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TERMITES

Termites and their Role as Plant Pests

Termites are pale yellow to dark brown, lucifugous insects, 5-25 mm long, which build nests of various sizes above or below the ground. One colony is composed of several distinct castes. As well as the winged and wingless reproductive forms there are also soldiers and workers which have only rudimentary and functionless sexual organs. In addition there are white larvae which may develop into individuals of any of the various castes (see Fig. 62).

Termite Castes

The *winged reproductive forms* are light brown to blackish-brown and fairly thickly chitinized. The head has large, distinct compound eyes. Both meso- and metathorax bear a pair of long, transparent wings each, folded one over the other when at rest. Males and females do not greatly differ morphologically one from another at this stage. The wingless reproductive forms, i.e. the queen and king, which live in the nest and can be seen only by breaking it open, develop from alate forms which have cast their wings after swarming and before building a new nest. The abdomen of the queen is distended, owing to development of the organs therein, especially the ovaries, to such an extent that it appears in certain species (Fig. 62) as a white, sausage-like sac with the sternites and tergites showing as brown rings. The queen of many termite species lives in a specially arranged cell and is waited on by the workers. It is extremely prolific. The dark and relatively large king does not change its shape, and lives within reach of the queen. The function of the reproductive forms is to found new populations and to create new generations of the species. The queen is probably fertilized several times by the king; it may live for a number of years but the exact life span is not yet known for any species.

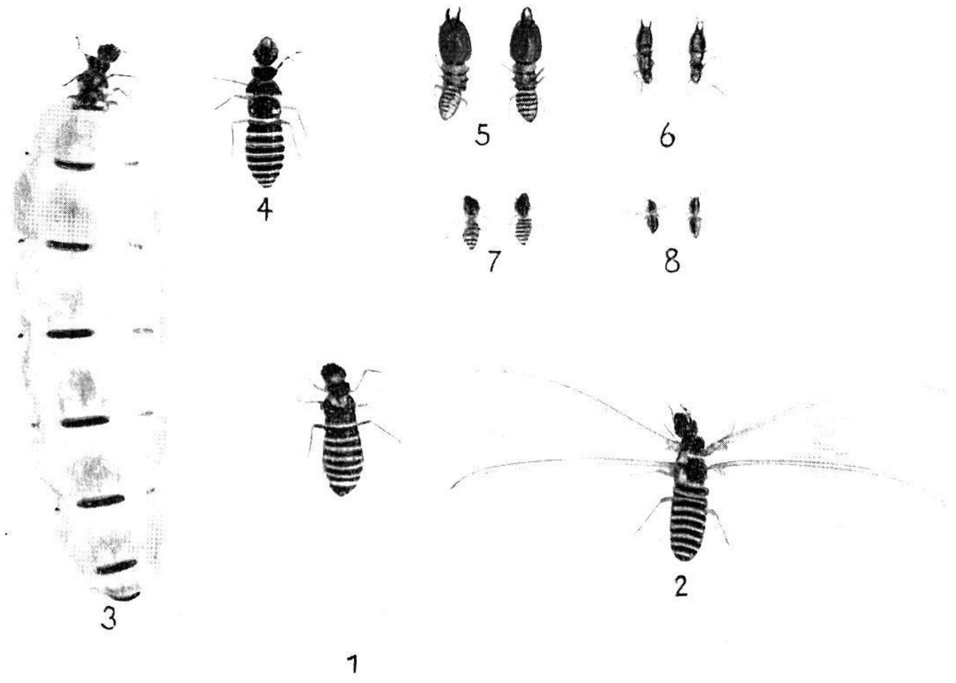

Fig. 62. Various castes of the termite *Bellicositermes bellicosus* Sm.; 1 = winged reproductive form; 2 = winged reproductive form with outspread wings; 3 = queen; 4 = king; 5 = large soldiers; 6 = small soldiers; 7 = large workers; 8 = small workers (slightly reduced in size).

Soldiers

This caste, which has mainly the duty of defending the nest against any kind of intruder, is remarkable for its peculiar morphology. Two fundamentally different types of head may be distinguished. While the soldiers of most species have strikingly large heads with strongly developed mandibles of various shapes (see Fig. 63), soldiers of other termite species have pear-shaped heads extending to a rostrum with greatly reduced mandibles (see Fig. 63).

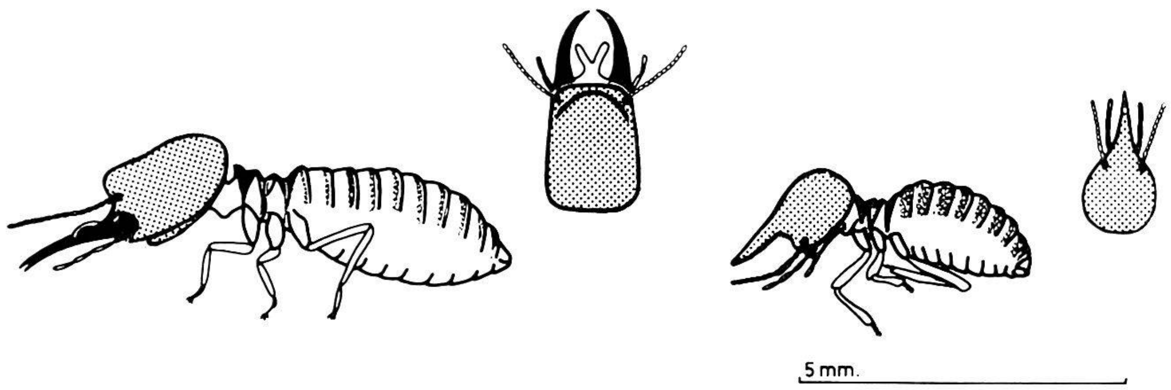

Fig. 63. Types of head of termites
left = soldier of *Cubitermes* sp.;
right = soldier of *Trinervitermes* sp. (Nasuti).

The whole cranium is occupied by a gland. The heads of soldiers are always thickly chitinized. Thorax and abdomen, on the other hand, are relatively small and thinly chitinized, especially the latter. Certain species may have at the same time large and small types of soldiers. Identification of termite species is primarily based on the morphological characteristics of soldiers. Therefore this caste has principally to be collected and preserved in methylated spirit, when it is intended to have the species identified by a specialist. The soldiers, considerably less numerous than the workers (1 : 20 to 1 : 100 in proportion), defend the nest, in whatever part it is damaged, against intruders. While the large-headed soldiers, provided with strong mandibles, bite any strange object presented to them, the nasuti forms squirt a viscous secretion from their frontal glands against aggressors, which solidifies immediately and immobilizes them.

Workers

The numerically strongest caste is that of *workers,* the smallest specimens of a termite population. Their rather small, usually globular head is provided with saw-toothed jaws and segmented antennae. They have neither eyes nor wings. The prothorax is narrow, the abdomen appears pear-shaped and convex owing to food intake, but inconspicuous in size. While the head and thorax are white to yellowish, slightly chitinized, the abdomen is white to creamy-white and so delicate that ingested food may be seen inside it. Workers and soldiers may be either female or male; their reproductive organs, however, remain underdeveloped. The function of the workers is the building and extending of nests and any recurring repairs, the distribution of food to all the members of the colony, the cleaning and care of the queen and king, the nursing and upbringing of the brood and the lay-out of fungus gardens as well as the general maintenance of the nest.

Differences Between Termites and Ants

Although termites and ants are systematically quite distinct belonging to fundamentally different orders, they have nevertheless some features of their biology in common. The fact that both live in colonies and have some morphological resemblance often leads to confusion. The popular name "white ants" for termites adds to the confusion among non-specialists.

The following table shows some basic differences and serves as a general orientation.

Differences concerning	*termites*	*ants*
Common name	termite (white ant)	ant
Order	Isoptera	Hymenoptera (Formicidae)
Appearance	thorax broadly joined	abdomen petiolate (Petiolus cf. page 465).
Development	hemimetabolous egg-larva-adult	holometabolous egg-larva-pupa-adult
Reaction to light	lucifugous, living underground or moving in earth tubes	diurnal (with a few exceptions), found on the soil surface
Food	herbivorous cellulose from wood and ligneous products. Humus	omnivorous/carnivorous. Honeydew (secretion of aphids and coccids), animal matter (insects and other small animals); leaves for fungus cultivation (leaf-cutting ants)
Damage, i.e. mandibular attack	direct on wood or plants; masonry (mortar used in building); plastics; insulation material	irritating when occuring in dwellings or stores, secondary plant injuries as a result of aphid protection. Defoliation of plants by leaf-cutting ants
Positive economic consequences of activity	destruction of decaying wood; formation of humus; breaking up of soil; raising of ground water	carrying away dead or alive insects

Termite Nests

Termite nests can have a great variety of shapes. They may be cylindrical or pillar-shaped, rising from several centimetres to several metres above ground level, or they may appear as large, dome-shaped mounds. In certain regions the high forms are so frequent that they give the landscape a characteristic aspect. Some of the termite species build more or less spherical nests, the size of a man's head, in trees; or large hemispherical earth nests may be found on walls of houses. Nests of some other species are totally concealed, often deep below the soil surface; some of them build nests extending to several square metres, which are connected with the soil surface by galleries and sometimes linked with a network of secondary nests. Two or more termite species may dwell close together in combined nests; the galleries of inimical species, however, never touch each other. Various kinds of building material may be used. Many species use earth particles, others wood, and still others use both. These building materials are mixed with saliva or excrement to render them strong and very resistant when dry. In the nests of some species there are cells containing fungus gardens; they are built of masticated spongy wood which the fungi disintegrate so that this material may serve as food for the termite brood and colony. Nests of various termite species have ventilating or climatizing channels. On the surface "termite roads", leading from a nest to a food source, are built of earth or wood particles, thus forming dark tunnels.

Economic Importance of Termites

In the economy of nature termites play an important part. As they feed on dead plants, they disintegrate fallen trees and thus create room for new plant growth. By doing this they fertilize the soil, and their mining activity underground contributes to aeration and mellowing of the ground. So, for instance, they carry minute particles moistened with ground water to the surface, stimulating in this way the cycle of matter and contributing considerably to the biological self-regulation of tropical soils. This explains the intense growth of trees and bushes on termite mounds, where their roots find all they need.

The activity of these insects in the course of biological evolution in untouched biotopes, however, has a fundamentally different aspect when such areas of large stretches of virgin soil are built on or planted with monocultures. The termites can then adapt themselves to the new conditions. While certain species disappear from cultivated areas, others, deprived of their original food sources, attack a great range of crops and timber. The change-over to a new food source may be only temporary, and cease after a few months: a definite adaptation of the termites to a new substratum is, however, possible also (host selection principle). *Hodotermes mossambicus* Hag. (cf. p. 383 No. 747), for instance, often occurs in great numbers on virgin soil, causing heavy damage for 2-3 years, after which this species gradually emigrates to other districts. Such species which cause damage through lack of food are joined by regularly noxious "immigrants" from neighbouring biotopes. The latter are termites which have definitely adapted themselves to a few favourite crops or timbers. Finally there are those species which cause secondary damage by building surface galleries with which they cover a crop and impair its growth and development (see Fig. 64).

Causes of Termite Attacks on Plants

Termite attack seems to depend greatly on the nature and chemical composition of a particular plant. It is well known that these cellulose-feeding insects prefer older plants, or young plants that are sickly or temporarily not thriving and flaccid. Coffee, Cocoa, Rubber, Tea and other trees and shrubs are not attacked by termites even in regions where these insects abound, if they are growing under optimal conditions; but if they are not planted under such conditions they are liable to be damaged. Age and the resulting increased lignification influence termite attack. In addition to old and sickly trees and shrubs, such herbaceous crops as Maize, Sorghum, Sugar-cane, Ground-nuts, Beans, Chillies and the like are liable to attack, particularly at a late state of ripening.

Soil structure and humidity have a considerable influence on the physiological state of a plant, while the ground water level and meteorological conditions (rainfall, wind, solar radiation) are also of importance. Damage tends to be greater in dry areas than in areas of medium or high rainfall, and most damage is done during the dry season.

Control

A. *Preventive Measures*

The mechanical, physical and chemical nature of the soil is of great ecological importance for the animal and vegetable life therein. In order to grow crops under optimal conditions these factors have to be taken into consideration when virgin or already arable soil is prepared. In order to avoid possible termite damage the following measures are recommended.

1. Thorough clearance of all tree roots.
2. Deep ploughing, with no application of undecomposed plant material.
3. Areas heavily infested with termites should be left fallow for a long time after clearance (emigration of termites).
4. Establishment of plantations during favourable weather conditions and application of fertilizing substances in order to give the crop a good start and allow rapid development.
5. Application of contact insecticides in powder or liquid form on the soil surface. For quantities required per hectare see appendix.
6. Application of granulated contact insecticide with contact and gassing effect on the soil surface and subsequent digging, 5-10 cm deep, with cultivator or harrow (see also appendix).

B. *Curative Measures* (cf. also appendix)

a) *Extensive application*

1. Application of contact insecticides in powder or liquid form on the soil and plants.
2. Application of a granulated contact insecticide with contact and gassing effect on the soil surface and subsequent digging. 5-10 cm deep, with cultivator or harrow (see also appendix).

b) *Treatment of single plants (trees)*

Application of an insecticide with contact and gassing effect as aqueous emulsion with soil injector or lance. Two injections per sq.m. within the root area of the tree. If no such apparatus is available 2-3 cuts, 30-50 cm deep, are made with a spade within the same area as above. The insecticide is then poured into the cuts with a watering can. For dosage see appendix (termites).

c) *Treatment of nests*

Direct treatment with fast-acting insecticides of contact or gassing effect. In order to introduce the toxic substance as deeply as possible into the nests, an aqueous insecticide solution, applied abundantly, is recommended.

Good control results are obtained with direct treatment of nests with "fog". Insecticide fog, produced with a special apparatus (swing fog, cf. also Fig. 85), is pumped into a nest through one of the main termite channels, which has been laid open (see Fig. 65).

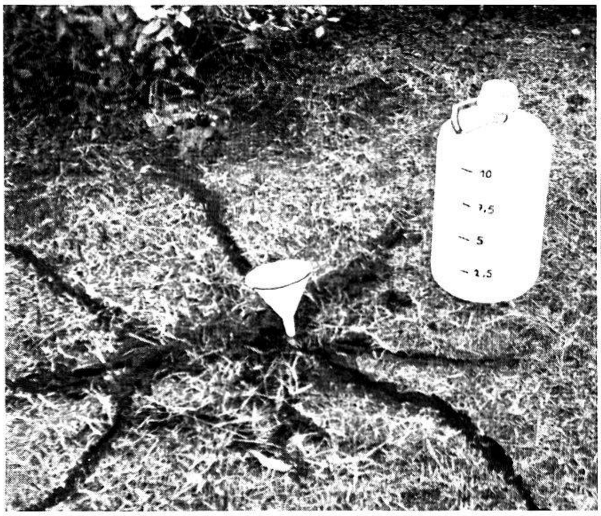

Fig. 64. Infusion of insecticide solution into a surface channel.

Fig. 65. Direct treatment with an insecticide fog.