CHAPTER ONE
INTRODUCTION:

Bihar hairy caterpillar, *Diacrisia obliqua* Walker (Arctiidae : Lepidoptera), a notorious polyphagous pest widely distributed in India, Bangladesh, Ceylon, China, Pakistan, Nigeria, Burma etc., had been infesting pulses, oil seed, fibre crops, vegetables and fruit plants at Orai (Jalaun) and surrounding areas but it never caused anxiety in farmers as its damage was always below economic injury level but from 2000 onwards, with the increased irrigation facilities which introduced changes in cropping pattern in crops, the population of *D. obliqua* started growing with a considerable speed and suddenly reached an explosive stage in September, 2003. There was hardly any crop field not infested heavily by this pest at that time. It was heavy and unusual out break, caterpillars in large number were found roaming on roads and in houses close to farm lands. Infact, farmers were scared by the sudden eruption of population of this pest.

Under the infestation referred to as above, the crops were badly defoliated and it was feared that these crops might be exterminated due to ravage of the pest if the situation was not controlled immediately. To save the crops from this pest, farmers used already recommended powerful insecticides such as BHC, parathion, malathion, endosulfan and other synthetic insecticides.
but surprisingly, the older larvae survived their toxicity. This demanded trial with
more powerful insecticides which would have controlled the abnoxious pest like
an avenging angel since the use of such insecticides have given spectacular
results in many cases but high hopes raised by their introduction has not been
fully achieved.

Economic entomologists had made good efforts in search of such
chemicals and consequently they have been successful in tracing a good number
of chemical insecticides to be employed as an alternative control strategy against
D. obliqua. But chemical insecticides may result in acute and long term effects
including sickness and death of people, and useful animals, development of
resistant population, environmental pollution, undesirable side effects on non-
target animals and plants and disruptive impacts on ecosystem. Such problems
forced the economic entomologists to proceed further in search of safer methods
of pest management.

With the growing realization of hazards and side ill effects
connected with the indiscriminate use of insecticides, entomologists have
developed a new concept of pest control and termed as Integrated Pest
Management (I.P.M.) which refers to a system that utilizes all suitable techniques
and methods in as compatible manner as possible and maintain the pest
population at levels below those causing injury to our crops and economy
(Mathur and Prem Kishore, 1987).
The I.P.M. system does not exclude chemical insecticides from the strategy of pest management, but it advocates its judicious use for combating the pest population in addition to other methods of insect control. In this context, the role of bio-control agents viz. parasites, predators and microbes need no emphasis due to their specificity, effectiveness, safety to nontargeted organisms including pollinators and natural enemies. It would be worthy for mention here that most of the biological agents are compatible with other methods of pest control.

In recent years, entomologists are leaning their attention on the exploration and exploitation of microbial agents including virus, bacteria and fungi for the pest suppression. Interestingly, few have been widely tested and proved very effective against pernicious pests of agricultural crops. In certain developed countries a number of bio-pesticides have been registered for field application on various vegetables, fruits and other crops of agricultural, horticultural and forest importance.

One of these approaches which has captured world wide attention is the development of compounds acting selectively on some groups of insects by inhibiting or enhancing the activity of biochemical sites such as respiration (diazinon), the nicotinyl acetyl chloride receptor (imidacloprid), the salivary glands of sucking pests (pyrethroid). Progress has been made to introduce improved bio-control agents such as Bacillus thuringiensis (B.t.) for controlling lepidopteran, coleopteran and dipteran pests. B. thuringiensis kills insects primarily through the action of δ-endotoxins, a proteinous constituent produced
during sporulation; it affects the insect mid gut epithelium upon ingestion (Hofte and Whiteley, 1989; Gill et al., 1992; Navon, 1993). Most conventional B.t. products are based on the subspecies kurstaki HD – 1 introduced by Abbott in laboratory, followed by Sandoz, Nova, Ecogen and Monsato for controlling lepidopteran pests (Navon, 1993).

*Bacillus thuringiensis* (B.t.) is an aerobic, gram positive, spore forming bacterium found in the environment. It produces a number of insect toxins, the most distinctive of which is a protein crystal formed during sporulation (Bulla et al., 1977; Whiteley and Schnepf, 1986). It is a crystalline protein inclusion, that is the principal active ingredient in formulations currently in use. Although B.t. was described by Berliner in 1911 and its potential as an insecticide was recognized in early 1980's. Now a days various formulations of B.t. *kurstaki* such as Dipel (HD-1,Abbot), Thuricide (HD-1, Sandoz), Biobit (HD-1, Nova), Javelin (NRD 12, Sandoz and MVP (monsanto) are available for controlling the lepidopteran pests. These insecticides are considered safe to the environment and natural enemies. Hence, they are considered important components in IPM programs.

Heimpel (1967) observed the toxicity of the pathogen and found it depends upon parasporal bodies which contain toxins. These toxins are known as α, β and γ – exotoxin and δ – endotoxin. Dulmage et al. (1981) reported more than twenty varieties of *B. thuringiensis* which differ from each other by the presence of endospore and exotoxin crystals. Although *B. t.* contains four toxins,
yet, more emphasis has been given only to the crystalline endotoxin because of its high toxic activity against lepidopteran pests.

Because of the great diversity of B.t. toxins occurring in nature, it has been suggested that these toxins might be used in mixtures and rotations to delay pest adaptation. The compatibility of Bt. with many chemical insecticides warrants the study to explore its feasibility under IPM system. Generally, small amount of insecticide added to B.t. suspension reduces the pest population and also minimizes the high cost of application of these biotic agents. As per literature available, it is pathogenic to more than 525 insect species belonging to different orders mainly to lepidoptera, diptera, hymenoptera and coleoptera (Sundrababu, 1985). Ramakrishnan and Kumar (1977) reported 170 species of lepidopterous larvae which were pathogenic to B. thuringiensis.

A perusal of literature divulge that work done in India related to B.t. is very scattered and fragmentary. Most of the work done in India under laboratory and field conditions is concerned with pathogenicity tests. However, there are other important aspects like effects of exposure period on insect mortality, effect of lethal and sublethal concentrations of B.t. on the development of insects, efficacy of different commercial products and their combinations with different insecticides against the particular insect species, which have not been paid due attention so far.

Considering the aforesaid facts in view, following studies have been planned against D. obliqua under laboratory conditions.
(a) Effect of different formulations of B.t. on growth of D. obliqua.

(b) Effect of different formulations of B.t. on development of D. obliqua.

(c) Effect of different formulations of B.t. on fecundity and fertility of D. obliqua

(d) Sex specific sterility of different formulations on sexes.

(e) Compatibility of Dipel with certain commonly used chemical insecticides.

The results, thus, obtained have been discussed critically in the light of earlier findings in the present thesis.