CHAPTER- 7

DISCUSSION

Globally termite fauna is estimated to be around 2,761 species, distributed over 11 families and 283 genera (Myles, 1998). Indian termite fauna shares a very small portion of the global fauna (*i.e.* 240 species / 9% species, 37 genera / 13% of generic strength and 07 families / 64% of the total families out of which 60 species from 04 families were recorded from Gujarat (Rathore and Bhattacharya, 2004).

From my study area15 (25 %) species of 07 genera and 02 families are recorded. Of the total (15) only five species of the total were found as pests of selected crops. These five species found as pests have been reported as pests, from other areas of the country also.

Termites remain active throughout the year (Imms, 1919) and cause extensive damage to agricultural crops. In India, loss to agricultural crops due to termites ruins hundreds of crores of rupees (Chhotani, 1980). Termites attack the roots of crops at all stages of plant development, seed setts, newly planted seedlings, tree trunks and wooden logs. According to Rajagopal (2002) termites are responsible for reducing soil fertility by removing both plant and animal debris, locking them in their underground nests thus making them unavailable for plant growth.

Studies clearly reveal that termites can attack plants at any stage of development from the seed to the mature plant.

As Vadodara district falls under the semi-arid region termite attack in agricultural fields cause significant yield loss.

Damage to seedlings:

Termites forage directly on underground plant material. Seedlings are either cut below or above the soil surface. In the latter case termites gain access to the crop from soil-covered galleries made by termites at the base of the plant. Usually, the seedlings are completely broken down or damaged affecting the plant growth.

Damage to maturing plants:

Damage to maturing plants is largely caused through attack on root system, which directly kills the plant or indirectly lowers the yield through decreased translocation of water and nutrients. Attack to root system can also lead to increased susceptibility to pathogens, or dislodging of mature plants. When the spikelet of dislodged plants touches the ground, soil fungi such as Aspergillus may invade it (UNEP/FAO, 2000).

According to Cowie and Wood (1989), termite attack on crops takes three forms:

1. Seedlings and young plants are attacked and cut near the base of stem, usually by *Macrotermes subphyalinus*, or more rarely by *Odontotermes* sp.
2. Roots and other subterranean parts of mature plants are attacked and hollowed out, with excavation sometimes extending into the stem, mostly by *Microtermes* sp.

3. Occasionally the outside of the stem and leaves are covered with soil sheeting, usually by *Odontotermes* sp.

Status of termite attack:

There are three types of termite attack: (Thakur, 2000)

1. Primary termite attack:

Termites attack young plants immediately after planting or when they are very young. Termite species eat up the tap root completely below the ground level. Affected plants become weak with yellow leaves. Such type of attack is the primary attack. Young plant exhibits signs of drooping of tender leaves followed by withering and death.

2. Secondary termite attack:

Many a time plants which are already weak due to drought, unfavourable soil conditions, abnormally high and low moisture conditions, nutritional stress or fungal pathogens become vulnerable to termite attack. Termite attack in such cases is called as secondary termite attack. Since the termite attack is secondary, chemical treatment cannot prevent mortality of the plant.

3. Complementary Termite attack:

Many a times roots are fed by white grubs or cut worms or attacked by Aphids, Jassids Thrips, Hoppers etc. Attacks on the plant are partially by

mechanical injuries like wind force, cattle grazing and human activity, in such cases injury exposes the soft parts of the plant. This leads to the disruption of flow of food material, and susceptibility of the crop to the termite attack. Such secondary attack by termites is called as "Complementary Termite Attack" (Anony. 1981; Wardell 1987) Withering of the plant or death of the plant is the result of combined factors.

Since all pest species were found in all study sites, all possible types of attacks by the termites were observed. It would be difficult to find the exact role played by individual soil type or any one factor. But some broad conclusion can be drawn from the existing pattern of termite distribution in study sites.

8, 7 and 9 species of termites were reported from Padra, Savli and Dabhoi areas which had Sandy loam soil while 13 species were reported from the Karjan area which has Deep Black Soil. Key for identification, based on soldier caste, has been provided for all the species recorded from the study area (Rathore and Bhattacharya, 2004).

In the present study, some species were recorded as dominant pests at specific stage (seedling and maturing) of the crop as stated in **Table V.** it is difficult to mention one particular factor, which promotes a specific termite species to infest a specific stage of crop.

The most economically important termite genus that attacks crops in India is *Macrotermitinae* (Pearce, 1997). Four species from same genera are

recorded as pests from study area. Only single species, from genera *Coptotermitinae* (*Coptotermes heimi)* has been reported from study area and this species is widely distributed and occurs throughout India and Pakistan (Thakur, 1991). This species was reported by Thakur (2000) as the most common wood destroying termite in India. According to Chhotani (1980), this is the common species found in the subcontinent. In Gujarat it is recorded from I and III ecological zones (Thakur, 1991). *Coptotermes heimi* is one of the wood destroying subterranean termite species and feed the inner portion of the attacked material leaving the outer sheath intact (Sen-Sarma, 1989).

During present study it was found that, the termite species which was found as pests of crops was very common in all the study sites (outside crop fields) and recorded as Generalist species. They were very common in study area, reason being their wide range of micro habitat and food. These reasons increase the possibility of access or attack to the crops at the time of foraging. Wood (1978) suggested that litter feeders and decomposing vegetation feeders are less selective.

Damage to Sugarcane occurred both, at the seedlings (setts) and mature stage. More infestation was found in the seedling stage whereas in Wheat, infestation was more in the mature crop plants. There was no marked difference in the pattern of attack or damage caused to cotton and castor as both seedling and maturing stages were infested. In India and Pakistan, *Odontotermes obesus* and *Microtermes obesi* species are recorded as the principal pest of Sugarcane (Thakur, 1996). Agarwala (1955) estimated a loss

of 2.5 percent in sugarcane tonnage and 4.47 per cent in sugar output in Bihar (India).

According to Roonwal (1981) the most important species attacking wheat and cotton were *Microtermes obesi* and *Odontotermes obesus,* further in Gujarat *Trinervitermes biformes* has also been recorded to attack Wheat. According to Roonwal (1981) damage by the *Microtermes obesi* to Wheat was observed to be less when the crop received 2 or 3 as against 0 or 1 irrigations. In cotton they attack the roots and later tunnel into the stem near ground level, as a result plant wilts and die.

Odontotermes obesus and Microtermes obesi are known to infest Chilli in arid areas of Rajasthan (Sharma and Bohra, 1966) and *O. obesus and Trinervitermes biformes* (Nasutitermitinae) in Gujarat (Thakur, 1996). Verma and Joshi (1984), reported damage to pearl millet, green gram and cluster bean by *Microtermes tenuignathus* but in my study area this species was not found as pest of any crop.

FACTORS PROMOTING TERMITE INFESTATION IN THE STUDY AREA:

Food availability:

Field margins as well as inside field conditions are responsible for termite activity. Food like dung, heap of weeds, crop residues and mulches and leaf litter attract termite activity.

Shelter and Moisture:

In all study areas it was found that, shelter places, type of soil and plant cover (ground shade) play an important role in providing optimum moisture and temperature to the termites.

Many objects were found surrounding the field which were providing shelter to termites e.g. big boulders, manure heaps, huge wooden logs, tree stumps etc. under which large colonies were found. According to Pearce (1997) large diameter objects provide greater shade and moisture to the termites which are the main reasons for movement of termites below the ground.

Soil type

Sandy soil has high water evaporation rate and lower water holding capacity than black soil, so drying of the soil forces the termites to move towards the roots of the plants for maintaining the moisture requirement.

On the other hand in black soil, water holding capacity is high and rate of water evaporation was low so there is less threat of termite attack. More damage was found in the crop fields of Savli, Dabhoi and Padra which had sandy soil as compared to crop fields of Karjan with black soil. This may be due to the soil type variation between these sites. According to Chhabra, (1981) soil type plays an important role in incidence and attack of termites on pulses in Punjab. According to him crops like Chick pea, Lentil, Black gram

and Green gram had comparatively higher damage caused by the termites in the light soil than in the heavy soil.

Sands (1998), reported that termite attack on crops and trees occur more during dry periods hence more infestation was found in dry fields.

Plant cover

As Sugarcane provides most ground shade than other three crops so, five species were reported infesting it while Castor provides lowest ground shade of all three crops so only two species were reported infesting it. Next to Sugarcane, Wheat provides more ground shade than Cotton so four species were reported infesting it while three species were reported infesting Cotton crop. Pearce (1997) also reported that the kind of plant cover also affects soil temperature and termite foraging.

The major and common problem in India was due to many species of termites being subterranean which by and large requires ground connection for moisture requirement (Thakur, 2000). *Odontotermes obesus* is another subterranean species distributed throughout India (Sen-Sharma, 1989). From Gujarat, this species has been recorded from many localities in all three ecological zones (Thakur, 1991). Many *Odontotermes sp.* have been recorded as pests of field crops, at both seedling and mature stages (Pearce *et al.* 1995, Sands, 1998).

The distribution and pest status of each species showed that *Odontotermes obesus* was found as pest of all four crops at seedling as well as maturing stage.

INFESTATION OF TERMITE SPECIES ON INDIVIDUAL CROP:

1. Sugarcane:

Sugarcane is one of the important cash crops in India. Sugarcane is reported to be a favourite plant for attack by termites. Germinating shoots as well as mature cane are subjected to attack. In severe case of attack the leaves and the crown die. Heavy damage has been reported in initial stages. Five species, *Microtermes obesi, Microtermes mycophagus, Odontotermes obesus, Odontotermes redemanni* and *Coptotermes heimi* were reported as pests of Sugarcane. *Microtermes mycophagus, Coptotermes heimi* infested only at seedling stage,

Work on termites on Sugarcane in India started around 1934 (Agarwal, 1972) and reported to be the most seriously damaged crop and with more number of species infesting this crop (Peswani and Katiyar, 1972).

Damage to sugarcane has been found in two ways, tunnelling the eye buds of the setts (seed canes) during pre-monsoon and young germinating shoots during post-monsoon period. Infested shoot being weak comes out of the ground on the slightest pull. Chhotani (1980) in his monograph has also reported similar findings.

It was observed that, after the infestation setts hollowed up and roots of shoots were eaten by termites. The termite infested shoots were differentiated by yellowing of outer leaves which begins to dry up first, and as the termites spread to the interior more leaves show the same symptoms, ultimately leading to withering of the whole crown. Since the eye bud and two cut ends of the setts are the soft portion, it serves as an easy entrance for termites.

Similar findings were made by Roonwal (1981) who mentioned that termites mainly enter the setts through injured eye-buds or through the cut ends of the setts and then completely eat up the soft, nutritious pith. This type of damage induces failure in germination. Singh and Kishan (1946) estimated that 40-60 per cent eye-buds were destroyed by termites. Agarwala (1964) reported damage as high as 88% to Sugarcane setts. Narayanan and Lal (1952) reported loss up to 3.75 (average 1.66) per cent of setts in the year 1946 and up to 1.54 (average 1.078) per cent in 1947, due to *Odontotermes obesus* and also to some extent due to *Eremotermes paradoxalis* and *Microtermes obesi.*

In the present study only single species, *Odontotermes redemanni* was recorded damaging mature stage of Sugarcane where as *Microtermes obesi, Odontotermes obesus* were found to infest both stages of the crop.

Shade cover provided by the sugarcane crop, high sugar content of the stem and the faster growth rate of the crop are the reasons for the preference of this crop by a wide variety of termites.

2. Wheat:

Termites are one of the major pests of this crop throughout the rain fed and irrigated regions (Parihar, 1981). The most important species attacking Wheat are *Microtermes obesi* and *Odontotermes obesus* (Roonwal, 1981). Parihar (1978) reported the loss of wheat crop to be 7.15 %. Thakur (1985, 1988), reported damage by *Microtermes obesi* to Wheat crops in Rajasthan, Gujarat and Haryana.

Four termite species were recorded as pests of this crop, *viz.*, *Microtermes obesi*, *Odontotermes obesus*, *O. redemanni* and *Coptotermes hemi.*

Microtermes obesi damages both seedlings as well as maturing (earhead stage) plants. It attacks the roots of germinating shoot leading to its drying, thus inducing failure in growth. In maturing plants, infestation was observed in the root portion due to which the plant looses stalk strength and gets dislodged. This exposes the ear heads and leads to drying, and results in no grain or loss in grain production.

Damage to Wheat by *Microtermes obesi* has been reported from Punjab, Rajasthan, U.P, Madhya Pradesh and Gujarat (Chotani, 1980).

Odontotermes redemanni damages the root system of both stages of the crop and stem portion at maturing stage and *Coptotermes heimi* reported

to damage the root portion and also the ear heads of the dislodged (fallen) plants.

3. Cotton:

Hickin from U.K. has reported 17 termite species as pests of the cotton plant. This occurs in most parts of the world where Cotton is grown with the exception of U. S. But Harris in his book on termites considers that much termite damage goes unnoticed.

Cotton is one of the most important crops of Gujarat state.

Till now In Gujarat, while working on control of termites on wheat and cotton, Patel (1962) recorded two species *viz.*, *Odontotermes obesus* and *Trinervitermis biformis.*

I have found three species attacking this crop, *viz.*, *Odontotermes obesus, Microtermes mycophagus and Microtermes obesi.*

Odontotermes obesus and *Microtermes mycophagus* were reported to damage both stages of the crop, while *Microtermes obesi* was found to damage only the maturing stage.

Odontotermes obesus damages the root system of the seedling and mature plants and stem of only the mature plant while *Microtermes mycophagus* damages the root system at both stages. *Microtermes obesi* was found to damage the stem and root portion only in the maturing stage.

4. Castor:

Castor is an important industrial oilseed crop but subjected to less research work when it comes to termite attack.

Two species were found to attack this crop, *viz.*, *Microtermes mycophagus* and *Odontotermes obesus.* Both these species damage the crop at seedling stage as well as maturing stage. Just one report by Parihar (1978) of *Microtermes mycophagus* damaging the castor crop at both stages is on record.

Only *Microtermes mycophagus* was found to be the most important pest of Castor. In tender plants it attacks the roots, through which it tunnels into the stem. Termites usually nibble the tap root and in the grown up plants they are seen around the root zone and in certain cases up to 3 feet of the stem (Parihar, 1977). The fine roots were more damaged. Some times, galleries ware also found in the roots. This species also attacks the fallen fruits of the crop.

It is envisaged that the present findings will be useful for farmers and entomologists engaged in the identification and control of the termite pests in various crops and their management.