Lymphatic filariasis is a major health problem and the second most important leading cause of permanent disability in India. The disease causes disfigurement of body parts and physical discomfort and the patients are burdened with significant social stigmatization and psychological trauma. The strong feelings of shame, fear and embarrassment are common among those with elephantiasis and hydrocele. Sexual problems, which are generally not openly acknowledged, include marriages devoid of physical and sexual intimacy and suicidal thoughts. The infection is rampant throughout coastal India and every third Indian is exposed to the risk of filariasis. It is ironical that about half of the world’s filarial patients live in India alone despite the existence of a formal National Filaria Control Program (NFCP). Amongst the infected population in India, about 28 million carry microfilariae in their blood whereas more than 21 million show clinical manifestations of filariasis (WHO, 1999). The consequences of lymphatic filariasis are enormous to the individuals, affected communities and Nation as a whole. The disease has an adverse impact on productivity and wage-earning capacity of affected subjects. The annual financial loss due to filariasis in India has been estimated to the tune of Rs 5355 crores (VCRC, 1998). Whilst countries like China have succeeded in controlling and eradicating filariasis, India has not been able to contain the spread of infection and the epidemiological situation of filariasis is deteriorating with the infection being spread to newer parts of the country year by year. The World Health Organization has now recognized lymphatic filariasis as one of the potentially eradicable diseases.

The causative organisms of filariasis was first discovered by Demarquey in 1863. Later, Otto H Wucherer independently demonstrated microfilariae in urine. Joseph Bancroft (1876) isolated adult filarial worms from lymphatic abscess and hydrocele from Australia, and Cobbold in 1877 named the parasite as Filarial bancrofti. Same year, Lewis found adult filarial worms in scrotum of an elephantiasis patient in Calcutta. The name Wuchereria bancrofti is the outcome of first critical investigation and description made by Wucherer who carried out his investigations at Tuebingen in Germany.

Filarial parasites belong to Phylum Nematoda under family Filarioidea that includes approximately 500 species. They are parasitic in nature and reside in lymphatics, muscles, connective tissues, body cavities etc of vertebrate host. The lymphatic group includes Wuchereria bancrofti (bancroftian filariasis), Brugia malayi (brugian filariasis) and Brugia timori (timorian filariasis), cutaneous group includes Loa loa, Onchocerca volvulus and Dipetalonema streptocerca and the
body cavity group includes *D. perstans* and *Mansonella ozzardi*. These filarial nematodes have complex life cycles that include an obligatory developmental stage in a haematophagus arthropod vector (intermediate host) and a reproductive stage in the definite host (vertebrate host).

Mosquitoes are specialized members of the class *Insecta*. Order Diptera is divided into three suborders, *viz.* Nematocera, Brachyera and Cyclorapha (Smith, 1973). Members of Nematocera differ from that of other two by having long, many segmented filamentous antennae. Smith (1973) divided it into eight families of which Culicidae forms one of the largest families. They are differentiated from the others (families) in having the second longitudinal vein forked once (Roy and Brown, 1970). The family is divided into three subfamilies *viz.* Anophelinae, Culicinae and Toxorhynchitinae with numerous genera (Knight and Stone, 1977; Knight, 1978). The subfamily Culicinae includes many genera such as *Culex*, *Aedes*, *Armigeres*, *Mansonia*, *Psorophora*, *Haemagogus* and *Sabethes* (Kreier, 1980) of great economic importance. Mosquitoes of the genus *Culex* are the vectors of filaria and encephalitis, *Aedes* of dengue and yellow fever, *Mansonia* of Malayan filariasis; *Psorophora* of Venezuelan equine encephalitis virus and *Haemagogus* and *Sabethes* of Sylvan yellow fever virus. Of the above *Psorophora* and *Haemagogus* are not represented in India (Harwood and James, 1979). About 3200 species of mosquitoes have been described throughout the world some with several subspecies (Service, 1986). As many as 250 species are reported from India (Dash and Behura, 1985).

*Culex quinquefasciatus* is the principal vector of bancroftian filariasis on Indian Sub-continent and was first described by Say in 1823 and the same species was described by Wiedemann in 1828 who named it as *Culex fatigans*. Thereafter, Stone (1956) and Stone et al (1959) considered *C. quinquefasciatus* to be the valid name. Belkin (1977) and Sirivanakarn and White (1978) stated that under the law of priority the name *C. quinquefasciatus* Say, 1823 takes precedence over all accepted junior synonyms. Our present knowledge of the taxonomic aspects of Indian mosquitoes is 50 years old and there are no classical accounts other than that of Christophers (1933) and Barraud (1934).

The transmission dynamics of filariasis relies on a number of parasitological and vectorial factors. Bionomics, which is the relationship between filarial vector and its environment, is of key importance in studying transmission intensity of filariasis and in planning appropriate strategies for vector control. The climate plays a significant role on the distribution pattern, biting habits and transmission capacity of vector mosquitoes.
During blood feeding, the vector ingest microfilariae and some of the microfilariae ingested by the mosquito shed their sheaths, penetrate the stomach wall, migrate to the muscles of the thorax, and develop there without multiplication. The slender active microfilaria transform to a short thick inactive sausage-stage or L1 larva. The L1 larva has a cuticle, which forms a conspicuous slender tail, characteristic of this stage.

After the first molt, the larva grow rapidly in length and width and becomes potentially more active, although usually it doesn’t move. It has a thin cuticle, which can be seen at the caudal end forming a short tail. This L2 or pre-infective larva is recognized by its short tail and the presence of one or two papillae at the caudal end.

After the second molt the parasite no longer has a visible cuticle and is known as infective or L3 larva. The L3 larva grows further in length but not in width, moving actively in the haemocoelic cavity of the mosquito, first towards the abdomen and later to the head and proboscis. During next bite, the infective larvae are deposited along with some haemolymph and gain access to the host via the puncture wound made by the mosquito (Yokogawa, 1939; Gordon and Crewe, 1953; Ewert, 1967). The infective larvae mature into adult worms in the definite host that mate and produce millions of microfilariae to ensure their survival and to infect an appropriate vector (Piessens and Partono, 1980).

In many filarial infections, the number of microfilariae circulating in peripheral blood fluctuates in a predictable rhythmic pattern over a 24-hour period. This phenomenon is known as microfilarial periodicity. The twenty four hour cycle in number of microfilariae present in peripheral blood which are maximum at certain period occurs and it correlates with the necessity for these microfilariae to be ingested by the arthropod vector for their development. Four main patterns viz., nocturnal, diurnal, sub-nocturnal and sub-diurnal are seen in different parts of the world. The life span of microfilariae of *W. bancrofti* was estimated to be 70 days (Rao, 1933).

The progression of microfilariae to infective third stage larvae (L3) in the mosquito is governed by a series of complex, interrelated events that profoundly influence the efficiency of filarial transmission by the vector. In general, the average number of infective L3 that develop in infected mosquitoes is directly proportional to the number of microfilariae present in the donor blood at the time of feeding, but the relationship is not linear. The pathogen-vector-host relationship in filariasis.
is more complex as compared to other vector borne diseases. Three epidemiologically important categories of relationships between filarial parasites and their mosquito vector were recognized viz., proportionality, limitation, and facilitation, which are reported to have significant epidemiological importance. The infection of the mosquito also has pronounced effect on the survival of the vector itself. Heavily infected vectors appear to have a decreased life span and many of them die before infective larvae become fully developed.

Bancroftian filariasis is characterized by a wide spectrum of clinical features that range from asymptomatic amicrofilaraemic prepatent infection to elephantiasis.

**Asymptomatic amicrofilaraemic prepatent infection**: A majority of population living in a filaria endemic region is amicrofilaraemic without any clinical symptoms of filariasis. It is not known whether these subjects remained unexposed to the infective mosquito bites or they are exposed but developed resistance in due course of time or they may be carrying a prepatent or a sub-clinical infection.

**Asymptomatic microfilaraemia**: Few individuals in an endemic area develop microfilaraemia but with no recognizable clinical manifestations of filariasis. Some remain microfilaraemic but asymptomatic for years together (some times even for life), others develop clinical disease in due course of time. Rao et al (1982a) estimated two and a half year as the minimum period of patency/parturition. The mean expected life span of patent infection was estimated to be 5.4 years (Vanamail et al, 1989). The authors calculated the mean expected fecund life span of *W. bancrofti* in an endemic area with continuing transmission of the order of 5 years.

**Acute manifestations**: The acute clinical manifestations of lymphatic filariasis are characterized by episodic attacks of adenolymphangitis associated with fever and malaise. In males with bancroftian filariasis this adenolymphangitis may be localized in the genitals and present as acute epididymo-orchitis. Inflammatory nodules in the breast, scrotum or subcutaneous tissue have also been reported as acute manifestations of infection.

**Chronic manifestations**: Hydrocele, lymphodema, elephantiasis and chyluria are the main clinical pathological consequences of bancroftian filariasis. The lymphedema is further classified into 3 grades on the basis of clinical condition.

For more than 40 years, diethylcarbamazine has been the drug of choice for treating lymphatic filariasis and was administered to millions of people throughout the world under widely varying conditions of endemicity and in various doses.
Clinical manifestation of filariasis at Raipur
The drug kills almost all microfilariae and a good proportion of adult worms. It is probably also effective against the L3 and L4 larval stages. The recommended dose of DEC is 6 mg/kg body weight daily for 12 consecutive days (Total dose, 72 mg/kg). Repeated courses of treatment may be necessary to achieve radical cure. DEC at a single annual dose of 6 mg/kg body weight also appears to reduce microfilaraemia significantly. Common salt medicated with 1-4 g of DEC/kg weight has successfully been used for mass chemotherapy in many endemic regions of India and elsewhere.

Ivermectin, the current mainstay for treating Onchocerciasis, has been evaluated for use in lymphatic filariasis. The question of whether ivermectin is effective in killing the adult worms of *W. bancrofti* is still left unanswered.

The control of lymphatic filariasis could be achieved either by reducing the parasite reservoir in endemic population by chemotherapeutic measures or by reducing the man-vector contact through vector control measures or by integrating both the strategies. A complete knowledge of the factors affecting the transmission dynamics of filariasis which includes physiological, environmental, epidemiological and socioeconomic factors would help in framing and implementing effective control strategies in a given geographic location.

The main objective of this study was to investigate various host and environmental factors affecting the vector efficiency of *Culex quinquefasciatus* at Raipur.

The specific objectives of the study included

1. Study of bionomics of *Culex quinquefasciatus* at Raipur and the impact of local meteorological conditions on prevalence of vector filarial infection and infectivity rates.

2. Study of prevalence of *W. bancrofti* infection in humans, frequency distribution of microfilariae carriers and association of blood group antigens with bancroftian filariasis.

3. Study of relationship of human-parasite-vector including rhythmic analysis and its impact on transmission dynamics of the infection and

4. Comparison of the efficacy of two different DEC regimens (standard & single annual dose) on microfilaraemia and analysis of socioeconomic factors which influence the dynamics of filarial infection in the affected community.
STUDY REGION

Raipur is a premier city of Middle east of Chattisgarh region of Madhya Pradesh State and lies between 21° 15’ North latitudes and 81° 38’ East longitude. The average height from the main sea level is 260 meter.

Raipur city in general is characterized by hot and dry summer (March to Mid June), humid in monsoon rains (Mid June to October) and cool dry in winter (November to February). The variation in temperature, rainfall and humidity during study period is given in Figs. 1.1.1 to 1.1.4.

The drainage of the city is carried to the Kharoon river by a number of drainage rivulets, which originate from the central high upland of the city. The sullage drainage channels of Raipur city are cemented in highly populated areas and are partly covered. The Raipur city is dotted with tanks and ponds. There are about 40 such water bodies within the boundary of Raipur Municipal Corporation.

The following types of soil are found in Raipur: Kanhar, Matasi, Dorsa and Bhata. The Bhata soils are lateritic lands on which the city is largely developed. As per the 1991 census the population of Raipur is 4,61,851. The details of study locations, based on the records of District Statistical Office, Raipur, are as follows:

<table>
<thead>
<tr>
<th>Locality</th>
<th>Name</th>
<th>Population (in person)</th>
<th>Area (in Sq Km)</th>
<th>Density (person/ Sq. Km)</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Budhapara</td>
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<td>09667</td>
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<tr>
<td>6.</td>
<td>Tikrapara</td>
<td>8106</td>
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