REVIEW OF LITERATURE
Mosquitoes are vectors of Malaria, Filaria and Dengue. Mosquitoes constitute an intolerable biting nuisance (Service and Youdeouwai, 1983). Singh and Balakrishnan et al. (2000) reported the silent spread of dengue fever and dengue haemorrhagic in Coimbatore and Erode District. The study showed that dengue has been endemic in the area but was not suspected earlier. The incidence of dengue like illness has not increased recent almost 89% in the community tested positive for dengue fever antibodies. Joshi et al. (2000) reported Epidemiological and entomological investigation in dengue out break area of Ahmedabad District. Thavara et al. (2001) studied the larval occurrence, oviposition behavior and biting activity of potential mosquito vectors of dengue on samul Island, Thailand. Endy et al. (2002) Studied Epidemiology of inapparent and symptomatic acute dengue virus infection in primary school children in kamphaeng phet Thailand. Focks et al. (2000) studied the transmission of thresholds for dengue in terms of Aedes aegypti pupae per person with discussion of their utility in some source reduction efforts. Diallo et al. (2003) reported the amplification of sylvatic cycle of dengue virus. Tewari et al. (2004) studied the dengue vector prevalence and virus injection in the south Indian rural area.

Mian and Mulla (1983) concluded that difference in susceptibility may be due to higher levels of proteolytic enzymes in the midgut of Aedes aegypti, which could denature the larvicidal toxin. Lacey and Singer (1982) reported the biological factors that affect efficiency include species of mosquito, age, larval density and feeding strategy. Younger larvae are considerably more susceptible than old instars and Culicine larvae are usually more susceptible than Anophelines. Standaert (1981) had found decreased Anopheline
susceptibility may be more related to surface feeding behaviour and settling of toxin than to innate susceptibility. Interaction of the various environmental parameters can increase (or) decrease larvicidal efficacy. Efficacy tends to be highest against early instar. Water depth and quantity of larval food interact by influencing diving rate of larvae. Biswas et al. (1993) observed breeding habitats of *Aedes aegypti* in Calcutta.

Aly (1983) reported oligotrophic deep habitats. In which larvae live deeper and consume settled toxin, whereas in more entrophic habitats diving rate is reduced owing to presence of food in the upper strata.

Mc Laughlin (1984) has found the toxin content in commercial formulation is usually determined by laboratory bioassay with *Aedes aegypti* larvae. Crickmore et al. (1995) stated that the cytolytic toxins are also mosquitocidal, although their mosquitocidal activity is generally lower than of the mosquitocidal cry toxins.

Subramaniam Thangam et al. (1991, 1993) demonstrated that mosquito larvicidal activities of Mangroove plant extracts and sea weed plant against *Aedes aegypti*. Pusphpalatha et al. (1995) studied the larvicidal activity of a few plant extracts against *Culex quinquefasciatus* and *Anopheles stephensi*.

Novak (1985) emphasized the urgent need for the investigation of phytochemicals as repellents for mosquitoes in his review of no chemical approach to mosquito control. Prolonged use of insecticide impregnated coils and mats may be harmful to human health. Liu et al. (1987) and Curitus et al. (1989) reported that essential oils and terpenoids also show repellency to adult mosquitoes.
Sharma et al. (1992) studied the effect of *Tridax procumbens* extract on fecundity and metamorphosis of *Culex quinquefasciatus*. Tyagi Ramnath et al. (1997) evaluated the repellency effect of the *Targets minuta* against Malaria and Filiaria and Dengue vector. Janten et al. (1999) evaluated the effect of Malaysian plants on the smoke toxicity against *Aedes aegypti*.

Mulla et al. (1984) studied negative correlation between increasing larval age and susceptibility was observed in most of these studies by using *Bacillus sphaericus*. Sinegre et al. (1980) reported no difference in susceptibility of 2nd to 4th instars of *Culex pipiens*. Burke et al. (1983) reported that the prolonged larvicidal activity of *Bacillus sphaericus* on mosquito species.

Padua et al. (1984) isolated *Bacillus thuringiensis* var. *morrisoni* (Serotype 8a 8b). Goldberg and Margalit (1977) isolated (serotype 14) are highly toxic to mosquitoes with virtually no activity towards Lepidoptera.

Wie et al. (1984) reported that on an enzyme linked immuno assay for the quantification of toxin in commercial and experimental formulations of *Bacillus thuringiensis* (H-14). Dame et al. (1981) reported several habitat-related and biological parameters can influence the distribution, ingestion and activity of the larvicidal toxin. The greatest disparity between laboratory – determined ITU using mosquito larvae and actual larvicidal activity is observed with black flies. Mulligan and Schaefer (1982) reported the effective integrated control of *Aedes aegypti*.

Baumann et al. (1985) has found the crystal toxin is composed of two proteins that are synthesized in equimolar amounts and assembled in crystal structures visible at about stage III of sporulation. The genes encoding both proteins have been cloned from several high toxicity strains.
Nicolas et al. (1993) conducted experiments have shown that P42 alone is toxic for mosquito larvae *Culex pipiens*, although the activity is weaker than that of its presence enhances the larvicidal activity of P42, suggesting synergy between the polypeptides.

Baumann and Baumann (1991) was observed in *vitro* assays on mosquito cell lines also revealed that the activated form of P42 done is toxic to *Culex pipiens* and *Culex quinquesfasciatus* cells, where as P51 appears to be inactive; however, no synergy between the components was observed in *vitro*. Berry et al. (1993) was found the presence of both proteins appears necessary for full toxicity, the activity towards various mosquito species displayed by the different *Bacillus sphaericus* strains depends on the origin of P42 as shown by analysis of toxin mutated in *vitro*.

Lacey and Undeen (1984) studied the parasporal crystal of this bacterium contains a stomach toxin of selective activity on larval mosquitoes, black flies, as a stomach poison, the toxic is only effective upon ingestion. Lacey (1985) described the effectiveness of *Bacillus thuringiensis* toxin against larvae of number of mosquito species has been described by feeding response.

Mulligan et al. (1980) and Molloy and Jamnback (1981) *Bacillus thuringiensis var. israelensis* has been showed the laboratory and field studies to be a potent larvicide of mosquitoes and black flies. Davidson et al. (1981) Lacey and Singer (1982) reported several formulations of the bacterial *Bacillus thuringiensis* and *Bacillus sphaericus*. Additionally, synthetic combinations of mosquitocidal toxins from different microbial strains could be engineered to increase toxicity and to expand the host range of microbial insecticides. Ideally, the latter approach would utilize mosquitocidal toxins that differ in structure and mode of action, which combined into a
recombinant bacterium may help prevent or significantly delay the development of insecticide resistance.

Miyasono et al. (1994) found that toxin free spores did not kill larvae, but spores increased the toxicity of Bacillus thuringiensis subsp kurstaki crystals to larvae from a susceptible strain of diamond back moth. Tabashnik (1992) observed interaction between these spores and toxins exemplifies synergism, in which the toxicity of a mixture is greater than expected on the basis of the independent toxicity of its components.

Tang et al. (1996) reported that for the susceptible strain and the resistant strain, synergism occurred between Bacillus thuringiensis subsp Kurstaki spores and cry 1c but not between the spores and cry 2A.

Poopathi et al. (1999) reported that combination of Bacillus sphaericus with need based biopesticide shows synergistic interaction and produced more mortality against Culex quinquefasciatus. Poopathi et al. (1999) studied that evaluation of synergistic interaction between Bacillus sphaericus and Bacillus thuringiensis var. israelensis against Culex quinquefasciatus. Margaret et al. (2000) found synergistic activities of Bacillus sphaericus against Aedes aegypti.

Mwangi (1988, 1987) has been reported that Melia volkensii extracts display insect growth inhibiting and antifeedant against the larvae of Schistocerca gregaria. The activity is similar to that observed in closely related neem tree, Azadirachta indica. Gill (1972) ; Schmutterer et al. (1981) was found it is probably by interfering with the insect endocrine system.

Amara et al. (1998) reported the effect of female size on fecundity and survivor ship of Aedes aegypti fed only human blood and versus human blood
plus sugar. Sieber and Rembold (1983) studied an Anti-feedant, has been shown to interfere with growth, moulting and ecdysis and reproduction of various insects. Fourty years later, Butterworth and Morgan (1968) isolated Azadirachtin, a steroid like tetranotriterpenoid (limonoid). Isman et al. (1990) reported target and non-target effect of neem insecticides and correlated with its bioactivity against test insects.

Schmutterer (1990) isolated Azadirachtin, a number of other active ingredients and identified from different parts of neem tree. Siddiqui et al. (1986) isolated some other compounds, such as alkalines were isolated from dried leaves of neem.

Ascher (1993) and Mordue and Blackwell (1993) revealed the neem products are capable of producing multiple effects in insects such as antifeedancy, growth regulation, fecundity suppression and sterilization, oviposition, repellency and changes in biological fitness. Use of botanicals especially neem (Azadirachta indica A. Juss) in management of vectors causing human diseases holds a great promise. Being safe, cheap and effective neem products are ideal for management of vectors.

Singh et al. (1996) studied the use of neem cream as a mosquito repellent in tribal area central India.

Morgan (1981) assumed that neem seeds are the richest sources of growth disrupting tetranotriterpenoid, azadirachtin and found the order of the growth inhibiting effectiveness of neem extracts for Plutella xylostella. Murugan et al. (1996) studied antipupal effects of neem oil, seeds kernel extract against Anopheles stephensi.

Barnard (1999) reported that the certain plant derived mosquito repellents generally are regarded as safe for use on the repellency of different concentrations and combinations of five essential oils Bourbon geranium, cedar wood, clove, peppermint to Aedes aegypti and Anopheloes Spp.


Murugan and Jeyabalan (1999) demonstrated the antifeedant and ovipositional activity of neem gum and root extracts against Spodoptera litura. Mulla and Su Tinayun (1999) reported that neem (Azadirachta indica) products have been shown to extract pesticidal properties against a variety of insect species. In mosquito control programmes, such products may have potential to be used successfully as larvicides. In exploring other advantages of neem products, the oviposition responses of Culex tarsalis and Culex quinquefasciatus. Sukumar et al. (1991) have listed 344 plant species as
having potential in mosquito control which exhibit various degrees of toxicity to mosquitoes.

Saxena and Saxena (1992) studied the number of plant materials like leaves, roots, and barks, flowers and seeds of differed species have been tested for their larvicidal effect on different stages of mosquitoes. Pandian et al. (1994) tested *Pongamia globra* on mosquitoes. Tunon et al. (1994) reported the mosquito repelling activity of compounds occurring in *Achillea millefolium*. Thorsell et al. (1998) studied the efficacy of plant extracts and oils as mosquito repellents. Al Daklil et al. (1999) studied the larvicidal activities of the peel oils of three citrus fruits against *Culex pipiens*.

Sharma and Dhiman (1993) studied advantages of synthetic repellents. Citronella oil has been used in commercial preparations and it still popular in India, through generally related less effective than repellents with synthetic active ingredients. He also reported the effectiveness of neem oil as an alternative and safe method of protection from mosquitoes.

Tawatsin et al. (2001) reported that the repellency of volatile oils extracted by steam distillation from four plant species *Curcuma longa*, *Citrus hystrix*, *Cymbopogon winterianus* and *Ocimum americanum* were evaluated against *Aedes aegypti*, *Anopheles dirus* and *Culex quinquefasciatus*. The repellent activity of methanolic extract of *Ferronia elephatum* leaves against *Aedes aegypti* was studied in the laboratory by Venkatachalam and Jebanesan (2001). Moore et al. (2002) studied field evaluation of three plants against malaria vectors.

Anyawu (2001) studied that the larvicidal action of ethanol extracts of peel of lemons, grapefruits and navel oranges was tested against fourth instar larvae of *Culex quinquefasciatus* and *Aedes aegypti*. Thomas et al. (2000)
studies were carried out with the essential oil of an indigenous plant, *Cannabis sativa* to evaluate mosquito larvicidal properties against *Culex tritaniorychus, Anopheles stephensi, Aedes aegypti* and *Culex quinquefasciatus*.

Ciccia *et al.* (2000) reported that the crude acetone extract of seeds of *Annona squamosa* tested against 3\textsuperscript{rd} and 4\textsuperscript{th} instar larvae and pupae against *Culex quinquefasciatus*.

Ansari and Razdan *et al.* (2000) started that to evaluate the larvicidal, insect growth inhibitor and repellent action of *Dalergia sissoo* essential oil against *Anopheles stephensi, Aedes aegypti* and *Culex quinquefasciatus*.

Ahmad and Kamal (2001) stated that studies on three ethanol extract of *Solanum nigrum* showed insecticidal activity against *Aedes aegypti* and *Culex pipiens* larvae. Venkatachalam and Jebanesan (2001), Vanitha *et al.* (2002) studied the larvicidal efficacy of leaf extracts of *Pavonia zeylanica* and *Acacia feruginea* were tested against the late third instar of *Culex quinquefasciatus*.

Kalyanasundaram and Das (1985) reported that the synergistic effect of plant extract used with synthetic chemical larvicides from ten indigenous plants. The plant extracts were tested against the fourth instar larvae of Pondicherry strains of Culex quinquefasciatus, Anopheles stephensi and Aedes aegypti.


Ansari and Razdan, et al. (1999) conducted laboratory and field and lab evaluation of Bacillus thuringiensis H-14 (Bt-H-14) Granule formation against Aedes aegypti. The results of laboratory evaluation revealed hundred percent mortality of Aedes aegypti larvae at 0.5 gm per mg within 24 hours of exposed in enamel trays. The field evaluation revealed that biolarvicide at 0.5 gm per m² provided and effective control of this species for more than four weeks in evaporation coolers and disused tyres.

Perich et al. (2003) reported field studies of lethal ovi trap against dengue vectors. Lethal ovitrap in designed to kill Aedes via an insecticide, treated ovitrap impregnated with delta methrin. The results demonstrate sustained impact of lethal ovitraps on dengue vector population densities in housing conditions of Brasilian municipalities.

The above stated review of literature Aedes aegypti clearly reveals that practically nothing is put on record on the Synergist effect of NSKE and Bacillus sphaericus against dengue vector and also necessary investigation of field trails in urban endemic and rural endemic area of DHF and D.F.