Preface

The most pressing problem today in agriculture is the need to reduce the loss of crops and their products from the attack or destruction by insects. Insects, the most abundant inhabitants of all corners of earth are mainly pests in man’s endeavors and also interact with other animal and plant species. Doutt and Smith (1971) expressed that the most powerful control forces are natural ones, some which can be multiplied to increase the mortality of the pest species. With the introduction of high yielding varieties, the pest problems have also been increased, the losses are mainly caused by the pod borer, Heliothis armigera (Hubner). A large number of insects have been recorded which feed on pods and leaves and ear heads of sorghum in vegetative phase. In general the complex of insects feeding on these crops causes the greatest loss during the past 30 years.

Heliothis armigera is a member of order Lepidoptera and family Noctuidae. In India it is commonly known as gram pod borer. Members of the genus, Heliothis ochsenhainer, are widely distributed in the tropic and sub tropical regions where they are serious pests of several crops. They are polyphagous, fruit feeding, voracious, highly mobile, highly fecund,
multi volatile with facultative diapauses. In India 3 species of *Heliothis* occurs.

*Heliothis armigera* (Hubner)

*Heliothis assulta* (Guenee) and

*Heliothis pultigera* (Schiff).

**Damage:**

*Heliothis armigera* causes severe damage to a wide variety of crops. Annual yield loss of 300 million US dollars on chick pea and pigeon pea due to *Heliothis armigera* occur in India (Reed and Pawar, 1982), contributing factors for loss include crop mono cultures and lack of crop rotation. In India, the following reports highlight. The extent of crop damage in Motipur (Bihar) 21% by *Heliothis armigera* infestation was recorded on maize (anonymous, 1974) while in Madhya Pradesh, Kaushik et.al. (1969) reported 41.56% infestation to the same crop. In Andhra Pradesh 25-65 % pigeon pea and 7.6% chick pea pods were infested (Bhatnagar et.al. 1981, 1982). Heavy damage to tomato fruit 40-50% in Tamilnadu (Srinivasan, 1959) and 80% in Karnataka (anonymous 1984) has been recorded.
The most severe damage is caused by the attack on reproductive parts such as flower buds and flower heads, capsules, berries, and maize inflorescences. When still very young and small, the caterpillars burrow deep into tomatoes and are overlooked in peeled fruits intended for canning, thus causing a high rate of commercial losses.

In sorghum the caterpillars feed on the head when the grains are in the milky stage. They are especially damaging to sorghum varieties with tight compact heads. Varieties with loose open panicles are rarely damaged.

In Pigeon pea the eggs are laid on flowers, flower buds, young pods, and at times on shoot tips and leaves. Flower buds and flowers damaged by small larvae may drop down to the ground. Larger larvae bore into pod lobules, and consume the developing grain. Short-duration and determinate varieties suffer more damage.

In Tomato the larvae damage flowers and young fruits. The later fall down following insect attack. Larger larvae bore into the maturing fruits. Secondary infections by other organisms lead to rotting of the fruits.
In Maize, Eggs are laid on the silks and the larvae damage the developing grains. Secondary infections in the damaged cobs are common.

In Cotton, the round holes made by the larvae are visible at the base of flower buds, flowers, and the bolls. Bracteoles become spread out and curled downwards. Leaves and shoots may also be damaged. Larger larvae bore into maturing green bolls. Young bolls drop down following larval damage. Eggs are laid on shoot tips, squares, flowers or young bolls, and at times on the leaves.

In Chickpea, eggs are laid on leaves and young pods. The larvae initially feed on the foliage (young leaves). The young seedlings may be completely destroyed. Larger larvae bore into pods and consume the developing seed.

**Present methods of control of the pest:**

Chemicals are commonly used to control the propagations & multiplication of injurious pests and thus certainly increase the yield of many crops. But simultaneously this had many side effects, viz,

1) Chemicals may cause physical or physiological changes in the soil.

2) Repeated application of chemicals may lead to air and water pollution.
3) Sprayed chemicals may bring about deleterious effects on beneficial insects like parasitoids and predators.

4) Natural balance & ecological cycle may be disturbed and

5) Repeated applications of pesticides may lead to the development of resistant varieties of pests which enforce in multiplying the concentration of the powerful chemicals.

These factors suggest a need for finding a new approach to pest management to involve reduced reliance on pesticides as suggested by Doutt and Smith (1971). Integrated pest management is the result of such efforts. For the effective control, a thorough knowledge of their life cycle, pest status, distribution, periodicity, host complex and behavior is a prerequisite factor. The present work is carried out to find the biopesticides of plant origin so that they can be effectively used to control Heliothes infestation. As the pest damages most edible materials it is must to use the safe pesticides, instead of chemical pesticides which has long residual effect and are very harmful to the nontarget organisms including man. Biopesticides of plant origin have usually low toxicity to nontarget organisms and they degrade very rapidly leaving poor residual effect.
The present investigation is structured in six chapters, which deals with different aspects.

**CHAPTER – I: INTRODUCTION**

The first chapter of introduction includes the data regarding the polyphagous pest, *Heliothis armigera*, losses caused by it to the field of cotton, tomato and chickpea and other plants of economic importance, the methods applied for its control and sources and nature of studied biopesticides for the control of the pest.

**CHAPTER – II: MATERIAL AND METHODS**

The plants *Argemone mexicana*, *Nerium oleander*, and *Euphorbia tirucalli* were collected from botanical garden of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad and from nearby areas while seeds of *Somecarpus anacadium* were purchased from the market. The plant materials were thoroughly washed by tap water to remove all the dust and dirt, were blotted on blotting paper and dried in laboratory under shed at room temperature.

Then fine powder was prepared in the mixer. Extract of each plant material was extracted by Soxhlet apparatus in different solvents i.e. chloroform, acetone, ethanol and methanol. Then solvent was allowed to
evaporate and the obtained extract after evaporation was used to study its biopesticidal property.

**Initial rearing of Heliothis armigera:**

The larvae of Heliothis armigera were collected from the field of tur, tomato, gram etc. near Aurangabad. These larvae were kept in different plastic bottles to avoid cannibalism and reared in artificial diet. After they went to pupation, the pupae were collected in large petridish containing soil to provide natural environmental condition at the time of adult emergence. Adults emerged were kept in rearing cage. They were fed on 10% honey solution and tender branches of gram plant to get maximum fertile eggs. Eggs were collected by soft brush from tender branch of gram plant and kept in the artificial diet for feeding after hatching the larvae. Life cycle of the pest and its life cycle stages were studied and recorded.

For the study of biopesticidal effect, the larvae were fed on different concentrations of the plant extracts of Argemone mexicana, Semecarpus anacardium, Euphorbia tirucalli and Nerium oleander in different solvents i.e. chloroform, acetone, methanol and ethanol in artificial diet. The artificial medium with the proposed doses of the
extracts were changed every day to provide fresh food and to remove the excretory matter. The mortality of the larvae was recorded daily the effect of extracts on gut of *Heliothis armigera* larvae was also studied.

The tissue architecture of gut of the experimental *Heliothis armigera* larvae which were exposed to lethal dose of biopesticides was done by the usual microtechnique method and the sections were stained by the Mallory’s triple stain. The stained sections were screened and photographed.

**CHAPTER-III: OBSERVATION AND RESULTS**

This chapter includes observations and results of the present work. Extract of seeds of *Semecarpus anacardium*, leaves of *Argemone mexicana*, *Nerium oleander* and *Euphorbia tirucalli* showed variable results in extracts of different solvents. Chloroform extract of *Semecarpus anacardium* was more toxic to *Heliothes armigera* and caused high mortality as compared to acetone, methanol and ethanol extract. In *Argemone mexicana* ethanol and acetone extracts caused high mortality as compared to methanol and chloroform extract. In *Nerium oleander* chloroform and acetone extracts showed high protective effects as compared to methanol and ethanol extract against the damage caused by
Heliothes armigera. The extracts of Euphorbia tirucalli had no significant effect on the mortality of Heliothes armigera. The affectivity of different extracts against the pest is presented in tables and graphs with statistical applications.

The histological studies showed the damage of the gut epithelium of the caterpillars exposed to the effective extracts of the plants. The details with the photographs are given in the thesis.

CHAPTER- IV: DISCUSSION

This chapter includes the results obtained by several workers in this field and the comparison of their results. It also includes the supportive documentation to support the results obtained in the present research work and its importance.

CHAPTER- V: CONCLUSIONS

From the observations and results, the conclusions drawn are summarized in this chapter.

CHAPTER- VI: REFERENCES

This chapter includes the alphabetical list of the research publications and books used in preparing this thesis.
The present work provides safe remedy for the control of *Heliothis armigera* infestation to several crops. It is more useful to protect the fruits and vegetables against the pest and minimize the toxic effect on humans and domestic animals.