

CHAPTER- II

2 REVIEW OF LITERATURE

Literature on *Spodoptera litura* unveils information availability on the biology of the pest on different crops & also influence of temperature & humidity. Only biotic factors were studied in Gujarat region and restricted to limited host range. No literature was found regarding work done on abiotic factors (Temperature & Humidity) in laboratory conditions against armyworm in Gujarat region. So I am glad to explore both abiotic and biotic factors against *Spodoptera litura* in laboratory condition. The literature pertaining to the different aspects of the present investigations was reviewed and is presented under the following headings.

2.1 Work done in Gujarat

Tobacco leaf eating caterpillar, *Spodoptera litura* is one of the most important insect pests of tobacco in nursery as well as in field. Varietal screening of tobacco was done in Anand against *S. litura*. The biology of *S. litura* on different tobacco varieties, Anand-119, GT-s, GT-g, GTH-1, ABT-10 and ABD-101, was studied at $26\pm 1^{\circ}\text{C}$ and 75 ± 1 percent relative humidity under laboratory conditions were studied by Patil et al., in 2014. All the biological parameters show influence of different host which indicates host plant relationship. The larval period ranged from 22 to 31 days on GTH-1 was longer than on other tobacco varieties. Fecundity was more on GT-9, least on ABD-1 01 and intermediate on Anand-119, ABT-10, GT-s and GTH-1. Pupal period, adult period and growth index was significantly higher on GT-S than on others and larval mortality (%) was also significantly lower on GT-5 than other varieties. Pupal mortality (%) was lower on ABD-101 than on other varieties. The overall suitability of the cultivars for the development of *S. litura* shows difference against different tobacco varieties. The fastest completion of life cycle (average 39.4 days) was recorded on tobacco

cultivar ABT-10 but on cultivar GTH-1, it takes an average of 49.17 days to complete its life cycle (PATIL et al., 2014).

2.2 Work done in India

The *Spodoptera litura* Fab. (Lepidoptera : Noctuidae) is a serious polyphagous insect causing immense damage to field crops like vegetables, oilseeds, pulses, throughout the country said by Gargav and Katiyar, (1971). Kumar D, (1993) reported that the insect has been causing extensive damage to a wide range of crops such as oilseeds, pulses, fodders, fiber crops, fruit trees, weeds, medicinal and ornamental plants. Dhir et al., in 1992 found that *S. litura* cause 26-100 percent yield loss in groundnut & also stated that host plant is a key determinant of the establishment, growth, survival and fecundity of herbivorous insects.

Influence of different host on *Spodoptera litura*

Though many host plants were reported for *S. litura*, every host does not support the pest in the same way. There have been a number of studies on the biological parameters of *S. litura* on different host plants under different environmental conditions, particularly, in India said by Patel et al., (1986). Mathur (1962) reported several host plants like cotton, jute, sunhemp, castor, linseed, sesame, pigeonpea, black gram, horse gram, green gram, pea, cowpea, soybean, potato, sweet potato, maize, sorghum, groundnut, tobacco and also *Albezziasp.*, *Antemisia vulgaris* L, *Asparagus officinalis* L, *Cannabis sativa* L., *Chenopodium ambrosioides* L. and *Chrysanthemum* sp. Singh., in 1993 observed insect host plant relationship is of fundamental importance, which helps to know the possible effect of host plants on insect development. It is also a fact that food plants and their physical and chemical constituents play a vital role in survival and reproductive potential of insects. The growth of insects follows a series of moulting or ecdysis under control and the increase in size can be expressed as growth law, which indicates that head capsule of caterpillar increases in width with each moult by a geometrical progression studied by Dyar., (1890). Moreover, evaluation of the effectiveness and efficiency of control technology

require the presence of the appropriate stage, quantity and quality of insect. Therefore, mass breeding technology using high quality of feed, easy to get, and affordable is needed in order to provide insect described as above. Even though this pest feed on various crops, the differences in morphological and chemical substance between host plants may likely interfere in the biology and behaviour of pest. Therefore, the present investigation was carried out to study the comparative biology of *Spodoptera litura* (Fab.) on different host plants under laboratory condition. Twelve synonyms of this insect have been reported by Kharub and Singh., in 1993 with different names given as *Mamestra albisparsa* (Walker), *Noctuaelata* (Fabricius), *Noctuahi strionica* (Fabricius), *Noctualitura* (Fabricius), *Prodenia ciligera* (Guenée), *Prodenia declinata* (Walker), *Prodenia evanescens* (Butler), *Prodenia glaucistriga* (Walker), *Prodenialittoralis* (Fabricius), *Prodenia litura* (Fabricius), *Prodenia subterminalis* (Walker), *Prodenia tasmanica* (Guenée).

Narvekar et al., (2018) studied & said that comparative biology of *Spodoptera litura* (Fab.) is important for knowing the best host that support the development of *S. litura* and can be used for mass rearing of *S. litura*. Similarly, the information of life history parameters of *S. litura* on different host plant species will help to make efficient strategies to control this economic pest. The comparative biology of *S. litura* on different hosts inferred that, the minimum larval development period of 11.67 days was noticed on castor, whereas, it was maximum (17.33 days) on tapioca. The minimum pre-pupal (2.00 days) and pupal period (7.33 days) were recorded on castor, while it was maximum (3.00 days pre-pupal and 11.67 days pupal period) on tapioca host. The pupal weight was maximum on castor i.e. 0.28 g and minimum on cowpea (0.19g). The maximum pupal success of 86.67 percent was observed in larvae fed on castor, whereas, it was significantly lowest on tapioca leaves (46.67%). Highest adult weight was found on tapioca leaves (0.20g) followed by groundnut (0.18g) and the lowest adult weights were recorded on Mulberry and cowpea (0.08g each). Among the eight hosts the adult longevity was recorded maximum on castor and sweet potato i.e.7.67 day's each and minimum on tapioca (5.33days).

Influence of temperature & humidity on *Spodoptera litura*

Being poikilothermic organisms, the developmental rate in insects is highly contingent on external temperature conditions. Hence, temperature is generally considered the single most significant environmental factor influencing behaviour, distribution, development, survival and reproduction in insects studied by Bale et al., (2002). A few number of studies that addressed the development of *S. litura* at a range of constant temperatures, were concerned with predicting only developmental rates and threshold temperatures using linear degree day or heat summation models, but no emphasis was given to the simulation of variability in development times, mortality and fecundity with temperature changes observed by Miyashita. K, (1971). Due to non-linearity in developmental response at temperature extremes, linear models are generally considered poor predictors of insect developmental rates. Yet, the specific effects of associated daily and seasonal temperature extremes on *S. litura* development are less understood which warrants estimation of the temperature-dependent population growth potential for understanding the impact of climate change on its future incidence and damage activity (Bale et al., 2002).

Selvaraj et al., (2010) studied temperature effect on *S. litura* & said maximum temperature that affected the incidence of *S. litura* damage was negatively correlated for all varieties where effect was non significant. Minimum temperature was correlated negatively with all varieties where effect was significant. The correlation between incidence of *S. litura* damage and minimum temperature was significant effect for all varieties. The effect of morning relative humidity and dewfall was correlated positively with all varieties except SVPR 3 with significant effect. The correlation effect of evening relative humidity, wind velocity and evaporation was non significant and correlated negatively for all varieties.

The common cutworm, *Spodoptera litura*, has become a major pest of soybean (*Glycine max*) throughout its Indian range. With a changing climate, there is the potential for this insect to become an increasingly severe pest in certain regions

due to increased habitat suitability. The study was based on temperature-based phenology model for *S. litura*, by constructing thermal reaction norms for cohorts of single life stages, at both constant and fluctuating temperatures within the ecologically relevant range (15–38°C) for its development. Life table parameters were estimated stochastically using cohort updating and rate summation approach. The model was implemented in the geographic information system to examine the potential future pest status of *S. litura* using temperature change projections from SRES A1B climate change scenario for the year 2050. The changes were visualized by means of three spatial indices demonstrating the risks for establishment, number of generations per year and pest abundance according to the temperature conditions. The results revealed that the development rate as a function of temperature increased linearly for all the immature stages of *S. litura* until approximately 34–36°C, after which it became non-linear. The extreme temperature of 38°C was found lethal to larval and pupal stages of *S. litura* wherein no development to the next stage occurred. Females could lay no eggs at the extreme low (15°C) and high (> 35°C) test temperatures, demonstrating the importance of optimum temperature in determining the suitability of climate for the mating and reproduction in *S. litura*. The risk mapping predicts that due to temperature increase under future climate change, much of the soybean areas in Indian states like Madhya Pradesh, Maharashtra and Rajasthan, will become suitable for *S. litura* establishment and increased pest activity, indicating the expansion of the suitable and favorable areas over time. This has serious implication in terms of soybean production since these areas produce approximately 95% of the total soybeans in India. As the present model results are based on temperature only, and the effects of other abiotic and biotic factors determining the pest population dynamics were excluded, it presents only the potential population growth parameters for *S. litura*. However, if combined with the field observations, the model results could certainly contribute to gaining insight into the field dynamics of *S. litura* (Fand et al., 2015).

2.3 Work done Globally

In Indonesia, *S. litura* has important status and caused damage on soybean up to 80% reported by Marwoto, (2008). *S. litura* attack leaves and also consume the pods that play an important role in the early reproductive phase thus have an impact on crop failure. A wide range of host plant is considered important for this species to survive better even in seasonal change. The management of *S. litura* can be performed using chemical insecticides, resistant varieties, and transgenic plants studied by Souza et al., (2012). Various insecticides such as organophosphates, organochlorines, carbamates, and pyrethroids have been used for the management of *S. litura* reported by Huang S, (2007). However, Arias et al., (2011) studied that the pest has developed multiple types of resistance due to the use of these chemical extensively, may likely contributing to the difficulties in controlling this pest in the field. Integrated pest management needs to be implemented in order to reduce the use of chemical insecticides.

Influence of different host on *Spodoptera litura*

The information of life history parameters of *S. litura* on different host plant species will help to make efficient strategies to control this economic pest (Greenberg SM, Sappington T, Legaspi B, Liu TX, 2001).

One alternative is by combining a chemical control with technical culture, such as crop rotation with non host plants, the use of trap crop, and sanitary selective of host plants that allow the pest to develop. The information of life history parameters of *S. litura* on different host plant species will help to make efficient strategies to control this economic pest stated by Greenberg et al., (2001). In addition, feeds also affect on the longevity, fertility, and reproductive capacity of parasitoids studied by Uckan and Ergin, (2003). Therefore, the study on the influence of host plant on biology of insect is very important. Shahout et al. (2011) said that there were many previous studies evaluated about the host plant preference of *S. litura* but not all of these studied the effect of the same host plant on biology parameter of *S. litura*. This polyphagous pest is responsible for huge

yield losses in cultivated crops and sometimes causes up to 100% in the field stated by Qin et al. (2004).

The difference growth and development of armyworm (*Spodopteralitura*) was studied on five host plants. *Spodoptera litura* is the important pest on soybean in Indonesia. The main objective was to determine the best feed that support the development of *S. litura* and can be used for mass rearing of *S. litura*. This research was conducted in Laboratory of Entomology, Indonesian Legume and Tuber Crops Research Institute on March-April 2014 using randomized complete design, five treatments and 30 replicates. The treatments were *Glycine max*, *Jatropha curcas*, *Ricinus communis*, *Ipomoea aquatica*, and *Amaranthus viridis*. One leaf of each host plant was entered into test tube and was infested by one larva of *S. litura* at 0 days after emergence. The result showed that feeds significantly affected the body size, survival rate, developmental time, reproduction, and longevity of *S. litura*. Total egg masses produced by female were high on *I. aquatica* (11.6 egg masses). In conclusion, *I. aquatica* and *R. communis* leaves were found to be preferred for *S. litura* life which shown the best growth and development of this pest, so it can be used as feed for mass rearing of *S. litura*(BAYU et al., 2016).

Influence of temperature & humidity on *Spodoptera litura*

Global changes are responsible for wide range of anthropogenic and natural environmental variation said by Ahmed AM, Etman H, (1979). These climatic and weather changes not only affect the status of insect pests but also affect their population dynamics, distribution, abundance, intensity and feeding behavior observed by Garad GP et al., (1984). Intensity of change in climatic ecosystem noted by meteorological science has showed a direct and indirect affect on the prey and host relationship, their immune responses and rate of development, their fecundity and various physiological functions observed by Dhir B C, (1992). Studies conducted during 2008-2012 by Shatz AJ et al., on various factors including anthropogenic, biotic and a-biotic were assume to be the responsible of Asian Longhorn Beetle distribution. A-biotic disturbances particularly upper and

lower thermal affects check the insect multiplication, diapauses, emergence, flight and the dispersal rate observed by Yamamura K et al., (1998). Not only high temperature thresh hold is responsible for these variation but cool temperature play an important role in intrinsic properties of insect species said by Régnière J et al., (2012). For instance, insects facing to cooled stress will possess dark body color as compare to those living in hot climate. In addition to a-biotic factors, biotic changes are also equally responsible for the physiological, behavioural and morphological adaptations in the insects along with its population fluctuation studied by Overgaard J et al., (2008). Among biotic stresses of agro-ecosystem, terrestrial flora played most vital role in the development of various stages of terrestrial insects, their oviposition and hatching success. On the plants different insects feed like pollinator and other herbivorous. Plants showed various responses against different insect pests. Certain herbivore induce plant volatile influence the carnivorous insects to attack on folivorous species noted by Bownes A et al., (2013). The study carried by Lucas-Barbosa D et al., (2011) observed strong effect of florivory and folivory were significantly affected due to emission of HIPVs contrary to the pollinator visitation. Knowledge on the temperature-dependent population growth potential of insect pests is highly imperative for understanding their population dynamics and implementing agro-eco region specific pest control strategies stated by Briere et al., (1999)