Life cycle, Nature of damage and Present methods to control *Heliothis armigera*

Agriculture is the main source of Indian Economy and currently the second largest producer of several agricultural products including dry fruits, roots and tuber crops, pulses, sugarcane, cotton, vegetables etc. Agriculture is provided employment opportunities in India. Near about 65-70% population in India is engaged in agricultural activities and nearly 60% of populations are depends directly or indirectly on agriculture. It is also the backbone of India's economy because it providing food security to the population.

In India there are 3 species of *Heliothis* studied i.e. *Heliothis armigera* (Hubner), *Heliothis assulta* (Guenee) and *Heliothis peltigera* (schiff).

All are widely worldwide distributed and out of these three species *Heliothis armigera* is the most destructive species with country-wide distribution. Host range are relatively less economic importance. It is also a most abundant of the three species of *Heliothis* that occur in India (CIBC, 1974). Until the late 1980s the genus was uniformly known as '*Heliothis*', both as a scientific and common name. While this name is still widely used, it has been split by taxonomists into *Helicoverpa* and *Heliothis*.

Classification:-

Kingdom : Animalia

Phylum : Arthropoda

Class : Insecta

Order : Lepidoptera

Family : Noctuidae

Sub-family : Heliothinae

Genus : *Heliothis*

Species : *armigera*

Heliothis armigera is a highly dreaded pest of several agricultural crops. It belongs to order- Lepidoptera and family- Noctuidae. It is also known as gram pod borer or catterpilar, cotton bollworm, corn earworm and tomato fruit worm. It feeds on wide variety of crops of economic importance such as chickpea (*Cicer arietinum*), pigeonpea (*Cajanus cajan*), tomato (*Lycopersicon esculentum*), okra (*Abelmoschus esculentus*), cotton (*Gossypium species*) and

maize (*Zea mays*) etc. It feeds on more than 170 species of plants belonging 41 families most notably in cotton (King, 1994). About 150 pests have been reported feeding on cotton, out of these *Helicoverpa armigera* is a major pest of cotton in Pakistan (Shabbier, 1973) and all West African cotton producing countries (Youm et. al., 2005). The larvae feed on the green leaves, buds, pods and fruits of their host plants. One larva can damage 10-12 fruiting bodies in its life span (Nyambo, 1988). Cotton bollworm, *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) is a serious pest causing 14-56 per cent damage (Kaushik et. al., 1969; Manjunath et. al., 1989; Jayaraj, 1990). An annual loss of about Rs. 2,000 crores in India by *Helicoverpa armigera* reported by Ignacimuthu and Jayaraj, 2003 is observed in India. *Heliothis armigera* is also a serious pest of chickpea, pigeonpea, maize etc. in tropic and sub tropic regions. The chickpea has relatively few insect pests but gram pod borer, *Helicoverpa armigera* is the major pest (Patel et. al., 1971; Reed et. al., 1980; Lal et. al., 1981; Naresh and Malik, 1986; Lal, 1996). They are polyphagous, fruit feeding, voracious, highly mobile, highly fecund, multi volatine with facultative diapauses. The ability to feed on various plants enables *H. armigera* populations to develop continuously during the entire cropping season as they exploit a succession of different hosts (Bhatnagar et. al., 1982, Nyambo, 1988). At the ICRISAT research station near Hyderabad in India, *H. armigera* occurs on groundnut in July and feeds on sorghum and millet in August and September, and moves to pigeonpea and chickpea from October to March (Bhatnagar et. al., 1982).

Life cycle of *Heliothis armigera*:-

H. armigera shows complete metamorphosis. The life cycle stages of *H. armigera* includes egg, larva (Caterpillar), pupa and adult (moth). Lifecycle of H. armigera is completed in 6-10 weeks depends on the environmental conditions i.e. temperature.

1. Eggs:-

Fertile eggs hatched in about 4-6days at the 25 °C average temperature. High temperatures were dehydrating and kill the eggs and also very small larvae. During the development of eggs, changes from white to brown to a black-head stage before hatching. All eggs are not fertile.

Eggs of *H.armigera*

2. Larvae:-

Larvae can develop in six instars. The newly hatching larva feeds on the egg shell to make an exit hole and emerges into neonate larvae. The first instar larva is very small and about 1-3 mm long, with a brown-black head and white or yellowish-white, dark-spotted body. After hatching they feed on tender young foliage for 1-2 days and then move to feed on buds, flowers or young pods, bolls or fruits. Second instar larva is smaller in size and about 4-7 mm in length while third instar larva is small medium in size with 8-13 mm in length. The medium large larva is about 14-23 mm in length and it is voraciously feeders i.e. fourth instar as well as the fifth instar can 24-28 mm in length and it is also voraciously feeding stage. Sixth instar larvae can stop feeding and enter in to a pre-pupal stage. It is about 29-32 mm in length. Pre-pupal stage lasts for 2- 4 days and enters into pupation.

First Instar Larva **Third Instar Larva**

Fourth Instar Larva **Sixth Instar Larva**

3. Pupae:-

Once larvae are fully grown, they crawl to the base of the plant, tunnel up to 10 cm into the soil and form a chamber in which they pupate. Pupae normally develops to emerge a moth in 10-16 days.

Pre-Pupa **Pupa**

4. Adult:-

The adults are stout-bodied moths, with a wingspan of 35 to 40 mm, and body length of 18 to 19 mm. The general colour varies from dull greenish-yellow, buff to olive-gray with light brown to blackish markings on the wings. *Heliothis armigera* is a cosmopolitan,

polyphagous insect causing serious damage to cultivated crops in India such as cotton, tomato, chickpea, pigeonpea, maize and sorghum etc. It is distributed throughout India. It is reported from Andhra Pradesh, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, New Delhi, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal etc.

Male

Female

Damage of crops by *H. armigera*:-

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. The extent of crop damage in Motipur (Bihar) 21% Heliothis armigera infestation was recorded on maize 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 Tamil nadu 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 6 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 locules, and consume the developing grain. 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 grain. 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. 7 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.

Nature of damage:-

Newly hatched larvae feed on surface tissues of the plant, but cause most damage by feeding on the buds and fruiting parts of the plants, and eating their way into flower buds, seed pods, and young fruits. On tomatoes, beans, etc., larvae bore completely into the fruit. On maize, after eating the silks, they feed on the soft seeds at the top of the cob. Agriculture plays a greater role in the economic status of developing countries as it provides livelihood to vast majority of people. 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 inhabits of all corners of earth and major pest to restrict man’s endeavours and also interact with other animal and plants species. Due to wider host range, multiple generations, migratory behavior, high fecundity and existing insecticide resistance, this became a difficult pest to tackle (Hussain et. al., 1991; Khan et. al., 1993).

Larvae of *H. armigera* feeding on leaves and pods of gram (*Cicer arientum*)

Present methods of the control of pest:-

Chemical pesticides are commonly used to control the propogation and multiplication of injurious pests and thus certainly increased the yield of many crops. But simultaneously this had many side effects, viz,

1) Chemical pesticides 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) Chemical pesticides have high residual value for long period and hence they reach to human stomach through food and water and causes health problems.

5) Natural balance & ecological cycle may be disturbed

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

Integrated pest management is the result of such efforts. For the effective control, a thorough knowledge of their life cycle, 9 pest status, distribution, periodicity, host complex

and behaviour is a pre requisite factor. Pesticide resistance in agriculture was first noticed in India in 1963 when a number of serious pests were reported to have become resistant to DDT and HCH (two of the most commonly used pesticides during the 1960s and 1970s). Since then the number of pests with pesticide resistance has been increased. The most serious problem of resistance is witnessed in cotton, for which American bollworm is a serious pest. The bollworm has developed resistance to almost all pesticides in a number of regions, and is particularly serious in parts of Punjab, Haryana, Andhra Pradesh, Karnataka and Maharashtra. Other important pests of cotton, white fly and jassid, have also developed pesticide resistance in some places. All methods described are insufficient to control the pest, *Heliothis armigera.*

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