addition, they constitute the food to several animals like **birds, reptiles, rodents** etc. Natives of South **East Africa** consume **queens** as a **delicious dish.**

[I] Diversity of termites

- Termites are **divided into six families**, however, **about 75% of the recent** termites belong to one family **Termitidae.**
- **Termitidae** is thus largest family with a wide range of food habit and colony structure.
- The **worker caste** is well developed, in Microtermes beesoni, M, anandi, Macrotermes serrulatus, Odontoterms banglorensis (**sugarcane pest**), Termes, Trinervitermes heirni (sugarcane pest).
- Another family **Kalotermitidae** lives in dry wood and have no worker caste, e.g., **Neotermes**, Kalotermes indicus, C'rypiotermes domesticus.

[II] Colony structure and polymorphism

- The termites are commonly confused with ants.
- This is probably the reason that termites are sometimes referred to as white ants but they differ from ants in several ways.
- Termites are soft-bodied and usually light coloured, while ants are hard-bodied and usually dark coloured; the fore and hindwings of termites are similar in size and venation and are held flat over the abdomen at rest, but in ants the hindwings are smaller, than the forewings and have fewer veins, and at rest are usually held above the body.
- The antennae of a termite are miniliform while those of ants are elbowed. There is no constriction between the thorax and abdomen in termites like ants.
- All termites are social insects and live in colonies ranging in size from a few hundreds to as many as 70 lacs individuals.
- A colony's population is initiated and maintained by a queen that may live for as many as 50 years in some species.
- The colony reaches its maximum size in approximately **4 to 5 years.**
- Two or more castes may be present, depending on the species, and all castes are composed of both males and females.
- Conveniently, castes can be divided into **reproductive and sterile** forms.
- There may be two kinds of reproductive forms in a colony of a given species.



- The sterile castes live for 2-4 years.

1. Primary reproductive forms.

- These are **macropterous** forms, e.g., **queen and king** which are thought to comprise the original caste in termite phylogeny; having dark, **sclerotised** bodies with completely developed wings and compound eyes .
- The queen, usually a pair in a colony, is monogamous.
- It becomes enlarged by largely growth of its abdomen.
- It losts her wings after founding the colony.



2. Secondary reproductive forms.

- These are brachypterous or apterous forms, e.g., ones with shorter wings, less pigmentation, and smaller compound eyes than the primaries.
- They substitute the primaries when they die (substitute or complemental queen and king).
- They are polygamous.
- In all reproductive castes there is remarkable post-embryonic growth, especially in the female.
- The inseminated female develops into a queen which is 5-7.5 cm long and 1.0 - 1.5 cm wide.
- The increase in size is due to the enlargement of the abdomen only, the head and thorax remains normal.
- The terga and sterna of the abdomen do not grow, but the pleural membrane expand tremendously due to an increase in the number and size of the ovaries and fat body.
- Because of this the queen becomes large, inactive, egg-laying individual.
- The queen formed from the macropterous female is largest.
- The queen normally lives for 6-15 years and lays a million eggs in its life.
- It was once believed that the destruction of the queen would ultimately kill out the community but this is not so because brachypterous or apterous queens will form and continue the community.

3. Sterile castes. The sterile castes include workers and soldiers and both castes are composed of male and female individuals.

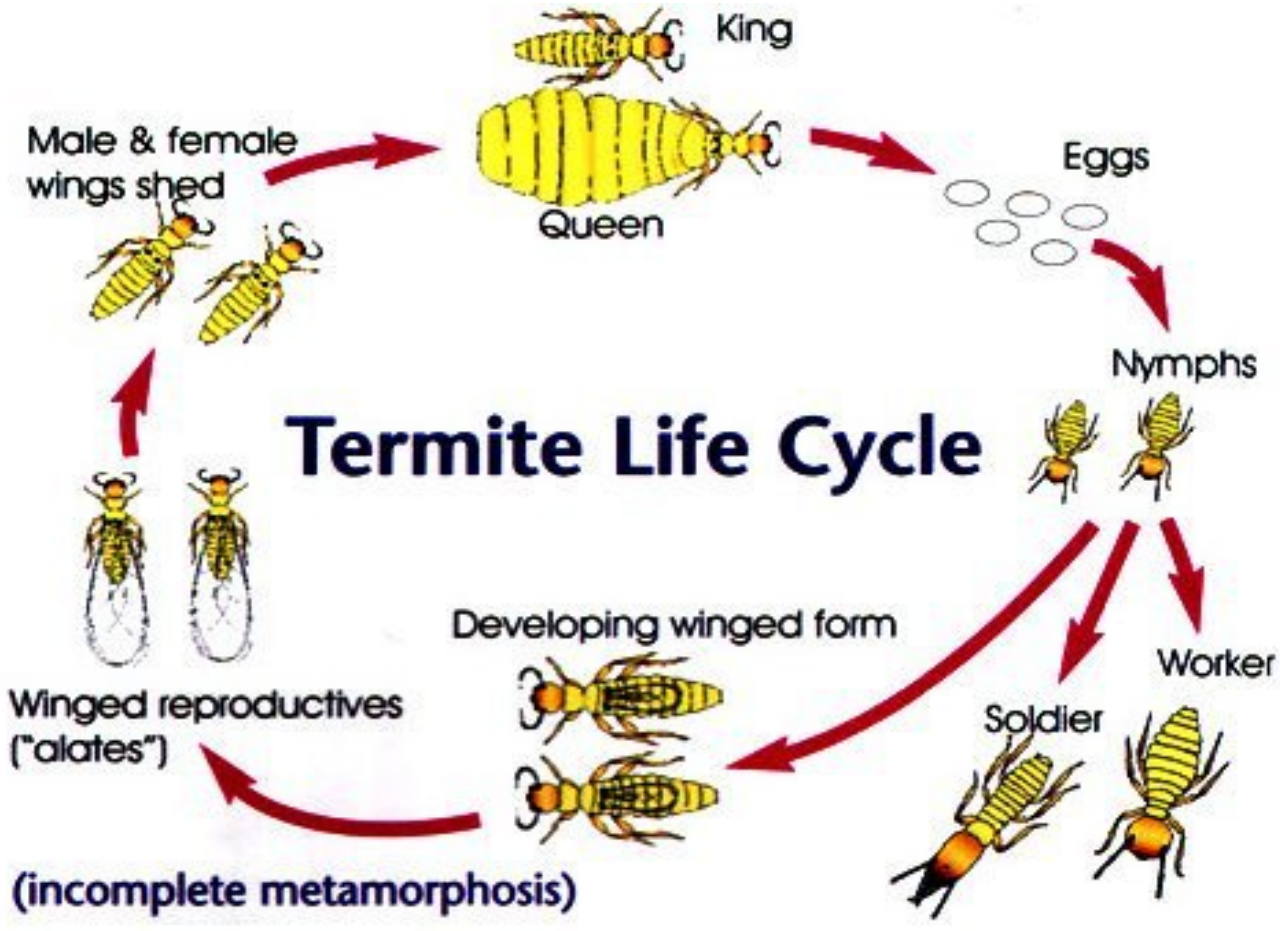
(a) Workers: -The colony may include 60,000 to 2, 00,000 workers which are soft-bodied, wingless, blind and creamy white.

- In early stages, they are fed predigested food by the king and queen.
- Once workers are able to digest wood, they provide food for the entire colony.
- The workers perform all the labour in the colony such as obtaining food, feeding other caste members and immatures, excavating wood, and constructing tunnels.
- Workers mature within a year and live from 3 to 5 years.
- Workers may be dimorphic, in one the head and mandibles are larger than in the other form as observed in Odontotermes.
- In case of Termes, the workers are trimorphic with small intermediate and larger sizes.
- Because of their gnawing habit the workers destroy crops, wood and human belongings and cause tremendous damage to man.

(b) Soldiers : -

- Like workers, the soldiers are creamy white, soft-bodied, wingless and blind, however, the head is enormously elongated, brownish, and hard and equipped with two jaws.
- Soldiers must be fed by workers because they cannot feed themselves.
- They are less numerous in the colony than workers and their only function is to defend the colony against invaders.
- Soldiers mature within a year and live up to 5 years.
- The soldiers are of two types:
  (i) Mandibulate soldiers having large powerful mandibles but no frontal rostrum, and
  (ii) Nasute soldiers (in Nasutetermes) having small mandibles and a median frontal rostrum on the head.
- Soldiers function as defenders of the colony, mandibulate soldiers with their mandibles and nasute soldiers by exuding a viscid repellent fluid through the frontal rostrum.
- At times, soldiers in some species defend the colony by plugging up holes with their heads.
- In the simplest social structures, mere are reproductives and soldiers, and the immatures of both these castes function as workers.
- Termites have the ability to change from one caste type to another during their immature stages.
- This allows the colony to change the proportion of different caste members as the need arises.

[III] Life history of termites



- The life-history and the origin of caste system in termites is extremely complicated.
- New colonies are formed when at certain times of the year, commonly in spring and fall, especially after a rain, winged primary reproductives appear in huge number and swarm from the nest.
- After a flight, the winged males and females return to the ground and shed their wings.

The wingless males and female's pair off and search for sources of wod and moisture in soil.the royal couple digs a chamber in the soil, near wood, enters the chamber and seals the opening.

- After mating, the queen begins to lay eggs.
- In a mature colony, the queen may lay over 30,000 eggs/day.
- The eggs are yellowish white (Fig. 3A) and hatch after an incubation of 50 to 60 days.

- Another method of nest foundation is sociotomy.
- In this process colonies divide by the separation of immatures and secondary reproductive forms from the parent colony or by division of a migratory colony into two daughter colonies.
- Soon after insemination, the female modifies as mentioned earlier attaining a size nearly 20-30,000 times larger than workers.
- About 4,000 eggs are laid per day.
- They are oval, elongated, smooth and pale coloured.
- Development is gradual with incomplete metamorphosis.
- The nymphs (Fig. 3B) undergo several moultings to attain adulthood.
- The mechanism of caste differentiation is not fully understood, however, it is believed that it is based on complex interaction of hormones, pheromones, availability of food supply and social behaviour, etc.

[IV] Termitaria or termite nests

- The termite nests vary from simple cavities in soil or wood to vast subterranean complexes or elaborate structures that project well above die ground.
- In the African savannas, high temperature and low rainfall pose a real threat to termites.
- To protect the colony Macrotermis bellicosus builds a towering earth mound up to 7.5 m high, most of the above ground portion being hollow to allow circulation of air. Similarly, the nest of Nasutitermes triodae has been reported to reach a height of 6 m and a diameter of 3.6 m at its base in Australia.
- The termitaria are provided with very elaborate ventilation systems, design that provide for maintenance of constant temperature; canopies that deflect rainwater and other structural adaptations.
- The means by which the behaviours of individual members of a colony are coordinated to produce such complex structure has long been a source of surprise.

[V] Communication in the colony

- Termites communicate primarily by secreting chemicals called pheromones.
- Each colony develops its own characteristic odour.
- An intruder is instandy recognised and an alarm pheromone is secreted that triggers the soldiers to attack.
- If a worker finds a new source of food, it fays a chemical trail for others to follow.
- The proportion of termites in each caste within the colony is also regulated chemically.
- Nymphs or immatures can develop into workers, soldiers or reproductive adults depending on colony needs.
- Sound is another means of communication.
- Soldiers and workers may bang their heads against the tunnels creating vibrations perceived by others in the colony and serving to mobilise the colony to defend itself.
- Mutual exchange of foods enhances recognition of colony members.

[VI] Food and feeding habits

- The termites are basically xylophagous, i.e., they feed wood. However, they may feed vegetation, faecal matter of termites, cast off skins and the dead of the colony.
- Some termites developed a symbiotic association with fungi of me genus Termitocytes, which the termites cultivate inside the nest on fungus comb made of vegetable matter and their own faeces.
- On the comb fungal hyphae grow producing white patches.
- Fungus gardens are grown in chambers located near the centre of the nest, they communicate with a royal chamber in which the king and queen is fed by workers only on saliva and fungal hyphae.
- The eggs and nymphs develop in fungal chambers or nurseries.
- The workers take care of nymphs feeding them on fungus and vegetable matter which are partly predigested by them with the help of certain flagellates (e.g., Trichonympha) and bacteria.
- In feeding, the symbiotic flagellates are also transferred to nymphs which develop either into reproductive forms which can leave the nest and form new colonies, or into sterile workers or soldiers.

[VII] Economic importance

- Termites often infest buildings and damage lumber, wood panels, flooring, wallpaper, plastics, paper products and fabric made of plant fibers.
- The most serious damage is the loss of structural strength.
- Other costly losses include attacks on flooring, carpeting, art-work, books, clothing, furniture and valuable papers.
- Subterranean termites do not attack live trees.
- The termites also damage the standing crops like sugarcane, wheat, paddy, groundnut, cotton, corn, sorghum, chilli, brinjal, cauliflower, cabbage, beans, potato etc.

- The crops are attacked from the time of transplantation to harvest.
- Damage caused by termites can be very serious indeed.
- The entire village of Sri Hargobindpur in the Punjab was abandoned in the 1950s because of the pervasive damage by the termite Heterotermes indicola.
- However, the termites feeding on wood are important agents in decomposing branches, logs and tree-stumps and are thus also beneficial to us, though the role of termites in cycling organic matter and soil nutrients has not been sufficiently investigated.
- Termites also serve as food for certain mammals like aardvark (Orycteropus afer) and aardwolf (Proteles cristatus) of Africa, pangolins {Manis gigantea) of Africa and Asia, anteaters (Myrmecophaga tridactyla) of South America. Other termite feeders are ants, spiders, geckos and other lizards, shrews etc.

[VIII] Evidence of termite infestations

- Wood damaged by termites always has remains of mud tubes attached to wood galleries or tunnels or in fields around the crops in an irregular pattern.
- The tunnels may contain broken mud particles with fecal materials.
- In the case of an active colony, white termites may be found in infested wood.
- The presence of flying winged males, females or their shed wings inside the building indicates an infestation.
- The presence of mud or shelter tubes extending from the ground to woodwork or on foundation walls also may indicate infestation.
- Workers travel periodically via shelter tubes to their nest to regain moisture and perform feeding duties.

[IX] Control measures

- Termite control needs prophylactic treatment as it is difficult to predict the intensity of attack at the beginning of the season and once the damaged noticed there is no scope to check the damage.
- Therefore, following measures should be adopted.

1. Prophylaxis: -

- No home, new or old is safe from termites.
- By building mini tubes, termites can cross concrete, brick, metal termite shields, pre-treated wood, or even a professionally applied termite barrier.
- Because termites need moisture and have low tolerance to air and light, they usually live underground, attacking a home from below.
- A loose mortar joint, a minute space around a drain pipe, or a settlement crack in the concrete slab is all they need to gain entry.
- Ground termites can create secondary nests above the ground called **"aerial colonies".**
- These independent nests may survive independently of the ground if a water source is available.
- Common interior water sources include roof leaks, plumbing leaks, leaky showers or tubs, toilet leaks, etc.
- Aerial infestations must be located for effective control.
- Therefore, following preventive measures should be performed:

1. Avoid having any woodwork of the buildings within 45 cm of contact with the ground.
2. Use treated timber during building construction.
3. Coat any untreated wood or exposed wood end cuts with an appropriate termiticide like chlorpyriphos.
4. Eliminate all wood-to-soil contact, remove any wood debris, and reduce the wood moisture content to below 20%.
5. Seal all cracks and crevices with cements.
6. Perform treatment to the soil before construction with an appropriate termiticide or a basaltic termite barrier.
7. Termitaria in nearby area should be destroyed mechanically and queen should be killed.
8. Eliminate conditions conducive to infestation.
9. For cultivated plants, highly susceptible crop cultivars should be sown in the border lines as trap crop to attract termites towards them, so that the main crop can be saved.

2- Insecticide application: -

- There should be a continuous insecticide barrier between the termite colony and wood in a building.
- Sometimes there may be a secondary termite colony above the soil (in the roof or other areas with a constant moisture supply) that requires additional treatment.
- Insecticide (e.g., chlorpyriphos) barriers may be established during or after building construction.
- In an existing building, termite treatments may involve any of the following procedures:
  - Mechanical alterations and/or use of an insecticide to treat the soil, foundation and wood.
  - Methods vary with each house, depending on the type of foundation or basement, construction materials,

number and type of porches, terrace, etc.
    - By digging narrow trenches along walls and drilling through horizontal surfaces insecticide can be applied where it will kill termites within home and block the colonies re-entry.
- Secondary and aerial colonies are controlled by correcting the moisture problem to dry out me moisture-source area.
- When it is desirable to rapidly reduce the secondary infestation, this can be done by intergallery injection or surface treatment with a pesticide labeled for these termites.
- Above-ground termite baiting systems that are placed directly on me termite infested wood follow following procedures.

(1) Locate kick-out holes.
(2) Lightly puncture kick-out hole.
(3) Inject appropriate insecticide (e.g., chlorpyriphos) in kick-out hole.
(4) Seal kick-out hole with cement.
(5) Prevent infection through education, detection and elimination of conducive conditions (as mentioned above) which are the most effective and cost efficient control measures.
(6) When activity is already present, apply liquid termiticide barrier and baiting programmes.
(7) For termite infested crops, traditionally farmers apply BHC or aldrin dusts in soil before sowing the seeds to control termites, but recent recommendations for termite control are seed treatment with chlorpyriphos or carbosulfan.
(8) The dose depends upon the type of crop.
(9) Neem oil treatment was found promising.
(10) Neem leaves applied in seed furrows not only significantly controlled termites but also help in manuring the soil and proved superior than traditionally used dust.

