

CHAPTER-2

REVIEW OF LITERATURE

2.1 Termites in Ancient Literature:

Termites are known since ancient times as it was known as **Kāshṭahārikā** meanings wood feeders, in the Sanskrit literature. It has been stated that the termites constructed a mound over sage Valmiki's body who was so engrossed in meditations. The sage derived his name Valmiki from *Valmi* (means white-ants or ant hill). Further according to one authority, their first known reference was in the earliest of the four Vedas of the Aryans in India, the **Rigveda**, (ca. 1350 B.C.), where termites are referred to as **Ghuna**. In work of Kalidasa, he mentioned about snakes and birds as members of termitophilous fauna.

Prasad the ancient Indian astronomer, Varahamihirga (A. D. 505-587), in his celebrated Sanskrit work **Brahat Samhita** (Master collection) deals with methods of ground-water exploration on the basis of hydrological indicators, like plants, termite mounds, soils and rocks.

The earliest references to termites in modern scientific literature was by **Linnaeus**, who, in 1758, in his famous work, **Systema Nature**, listed three species of termites. Konig (1779), who described large termite mounds in South India and Sri Lanka and Smeathman (1781), reported huge termite mounds in tropical Africa.

2.2 Studies from Abroad:

The first scientific description on large termite mounds was given by Smeathmen (1781) from Africa. Observations on castes and polymorphism of termites were observed by Latereille (1775) and Lespes (1856) in Europe. The first account on life history was given by Muller (1873). Alston (1947) reported 100% mortality of termite species *Coptotermes curvignathus* due to the parasitic fungus, *Entromophthora sp.* in Malaya within forty-eight hours.

Wood (2000), stated general principals about infestation of termites in agriculture and also added some comparative conclusions about pesticides. Harris (1969) reported 57 species of termite on sugarcane from 27 countries under 3 families namely Mastotermitidae, Rhinotermitidae and Termitidae.

Constantino (2002) reported 77 species of termites as structural or agricultural pests in South America and also mentioned indication of the damage they cause, their pest status and distribution. Among these, 53 species were agricultural pests, 40 species were structural pests and 15 species as both. Further more Constantino (2002) discussed taxonomic problems and also presented distribution maps of the main pest genera and species. The main agricultural pests are *Heterotermes sp.*, *Nasutitermes sp.*, *Cornitermes sp.*, *Procornitermes sp.* and *Syntermes sp.*, and the most affected crops are sugarcane, upland rice and eucalyptus.

Akhtar and Shahid (1993) recorded six species of termites from Wheat crop fields of Pakistan, viz. *Odontotermes guptai*, *O. gurdaspuriensis*, *O.*

obesus, *Microtermes obesi*, *M. mycophagu* and *Eremotermes pradosalis*. Akthar and Sarwar (1997) reported four termite species, i.e. *Microtermes mycophagus*, *Microtermes obesi*, *odontotermes guptai* and *Eremotermes paradoxalis* foraging in Wheat crop, from Bahawalpur division of Pakistan.

2.3 Studies from India:

Globally, 2,761 different species of termites belongs to 283 genera from 11 families (Myles, 1998) out of these, 240 species have been reported from Indian region (Rathore and Bhattacharya, 2004).

In India, during 1960-69 work on termite systematics was done mainly at the Zoological Survey of India, Calcutta, and the Forest Research Institute, Dehradun.

Petch (1906, 1913), Annandale (1923, 1924) and Dass *et al.* (1962), made an observation on the fungus combs in the nests of Macrotermitinae as a possible source of food for the termites. Ghidini (1938) considered that the fungus garden serves as humidity regulator for termites.

Snyder (1949) published a catalogue of world termites. Snyder has listed 154 species, belonging to 34 genera of 4 families, from Indian sub region. In 1970, Krishna reviewed Isopteran taxonomy comprehensively. Myles (1998), proposed a new scheme of taxonomy which is yet to gain its acceptance. Dr. Roonwal, the well known termitologist and his co-workers, did extensive and effective work on taxonomy, systematics and various aspects

of termites. From Indian region biology of the termites was given by Roonwal. According to classification proposed by Roonwal and Chhotani (1989) and Chhotani (1997), they considered 9 (instead of 6 of Krishna, 1970) families and 12 sub families. In the Indian context, Classification given by Roonwal and Chhotani (1989) and Chhotani (1997) is more acceptable and satisfactory because it is based on study materials from India and its subcontinent.

Extensive work has been done in control of termites in buildings by many scientists. Roonwal and Chhotani (1961 and 1967) have dealt with the Indian wood destroying termites. Sen-Sarma *et al.* (1975) has brought out monograph on the Indian wood destroying termites.

Beeson 1941, Harris 1961 and 1971, Hickin 1971 have given some account on termites that are injurious to agriculture crops and their control. Sands (1973), Roonwal (1958, 1979), Kapur and Bose (1972) dealt with the termite injuries to agriculture and their control.

In India, several workers, e.g. Narayanan and Rattan Lal (1952) worked on control of termites, damaging crops in India. Rattan Lal and Menon (1953) came out with a catalogue of Indian Insects.

During earlier times control of termites was mainly tried with chemical insecticides. Thakur *et al.* (1956, 1957) had tried Aldrin, dieldrin for the control of Termites. Gupta (1959) tried to control the sugarcane termites with 5% BHC dust at 20 kg. / ha. in furrows. Agarwal (1957) also tried BHC, Aldrin, chlordane, dieldrin etc.as dust or sprinkle, on seed setts at sowing time.

Bindra (1960) worked in the state of Madhya Pradesh on the control of termites using chemicals.

Logan *et.al.* (1990) tried non chemical practices for termite control by preventing termite access to the plants, increasing resistance of the plants, using good quality seeds and appropriate transplanting procedures.

Wood and Johnson (1986) recommended vertebrate and invertebrate predators against termites. (Bio-control).

Parihar (1981) recommended ants e.g. *Pheidole smythiesi*, *Dorylus labiatus* against *Odontotermes obesus* and *Microtermes mycophagus*. He also recommended Crow, Sparrow and Myna for controlling termites. He also mentioned *Calotes versicolor* and *Funambulus pennati* feeding on swarms of *Microtermes mylophagus* and *M. obesi* respectively.

Sen-Sarma (2000), reported several common termite pest species causing serious damage to crops like Wheat, Millets, Pulses, Cotton, Spices and Vegetables from FRI Dehradun. Sen-Sarma also reported that ecological factors like; rainfall pattern, atmospheric temperature, atmospheric humidity, altitude and natural enemies also influence distributional pattern of the termites. He opined that vegetation and soil type are perhaps more important factors. He determined a brief swarming period, during which the flight range is not great, so small water body also constitutes a barrier for dispersal of termites. Sen-Sarma (2000) mentioned, Termitidae is the largest family and comprises three-fourths of the entire world. Four sub families Amitermitineae,

Chapter 2

Termitinae, Macrotermitinae and Nasutitermitinae are generally recognized from the Indian region. The genus *Odontotermes* is most dominant in India and includes over thirty-eight species.

Hussain (1935) reported 6-25 % loss in the Wheat crop from India. Patel and Patel (1954) reported the species *Trinervitermes biformis* causes serious damage to crops like Cotton, Wheat, and Groundnut etc. in Maharashtra.

Damage to Wheat in India has been reported by *Microtermes obesi*, from Punjab, Rajasthan, Delhi, U.P., M.P., A.P. and Bihar states ; by *Odontotermes obesus* from Punjab, Delhi, Rajasthan, Uttar Pradesh, Madhya Pradesh and Gujarat by *Odontotermes gurdaspurensis* from Rajasthan ; by *Nasutitermes* sp. from Madhya Pradesh; and by *Trinervitermis biformis* from Gujarat and Maharashtra, states (Chhotani, 1980).

Chhotani (1980) published a technical monograph on termite pests of agriculture in India and their control. He mentioned the identity, distribution, pest status ecology and biology of various pest species and their control measures. Further more he provided keys for the identification of the termites of agricultural importance in India, together with information on their distribution in India.

Peshwani and Katiyar (1972), mentioned several termite pest species of various crops like; Tea, Rubber, Coffee, Mango, Sugarcane, Cabbage, Cauliflower, Jute, Guava etc; from Kerala, Madras, North East of India,

Chapter 2

Mysore, Punjab, Delhi Uttar Pradesh, Madhya Pradesh, Bihar, Andhra Pradesh, Rajasthan, West Bengal and Maharashtra. Kumar (1965) reports 4.7-6.5 % potato tubers are damaged by termites in Bihar.

Agarwala (1955) has estimated a loss of 2.5 % of cane tonnage in sugarcane and 4.5 % sugar output in Bihar due to the termite species *Micritermes obesi* Holmgren. Kapur (1958), reported serious problem of termites in Sugarcane setts (planting material).

Roonwal and Chatterjee (1962) advised chemical methods to control the termite mound. Snyder (1933) figured the infestation of the leg of *Nasutitermes fletcheri* from India by *termitaria* sp. From South India, Sannasi (1969) observed that the fungus *Aspergillus flavus* is pathogenic for kings and queens of *Odontotermes obesus*.

Scientists like Lefroy and Howlett (1909) have remarked that Lizards, Frogs and birds are predators of termites. Fletcher (1914) reported, cockroaches devour the winged adults, as they swarm out of the nest. Mathur (1962) first listed the natural enemies of termites. Roonwal (1949) mentioned, Frog, Toads, Birds and mammals as voracious feeders of termites.

Thakur (1985, 1988), reported *Microtermes obesi* cause damage to wheat crops from Rajasthan, Gujarat and Harayana. Verma *et. al.* (1980) reported the same from Hisar region from Harayana.

Maan Singh and Madan (2002) conducted an experiment in Karnal, Harayana, with 43 genotypes of sugarcane to determine incidence of *Odontotermes obesus* and *Microtermes obesi*. He recorded 3 genotypes as moderately tolerant (6.97%), 21 as susceptible (48.83%), and 19 as highly susceptible (44.18%) to termite infestation. He opined that, seed and soil treatment at the time of planting must be done with insecticides to save the crop from the attack of termite and shoot borer and got a bumper crop of sugarcane.

Maan Singh *et al.* (2001) conducted field experiment in Karnal and Harayana to determine the efficacy of different soil insecticides against termites infesting sugarcane cv. Co. H. 99, they concluded that, Chlorpyrifos 20 EC and chlorpyrifos 10 G applied alone or in combination showed higher control of termites compared to the other insecticides and insecticide combinations.

Rana *et al.* (2001) in Harayana, conducted an experiment to study the effect of various seeds treated with insecticides *i.e.* cypermethrin, imidacloprid, carbosulfan, triazophos, chlorpyrifos and endosulfan for the management of the *Microtermes obesi* under field conditions. The termite was found as a potential pest of wheat crop in less irrigated fields. Further more they found out, plots where seeds were treated with chloropyrifos and endosulfan at 0.9 and 2.4 g a.i. / kg were least infested by termites.

Parihar (1985) reported roots and stems of castor were attacked by *Microtermes mycophagus* in Rajasthan. Out of 8 varieties he tested, 157-B was found heavily infested (17.3%) than local variety (4.8%) and also proved that seed dressing with aldrin 30 e.c. at 10 ml/kg seed gives best protection against termites followed by 5% aldrin dust at 10 g/kg seed. He opined that pre-sowing soil application of 5% aldrin dust at 37.5 kg/ha also gave good results, and the commonly used 10% HCH dust was least effective.

2.4 Studies from Gujarat:

The first published record of termites from Gujarat State was back in the year 1913 when Holmgren studied Assmuth's collection and recorded five species. After that in the same year, Assmuth (1913) reported four new species from Gujarat.

Chatterjee and Thakur (1968) and Roonwal (1973) dealt with taxonomy and biology of many termite species from Gujarat. Chatterjee and Thakur (1968) recorded three species i.e. *Neotermes fletcheri* Holmgren and Holmgren, *Heterotermes malabaricus* Snyder and *Microcerotermes cameroni* Snyder from Valsad.

Roonwal (1973) described the mound structure, fungus comb and primary reproductives of *Odontotermes brenneus* (Hegen) from Rajkot. Thakur (1976,1981), recorded the occurrence of *Odontotermes assmuthi* Holmgren, *Odontotermes distans* Holmgren and Holmgren, *Odontotermes*

indicus Thakur, *Odontotermes obesus* Rambur and *Odontotermes wallonensis* Wasmann from various other areas of Gujarat.

Thakur (1989) of sandal research centre, Bangalore did most extensive work in Gujarat on termite fauna. During this survey he recorded 46 species, 14 genera and 4 families with discussion on sound taxonomic base, field ecology and distribution in Gujarat and other states. Further more, in addition to the already known taxa of three families, six genera and thirteen species; Thakur added one more family, eight genera and thirty-three species, which included six species new to science.

Thakur (1991) published a series on the field ecology, eco-biogeography, and economic importance of termites. During this survey he recorded occurrence, abundance, distribution and economic significance of termites of Gujarat.

Recently Rathore and Bhattacharya (2004) added to the taxonomic strength of termite fauna of Gujarat (one more genus and fourteen species). Presently, 60 species of 16 genera, four families and eight sub-families are reported from Gujarat. Out of which, 18 species, belonging to 7 genera and 2 families were from Vadodara district.

Termite fauna still remains unexplored when it comes to the agriculture fields and the surrounding areas of Vadodara, Gujarat and it is hoped that this piece of research will partially fill that void.