SUMMARY

*Spilosoma* (*Diacrisia*) *obliqua* Walker (Lepidoptera: Arctiidae), commonly known as Bihar hairy caterpillar, is a highly polyphagous pest, which is distributed all over India and neighbouring countries. The larvae of this insect are voracious feeder and are main causative agent for the crop loss. It infests nearly 126 important crop plant species, which include soybean, groundnut, sunflower, oilseed crops, fodder, vegetable and fruit crops (Pandey *et al*., 1968; Tiwari *et al*., 1988; Singh and Singh, 1993; Sharma and Kalita, 2001; Singh and Varatharajan, 2005). For management of *S. obliqua*, heavy reliance on synthetic pesticides lead to numerous environmental problems including disruption of natural biological controlling agents (predators and parasitoids) and development of resistance. Hence, there is urgent need to search environmental friendly, biodegradable and sustainable control measures.

An important alternative method could be the use of botanicals. Plants are rich source of organic chemicals on earth. These phytochemicals are called as allelochemicals, which have no nutritional value for the plant, and have evolved for protection against the herbivores. These plant chemicals act as antifeedants, attractants, repellents, chemosterilants, growth inhibitors, or as insecticides. Since these naturally occurring phytochemicals are usually biodegradable and non-hazardous for the environment, they have great potential as safer, more effective method for management that will be economic and sustainable (Lawati *et al*., 2002).

Among botanical biopesticides, studies have centered on plants from the Mahogany family, Meliaceae, particularly on members from the genera *Azadirachta indica* and *Melia azedarach*, which are outstandingly effective against insects (Schmutterer, 1995). In the Meliaceae family, the genus *Melia* has shown great potential for pest management in terms of secondary plant chemistry or the presence of allelochemicals in its various species (Koul *et al*., 2002). *M. azedarach*, also known as chinaberry, is deciduous tree. This is native of Northwestern India and its active chemical compounds have been used extensively against a number of pests. The main active ingredients found in this plant are limonoids, a group of modified triterpenes, which have been reported to possess insect antifeedant activity and other insect control properties.
The bioactive compounds from the leaves, bark, seeds and fruits extracts of *M. azedarach* tree that display feeding inhibition, oviposition deterrent, growth regulator (IGR) and insecticidal activities against some insects. However, the report of its effects on the biology of *S. obliqua* are lacking in the previous studies. Therefore, present studies were initiated to assess the bioactivity of *M. azedarach* fruit extracts on various behavioural and physiological aspects such as food preference, survival, growth, development, oviposition and egg production of *S. oblique* in the laboratory condition.

An extensive review of literature on biology of *S. obliqua*, damages caused by it to various crop plants, and various control measures, including botanicals for its management have been compiled in CHAPTER I. This chapter also include, review of published reports on the phytochemistry and bioactivity of *M. azedarach*, against insect pests.

**CHAPTER II**, entitled as ‘Materials and Methods’ include methods for conducting bioassays to evaluate the activities of *M. azedarach* extracts on behavioural and physiological components of this insect. For this study *S. obliqua* larvae were collected from wild castor plants, and maintained on castor leaves and semisynthetic diet in the laboratory. Ripe fruits of *M. azedarach* were collected from trees in Delhi University campus. Solvent extraction was done to obtain crude extracts of fruit powder. These extracts were further fractionated for use to perform various bioassays with different life stages of *S. obliqua*. A number of experimental arena/equipments were designed for conducting behavioural bioassay suitable for this study.

The result of the bioassay about the effect of plant extracts on the survival, developmental period, growth and adult emergence, have been described in **CHAPTER III**. The result showed that the Acetone Fraction of Methanol Extract (AFME) had significant effect on all stages of *S. obliqua*, as compared to Methanol Fraction of Methanol Extract (MFME) or control. Bioassay with neonate larvae revealed higher toxicity of AFME as compared to MFME. Moreover, dose dependent effect of toxicity on neonate larvae was evident, higher the concentration more toxic effect on larvae. LC$_{50}$ values of larvae, obtained for extracts, also corroborate the findings. The AFME caused higher mortality in early larval stages, delay in the larval period and prolongation in developmental time. It showed a negative correlation between survival and concentration.
This extract also exhibited growth-disrupting activities and produced deformed larvae, pupae and adult *S. obliqua*.

These results revealed that crude AFME of *M. azedarach* contains potent phytochemicals that show higher bioactivity against *S. obliqua* as compared to the ingredients present in MFME.

**CHAPTER IV** includes the results of bioassays conducted to evaluate the effect of *M. azedarach* extracts on feeding behaviour and nutritional physiology *S. obliqua* larvae. The preliminary bioassay indicated that antifeedant index of AFME extract was higher as compared to MFME at all the tested concentrations. Moreover, dose dependent relationship between concentration of extract and antifeedant index was observed for AFME. The leaf area consumption by fourth instar *S. obliqua* larvae significantly decreased as concentration of AFME increased from 1000 ppm to 4000 ppm. Antifeedant activity of *M. azedarach* extracts was also confirmed by the fecal pellet counts. Feeding deterrence of AFME extracts under choice bioassay demonstrated strong deterrence against sixth larval instar of *S. obliqua* in a dose dependent manner.

Results of the nutritional indices revealed a significant reduction in growth of larvae that consumed diet incorporated with AFME extracts. Their consumption rates were inversely proportional to the concentration of extract in the diet that were fed to larvae. Food consumption and larval weight gain was significantly inhibited on AFME treated diet. This is reflected from the percent growth inhibition on *S. obliqua*. In case of MFME, growth inhibition was significant only at higher concentrations of 5000 ppm. Efficiency of Conversion of Digested Food (ECD) and Efficiency of Conversion of Ingested Food (ECI) values suggested post-ingestive effects of AFME, as there is a reduction in food consumption was compensated by maximizing the utilization of whatever the food they consumed at higher concentrations of AFME. The results indicated that AFME of *M. azedarach* was more effective than MFME against *S. oblique* and its activity was dose dependent.

Oviposition bioassays of *S. obliqua* adult females and ovicidal activities of different concentrations of extracts have been presented in **CHAPTER V**. The result of bioassay about larval orientation has also been incorporated in this chapter. The results on the choice bioassay indicated that the AFME had repellent activity towards neonate
larvae. The larvae moved towards the control leaf in significantly higher number as compared to treated leaf. However, in case of MFME the repellent efficacy was negligible at lower concentration, as the number of larvae moving towards the control and treated leaf was statistically similar. This clearly indicate that distance perceivable chemical is present in non-polar fraction of extract.

Oviposition bioassays showed that both AFME and MFME of *M. azedarach* suppress the egg laying of gravid females. Females laid fewer numbers of eggs on AFME at all the concentration when compared to control in a choice bioassay. A positive correlation has been observed between the concentration and the oviposition deterrence. In choice bioassay the mean number of eggs laid by female moth on MFME was statistically lower than control surface. The oviposition deterrence index (ODI) value suggested higher inhibition of AFME compared to MFME of *M. azedarach*. Moreover, bioassay with AFME showed strong oviposition deterrence activity as the number of eggs laid by female was significantly reduced at all the concentrations. However, the deterrence activity of MFME was non-significant at lower concentrations when compared to control. ODI values further proved that AFME extract is strong deterrent than MFME in no choice bioassay, and a positive correlation with concentration of extracts and oviposition deterrence. This again indicates presence of distance perceivable chemicals for oviposition in non-polar fraction of extract.

AFME also showed ovicidal potential, as there was substantial reduction in percent hatchability of eggs when coated with extract. However, MFME did not show such effects. These results suggest that the extracts of *M. azedarach* consist of phytochemicals that act as oviposition deterrence, and these extract has also the potential to inhibit larval hatching when applied directly to eggs.

The results obtained by various bioassays with larvae and adult *S. oblique* to assess the impact of *M. azedarach* extract have been discussed in the light of previous published reports in the CHAPTER, “DISCUSSION”. Importance of the present study and its implication in the management of *S. obliua* has also been highlighted in this chapter.