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Destruction of *Solanum lycopersicum* (L), by the pest *Helicoverpa armigera* Hubner, (Lepidoptera:Noctuidae) (tomato fruit worm) a case study at Ramgarh, Jharkhand, India

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Abstract- The plant *Solanum lycopersicum* (L) 'Tomato' is cultivated and commonly used in domesticated agro business, consumed as raw and in cooked form. The plant naturally contains tannins and cyanide precursors protect it from pests, predators and fungal attack. The serious pest *Helicoverpa armigera* Hubner (Tomato fruit worm) destructs the crop and causes the loss of its agribusinesses. It is a polyphagus pest infests the green plant *Solanum lycopersicum* (L) and other cultivated vegetables. High reproductive potential makes it the serious pest causing significant economic damage. High dispersal capacity of the pest makes it cosmopolitan. Activity of *Helicoverpa armigera* was maximum during February to October and completed 03 to 04 over lapping generations in a year. The caterpillars of the pest damage the standing crops at night. During day time they hide in cracks and crevices in soil. The larva attains its maximum size in 17 to 30 days and enters into cracks or crevices and forms their earthen chamber and pupates underground. The pupal period varies from 13 to 25 days and the moth emerges out at night. The life cycle gets completed in 35 to 65 days. The life cycle was studied during the year 2018-2020 at Ramgarh. And it was found that the life-cycle of the experimental pest *Helicoverpa armigera* Hubner (Lepidoptera:Noctuidae) was very simple. The larvae after 3rd to 4th instar were photo negative, hidden in the soil during day time. In extreme hot climatic season the pest larvae and pupa hide under 20 to 30 mm in cracks and crevices in the soil. There was an observation that the moth migrates towards cold region of hills during extreme hot climate. Destruction of host plant by pest was 50% to 80%. Prevention from the pest was very difficult. The farmers were advised to control the pest by spraying the chemical pesticides as lindane 02% or carbaryl 0.1% or endrin 0.1% etc. Various natural enemies like moles, grubs, wasps, predaceous and parasitic flies destroy the larvae of the pest and were natural control of the pest population.

Key words: pest, cholesterol, quality, health supplement, photo negative, food, larvae, natural control, chemical control, endrin.

INTRODUCTION

Tomato fruit worm or tomato fruit borer is genetically the *Helicoverpa armigera* Hubner is a polyphagus pest. The morphology of larva on tomato plant is quite different than the pest larva found on other host plants it was lighter and smaller in size. It was one of the serious pests to destruct the various types of cultivated and ornamental crops, damage the crops as well as the financial capacity of farmers of Ramgarh. It was observed that the experimental vegetable *Solanum lycopersicum* (L.) is an important agribusiness product of Ramgarh and the farmers cultivate it on commercial level. The pest *Helicoverpa armigera* Hubner was a serious pest damage this commercial crop significantly, sometimes it damages the standing crop up to 80%. It was also observed that

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Legumes and dry bean have been preferred by host whereas Corn and Sorghum was the least preferred crop of the experimental pest. The attack of the pest starts in the month of February, March, when the flowers of the host plants become visible. The larvae of the pest consume the crop, the tender leaves and the flowers were consumed by small larvae and the developed larvae feed the berry. The first instar larvae feed on the chorion and then crawl individually in search of food if no suitable food is found they will consume unhatched eggs and other less active larvae, but in normal stages cannibalism was not observed. The pest *Helicoverpa armigera* Hubner having global distribution and serious infestation of cultivated plant causes significantly economic loss in agricultural products. The experimental host plant produces one of the most important vegetable for agro-industries consumed by the people around the globe. It is rich in essential vitamins, fibres and lacks in cholesterol, fat. It is the main ingredient of most of the delicious dishes. It also offers a variety of health benefits and apply as a sauces, salad and drinks.

The pest *Helicoverpa armigera* Hubner, cause severe damage to different host plants including vegetables, field crops, weeds and turf grasses. It infests a number of agricultural plants very fast and destroy 50 to 80 percent of crop population, sometimes in absence of host plant it consumed non host plant for their survival. Considerable works had been done by several workers on the life history of *Helicoverpa armigera* Hubner, On different crops but none of the researcher studied the life history of the pest *Helicoverpa armigera* Hubner, (Lepidoptera : noctuidae) on the vegetable *Solanum lycopersicum* (L) at Ramgarh. The present author deals with the destruction of *Solanum lycopersicum* (L) by the pest *Helicoverpa armigera* Hubner, (Lepidoptera: noctuidae), tomato fruit worm. A case study at Ramgarh, Jharkhand, India.

Ramgarh is a district town located at latitude: 23.38^{o}N and longitude: 85.34^{o}E, situated at 40 km South-East from Ranchi. The temperature is moderate with more humidity. This good climate is favourable for the growth and development of animal and plant population. The forest of Ramgarh plays a considerable role for the study of diversity in animals and plants. The experimental pest successfully completed 03 to 04 overlapping generation in a year from February to October. The adults emerges after sunset, the female mates several times and lays 80 to 120 eggs per day in cluster or in single and it continues for 04 to 15 days and up to 800 eggs. They lay eggs at night on various suitable places like under surface of leaves of host plant, grasses, other plants, and the moist soil near the host plant. The tiny caterpillar emerges after the incubation of 04 to 10 days. Neonates start to feed their chorine and crawl individually in search of food to tender leaves and flowers of the host plant and then to fruits, after 03 to 04 instar the larvae avoid day light and become nocturnal feeder and remain in the soil in day time. In 17 to 30 days the larvae develop completely, and then it enters 25 to 35 mm deep in cracks or crevices in the soil and pupates there. Pupal period last in 15 to 25 days, then moth emerges out during night. 03 to 04 over lapping generations were observed in a year.

It had been observed that the moth is migratory in nature and can move a long distance with the help of flow of wind. These peculiar characters of pest makes hurdle in study of lifecycle. Prevention from pest was very difficult and costlier. Farmers were advised to apply chemical pesticides as 2% lindane or carbaryl 0.1% or endrin 0.1% after the sowing of crop. Field should be often flooded moderately. Some natural enemies were observing to control the pest population.

MATERIALS & METHODS

Standard methodology was applied for the destruction of *Solanum lycopersicum* (L) by the pest *Helicoverpa armigera,* Hubner, (Lepidoptera: noctuidae), a case study at Ramgarh. The life history of the experimental pest and the nature of damaging the host plant were studied in the crop field as well as in the laboratory. The life history was studied during the year 2018-2020. Ten healthy selected plants of *Solanum lycopersicum* (L) were completely and carefully covered by a small mesh mosquito net separately. One pair (one male and one female) of experimental pest were introduced on the plant covered by mosquito net and observation was taken daily. One pair (one male and one female) of the experimental pest were kept in the cage of 20 cm X 20 cm X 30 cm. Space and fresh, soft leaves of host plant were provided for egg laying and hatching, this was food for caterpillar as well. In a separate cage some leaves of other plant were also provided to larvae to observe their feeding interest and survival rate. The data were recorded for further study.

Methods of prevention of crop and control of pests by chemical and biological methods were applied, observed and recorded.

OBSERVATION

Solanum lycopersicum (L) is itself a tastier vegetable, applied to improve the taste of food. It is consumed as raw and cooked form is the main ingredient of many dishes. The experimental pest *Helicoverpa armigera* Hubner (Lepidoptera: noctuidae) is a major economic pest destruct the vegetable *Solanum lycopersicum* (L), also infest many floral plants, migratory in nature makes it cosmopolitan in distribution, and difficult in protection. It travels more than 1000 km with the help of wind flow infest a wide range of vegetation. It was observed that the experimental plant was not the favourable host of *Helicoverpa armigera* Hubner, development of its larvae were retarded on this plant. As a result the growth was ill and passive. Ramgarh is a beautiful industrial town surrounded by hills, covered with green and dense forest and small agricultural field. It is one of the best places to study the ecological biodiversity, a niche of variety of plants and animals. The climatic condition of Ramgarh is suitable for the vegetable and crop cultivation. Therefore, a variety of species of animal and plants increase population comfortably. The pest *Helicoverpa armigera* Hubner, was also observed here, it is a polyphagous pest which generally infest vegetables as well as the rabbi crops. The experimental crop *Solanum lycopersicum* (L) is an important cash crop; common farmers of Ramgarh cultivate it as their capacity. The experimental pest *Helicoverpa armigera* Hubner, is a serious pest and damages 50 to 80 percent of the crop production.

The present author expresses and deals with Destruction of *Solanum lycopersicum* (L) by the pest *Helicoverpa armigera* Hubner (Lepidoptera: noctuidae), a case study, at Ramgarh (Jharkhand, India). The vegetable crop *Solanum lycopersicum* (L) is a cash crop the people like the taste and farmers cultivated by a vested interest. Infestation of crop by the experimental pest ceases the financial progress of the farmers.

Morphology of the adult pest: The experimental adult moth was large in size, 14 to 18 mm long with wingspan 35 to 40 mm. tapered thorax; fine hairs on antennae, colour of fore wings of male were greenish-grey, hind wings were pale- brown a pale patch was observed near the centre of dark region as indicated by red circles. The fore wings of female moth were orange-brown in colour.

Morphology of eggs: The freshly laid eggs were white in colour, later the colour turns to green. The eggs were 0.43 to 0.60mm high and 0.50 to 0.55mm wide, spherical in shape, generally laid on the lower part of the foliage or on the moist soil as single or in cluster of 3 to 5.

Morphology of the larvae: The newly hatched tiny larvae fed on the chorine and crawl individually in search of food. They were uniformly yellowish-white in colour later change to reddish –brown and dark spotted body grown up to 07mm. Full grown larvae having pale-brown head, after 07 developmental stages some of the larvae moult to 8th stage the full grown larva developed up to 30 mm.

Morphology of the pupa: The last instars of full grown larva (7th or 8th) will borrow and enters in the soil up to 25 to 35 mm below and form an earthen chamber and get in pupation stage. The size of pupa was 10 to 13 mm, it was barrel shaped and yellowish-brown in colour later it becomes dark- brown.

Life cycle of pest: The moth *Helicoverpa armigera* Hubner (Lepidoptera: noctuidae) was a serious polyphagous pest. It is a leading species causing extensive damaged in vegetables, ornamental plants, the commercial plants, field crops, weeds etc. It was a nocturnal pest; adult moths became active at the dusk. Copulation of adults took place since late night to the early morning sometimes the copula remain upto three days. After 01 to 02 days of incubation the female laid eggs in the morning on the lower surface of leaf of the experimental host plant *Solanum lycopersicum* (L) or on moist ground around the host plant singly or in a mass of 03 to 05 eggs. The process of oviposition was continued for 04 to 10 days depended on climate and availability of food. The total number of eggs laid by a female was 80 to 120, sometimes up to 800.

After the incubation of 04 to 10 days the tiny caterpillar were hatched out from egg at night. The neonates started feeding their chorion and grow rapidly, then crawl individually in search of food. In the absence of suitable food the neonates consume unhealthy eggs and other less active larvae. Up to 3rd sometimes 4th instar the larvae remain on foliage or on flowers and attempts on

the berry, then it became photonegative in day time it enter in the soil, the crack or in the crevices and come out during night. After seven to eight instars the larva reached to full grown stage, it would be 30 mm long maximum. The mature caterpillar enters in to the soil up to 30 mm below and get in rest and stop feeding it release reddish secretion before burrowing in to the soil. Later with the duration of 13 to 25 days the moth emerges out from pupa during night. The life cycles were completed in 35 to 65 days. Three to four generations had been observed in a year.

Table 1. Tabular representation of life-cycle of pest *Helicoverpa armigera* Hubner on host plant *Solanum lycopersicum* (L)

Name of the month	No. of eggs laid/day	Incubation period of eggs in days	Larvae mature in days	Pupa mature in days	Life-cycle completed in day
February - March	80-100	05-07	20-25	15-20	40-52
April-June	100-120	04-06	18-22	13-18	35-46
July-September	90-120	05-08	17-22	15-18	37-48
October-November	80-120	05-08	17-20	18-22	40-50
December-January	70-90	07-10	20-30	20-25	47-65

SUGGESSION FOR CONTROL OF PESTS:

- Farmers were advised to adopt the clean cultivation.
- The caterpillars can be trapped using hand- pick method applied in small area.
- Field should be often flooded moderately.
- Regular raking up of soil the cultivated field help to destroy the pupa.
- The application of 02 % lindane, 0.1% carbaryl, or 0.1% endrin after the sowing of crop can control the pest.

DISCUSSION

Solanum lycopersicum (L) is a widely accepted vegetarian food, consumed in raw and cooked form also by the people of globe. It is cultivated by the common farmers of Ramgarh for agribusinesses and for their own consumption. This crop is destructed by a serious pest tomato fruit worm *Helicoverpa armigera* Hubner, it is a polyphagus serious insect pest. The experimental plant *Solanum lycopersicum* (L) is a sub optional host plant of the experimental pest. Development of larvae were retarded on this plant, it takes more time to mature. On other host the larva fully matures after 6th to 7th instar but on tomato it mature on 8th instar. *Solanum lycopersicum* (L), (tomato) is commonly called by the local people as bilaiti consumed by the population around the globe. It is rich in fibres, various essential vitamins, free from fat, cholesterol, very low caloriesuse in various traditional medicines, control the blood sugar, weight- loss, and improve immunity. The high nutritional values, high contents of minerals, low in calories, make it a good health supplement.[1,2] The experimental pest *Helicoverpa armigera* Hubner, was a serious pest commonly known as cotton bollworm. It attracts towards the flowering plants. Adult moths make pairs remain in copula for few hours to three days, after the incubation of 04 to 10 days oviposition starts. The neonates will feed on chorion and then crawl individually in search of food. If suitable food is not found they will consume unhatched eggs and other less active larvae. Subsequent generation may cause economic damage with small larvae feeding on leaves and flowers and large larvae primarily feeding on fruit. Larvae were the only destructive stage. The larvae of 03rd to 04th instar were very sensitive to light, they hide in daytime in soil and come out at night. The period of pupal diapause varies and highly dependent on temperature and photoperiod. The life cycle is directly influenced by light, temperature, humidity, pH. etc.[3-8] The pest declines the production of berry, their size, number and the taste of the crops the fruit became unfit for human consumption and unmarketable. The pest not only declines the production of the crop but also declines the financial status of the farmer.[9,10] The town Ramgarh is situated at very prime location. It is surrounded by wide National Highway and good connectivity of railway which makes Ramgarh good and prime market for vegetable sale.[7,9,10] The life cycle of this moth was very simple. It was observed that the larvae were very active during night and the full mature larvae enter the soil, cracks or the crevices, form an

earthen chamber and pupate there. The adult emerged out in the morning and took part in reproduction at night. The life span may increase depending upon availability of food and favourable temperature.[8] It has been observed that the moth migrated to hilly cold region during extreme hot season, with the help of wind current sometimes they rich up to 1000 km.

It was observed that it is one of the most expensive pest. Prevention and control was a difficult phenomenon. The spray of chemical pesticides like 02 % lindane, or carbaryl 0.1% or endrin 0.1% kill the eggs, larvae and adults on the surface of the host plant.[11,12] Some natural enemies as moles, grubs, wasps, predaceous and parasitic flies destroy the larvae and control the pest population. Viral control of pest by (HvAV-3i) also apply.

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