CHAPTER- V

5 DISCUSSION

Ideal biotic and abiotic conditions allow a species to flourish. Other conditions may lead to a species' decline or even extinction. Both abiotic and biotic factors determine where a species can live. A limiting factor is any factor that places an upper limit on the size of a population. Limiting factors may be biotic, such as the availability of food, or abiotic, such as temperature and humidity. Human influences often act as limiting factors. Abiotic and biotic factors probably exert more influence upon *Spodoptera litura*, developmental rates than any other factors. The effect of constant temperatures upon *S. litura* development was well documented (Briere et al., 1999). So current study focuses on influence of these factors on life cycle of *S. litura*.

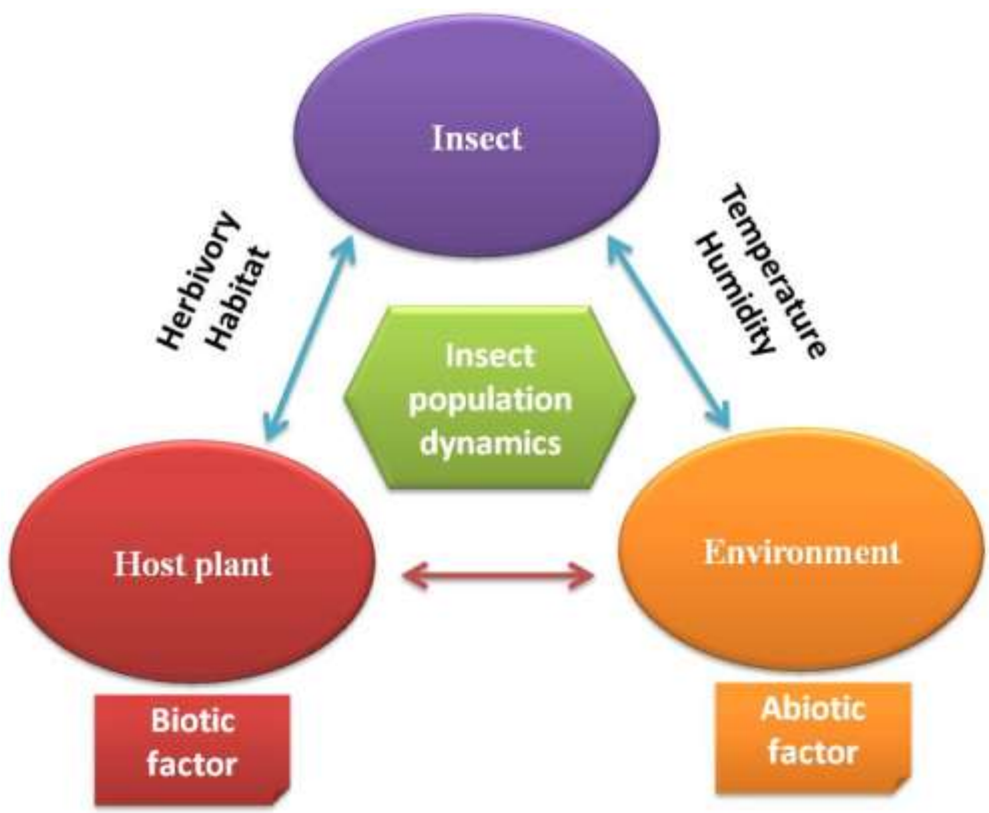

Figure 1 Interaction showing insect population dynamics

Influence of biotic factors on life cycle of *S. litura*

The results from this present study revealed the effect of different host plants on the growth and development of *S. litura*. Generally, shorter developmental times, higher reproduction rates, and low mortality of insects on a host indicate greater suitability of a host plant (Bale et al., 2002)Many studies concluded a significant difference in larval feeding, growth, food consumption pattern and utilization by *S. litura* larva when fed with different host plants. Thus, there is some nutrient or essential component in the food it takes, which supports the insect for its preference, growth and survival. 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 Patel et al., (1986). The host plant that support pest and make it attain maturity in a short duration may be regarded as the best but it should make insect healthier also. Consumption of food is one such criteria of a healthy larva but it is not enough to consume food but should have contributed to its growth rate. Finding the digestibility is a criterion to know the food consumed, get digested or not i.e. utilized or not. Here also, the process of food utilization does not end with digestion but absorption and conversion of absorbed nutrients into body matter which can be analyzed by calculating the efficiency of conversion of ingested/ digested food. If a host plant attracts an insect to feed on it by presenting itself as a preferred host and also gives nutrients for digestion and utilization of it into its body mass can be regarded as the best host plant for successful survival of the pest. Studies on effect of host plants on the biology of insect are important in understanding host suitability of plant infesting insect species. This also forms the basis for an important management technique known as trap crop strategy(Patel et al., 1986).

We demonstrate here that immature stages of *S. litura* tend to develop better when larvae are fed on tomato leaves as compared to other hosts. The longer duration of the larval and pupal stages and consequently the life cycle of *S. litura* seen when larvae fed with leaves of cotton indicate that some secondary substance or non-nutritional compounds may affect the growth and development of *S. litura*, as observed for other hosts of *Spodoptera* species. The four hosts belong to different families, Tomato & Chili comes under Solanaceae, cabbage comes under Brassicaceae and Cotton comes under the family Malvaceae. So from the results it was clear that *Spodoptera litura* prefers host form Solanaceae family followed by Brassicaceae and last Malvaceae. The effect of the host plant used by insects in the larval stage also influences the biological attributes like weight gain & food consumption. Analysis of the combined biological data obtained for different stages of development by analyzing the life cycle study showed that tomato is the best host for the development of *S. litura*, probably due to the fact that this species is already adapted to this host, being considered major pest of this crop (Patel et al., 1986). Life tables are of a great value in understanding the population dynamics of a species because they provide an integrated view of the biological characteristics of a given population under certain environmental conditions (Coppel HC, 1977). Although the present work was conducted under controlled conditions against different host, insects in nature might experience adverse biotic factors that affect their fitness, so these types of life table studies were useful in evaluating these ecological factors. Understanding the differences among the four host plants in terms of their nutritional benefits has practical implications for managing *S. litura*. The present study indicates that the larvae reared on tomato leaves require frequent changing and we have to provide more fresh food more as compared to other hosts. Different growth indexes were also recorded which clearly indicated tomato gives high index which reflects more consumption as compared to other hosts like Chili, cabbage & cotton.

Influence of abiotic factors on life cycle of *S. litura*

Abiotic factors such as temperature, humidity, light, and soil can influence a species' ability to survive. Every species is able to survive within a tolerable range of each of these factors. This range is called the species' tolerance range. Near the upper and lower limits of the tolerance range, individuals experience stress. This will reduce their health and their rate of growth and reproduction. Within a species' tolerance range is an optimal range, within which the species is best adapted. The largest and healthiest populations of a species will occur when conditions are within the optimal range. Each species has a tolerance range for every abiotic factor. Species can be successful over a range of abiotic conditions. However, they will become stressed and will die out if conditions exceed their tolerance limits.

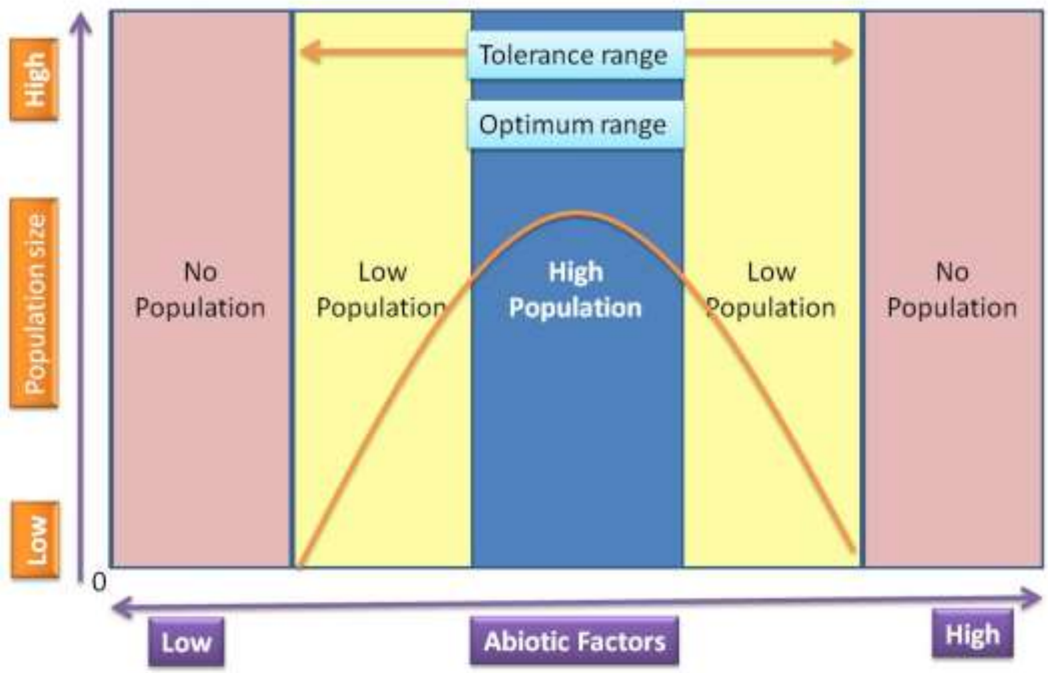

Figure 2 Interaction between abiotic factors and population size

Current study emphasized to see influence of temperature and humidity on life cycle of *Spodoptera litura*. Here, we used life cycle based approach to describe the temperature-dependent& humidity-dependent population growth potential of the common cutworm *S. litura* reared on artificial diet in laboratory. Our study revealed that *S. litura* could sustain under constant temperatures at 20°C but prolong its life cycle. Same observations were found when we checked on 40% humidity. However favorable temperature range observed was only between 27±2°C. In similar study done by Fand et al., in 2015 found that the females of *S. litura* were unable to lay eggs at constant temperatures of 15°C, 35°C and 38°C; as a result they could not estimate population growth parameters at these temperatures. Our results are in larger agreement with those reported by (Rao et al., 1989), who also did not get *S. litura* oviposition at constant high temperatures of 35°C and 37°C, however, only deviation that existed for low temperature of 15°C,where they reported egg laying. The studies by Miyashita, in 1971 on the developmental effects of constant and alternating temperatures on *S. litura* addressed only the development rates and estimation of thermal constants. However, they did not consider the temperature-dependent immature mortality, adult senescence and female fecundity which are considered highly important in understanding pest population dynamics& can correlate to field situations. Rest of the studies that deal with estimating *S. litura* life table parameters were conducted using only single constant temperature (Sunil et al., 2019). In the present work, we evaluated the effects of ecologically relevant range by literature survey and come to a point where the data point set for temperature and humidity were not detrimental for *S. litura*& can only influence the life cycle. Thus, our predictions have taken into account the whole life history for estimating *S. litura* population growth potential behaves at particular temperatures& humidity. It seems that these discrepancies are largely due to the deviations from the selected sub-model for development, which are considered to be the most variable factors. Difference in phenology model formulation & different host plants used for the study may be responsible for the overall discrepancy between the results presented here and those reported by previous authors. Maximum temperature that affected the incidence of *S. litura* damage was negatively correlated for all varieties where effect was non-significant. Similar study performed by Selvaraj et al., in 2010 but in field condition observed that 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. Sunshine hours and rainfall had a significant effect and correlated negatively for MCU 7 and non significant negatively correlated for SVPR 3 and SPCH 22. It was found that weather factors have significant influence of incidence of *S. litura* damage. Another field study done by Miyashita., in 1971 also gives same indication about influence of abiotic factors that the development of *S. litura* larvae and pupae tended to be faster under alternating temperature. In our study, the mean developmental periods of *S. litura* at constant 25°C were not necessarily longer than the times taken for development under fluctuating outdoor conditions. Furthermore, the shortest duration pre-adult stage occurred in the fall and the longest was in spring. They also demonstrated that the maximum development rate occurred in the fall, when the weather is warmer. The fall had an average temperature of 28.6°C (ranging from 23 to >40°C), and the fall group development time was shorter than that of either the 25°C group, or the spring group (mean springtime temperature 23.6°C, ranging from 12 to 35°C). According to Rao et al., in 1989, under constant temperature conditions, the duration of pre-adult stages of *S. litura* decreased as temperature increased through 35°C, 37°C, and 40°C. However, 40°C was the upper developmental threshold, and mortality became significant at this temperature. In our outdoor experiments, the maximum daily temperature was occasionally greater than 38°C (less than 2 h per day) and exceeded 40°C on one occasion. However, the overall survivorship of all larval stages remained at 84%, similar to the 25°C group survivorship. Thus, under variable temperature conditions, *S. litura* was able to complete its life cycle and continue to thrive over a wide temperature range. All organisms experience a diurnal temperature fluctuation in the field. Therefore, population projections based on data collected at constant temperature in a laboratory alone might overestimate or underestimate a population growth. However, the observed differences in development time among individuals in each developmental stage should not be ignored, particularly under fluctuating conditions (Fand et al., 2015).

The effects of other abiotic (light, rainfall, etc.) and biotic (parasitoids, predators, microorganisms, etc.) factors influencing the pest population abundance and dynamics were not considered in this study& can be a future scope. Thus, it needs to be cautiously interpreted while predicting field situations along with abundance of *S. litura* population, where abiotic and biotic factors other than temperature, humidity & host do come to play the role in regulating pest population dynamics. However, prefect opinion that if coupled with field observations, the correlation can certainly contribute to the improved understanding of the field dynamics and the activity of *S. litura* under a range of temperatures& humidity conditions along with more host.