



## RESEARCH PAPER

# A study of life cycle of vegetable pests in Ranchi

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**Abstract :** The study is done to investigate the different pests found in the vegetables in Ranchi. The pests who damage these vegetables are *Plutella xylostella* (cauliflower pest), *Earias vittella* (Okra Pest), *Etiella zinckenella* (pea pod borer) and *Thysanoplusia orichalcea* (coriander leaf pest). The pests' life cycle was studied in detail by culturing the insect in the laboratory. Pest problem is one of the major constraints for getting good yield in the agricultural crops. India also suffers a huge loss in crop yield due to pests and diseases each year. The study of life cycle of the pests show that the insects undergo metamorphosis and the larval stage is the damaging phase of the life cycle. The use of pesticides to kill the pests causes environmental pollution which has become an increasing problem.

**Key Words :** *Plutella xylostella*, Okra, Metamorphosis, *Thysanoplusia orichalcea*, *Earias vittella*, *Etiella zinckenella*

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## INTRODUCTION

India is the second largest producer of vegetables in the world (ranks next to China) and accounts for about 15% of the world's production of vegetables. India occupies the prime position in the production of cauliflower, second in onions and third in cabbage in the world. The total production of vegetables in India was 111.77 million tonnes during 2016-17. Five vegetables, viz. potato, tomato, onion, cabbage and cauliflower account for 60% of the total vegetable production in the country. Vegetables are good sources of proteins (peas, beans and garlic), vitamins (tomato, carrot, peas, tomato, garlic, green chillies and Cole crops), minerals (drumstick pods) and carbohydrates (leguminous vegetables, methi, potato and sweet potato). Many of the vegetable crops,

such as onion and garlic, possesses high medical value that helps to reduce the risk of heart disease, stroke, certain types of cancer, gastrointestinal issues, high blood pressure, eye disease and many more (Kunjwal and Srivastava, 2005).

Insect pests are a major threat to production of vegetables and cause considerable loss in terms of quality and quantity. Estimation of crop losses caused by the pests is very important and useful in pest management to determine the economic status of pest, to establish the economic threshold levels and economic injury levels of pest, to estimate the effectiveness of control measures and to evaluate the crop for its reaction to the pests. These problems have necessitated the use of safe and efficient integrated pest management (IPM) methods for pest control, including biocontrol, behavioural and use of

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biopesticides. The most developed bio-intensive IPM depends primarily on beneficial organisms to manage insect pests at high pest density; interventions taken are complementary to the survival of these beneficial and which addresses public concerns about environmental and food safety that includes resistant varieties, crop rotation, altering planting dates, crop sanitation, spacing of plants, physical controls, mechanical controls, biocontrol agents, biopesticides, biotechnology, forecasting models and chemical controls. Nanotechnology, another innovative way, includes physical, chemical and biological properties with its novel applications in the field of agriculture. This technique involves slow release of agrochemicals, encapsulation of fertilisers, plant growth regulators, pesticides and herbicides, pest detection as well as its management. The greatest challenge to vegetable producers is the pest control. Successful production of vegetables requires consistent and reliable field monitoring, good understanding of the pest and all crop management component inter-relationships in a given crop, ability to anticipate pest problems and all possible practices that can minimize pest population (Kunjwal and Srivastava, 2005).

To help minimize losses to insects and other pests, growers should have an awareness of the types of pests which attack crops in their locality and a knowledge of pertinent pest biology. Both are equally important to the proper implementation of management and control practices. Scouting methods, equipment selection, timing of controls, and other pest management practices are derived from accurate knowledge of the pest (Atwal, 1976).

## MATERIAL AND METHODS

The various pests were observed to grow on their respective hosts under the following conditions:

Place	: Ranchi, Jharkhand, India
Sea Level	: 2136ft
Month	: Jan- Feb 2020
Temperature	: 24 °C -31°C
Humidity	: 55-65 %

The following vegetables are used for the present study:

- Cauliflower (*Plutella xylostella*,)
- Okra (*Earias vittella*)
- Pea (*Etiella zinckenella*)
- Coriander (*Thysanoplusia orichalcea*)

## Collection of pest infected vegetable crops:

The study and the collection of the insect pests was done by collecting the infected vegetables from the local vegetable vendors. Pest infected vegetable crops (cauliflower, ladyfinger, pea and coriander) were obtained from a commercial market in Ranchi, Jharkhand, India. The vegetables selected were easily recognised to be infected as they possessed either having a hole, or a mark of infection. Before handling the infected vegetables or pests, disposable gloves were worn. The pest was spotted on the vegetable and then the vegetables were sliced carefully with a sharp stainless knife.

The cauliflower pest, *Plutella Xylostella*, was found in its larval stage and the leaves had some deposited eggs on it. The Okra had three larvae of the Okra Pest, *Earias vittella*, which is a fruit borer and its eggs were collected from the leaves. The pea crop pest, *Etiella zinckenella*, is a pulse pod borer and was found in its larval stage in the seed inside the pod. The coriander leaf pest, *Thysanoplusia orichalcea*, was found on the leaf in its pupal stage. The pest had formed the cocoon by rolling the leaf towards inside. Also the eggs were found on the leaves.

## Culture of the pests:

The infected cauliflower leaf and the cauliflower with larvae were kept in two separate transparent boxes, respectively, with an air passing lid on the top at hygienic places. The box with the eggs on the leaf, was provided with some cauliflower to serve as food for the growing larvae. The eggs hatched in about 4-5 days. Each larval stage was studied for its morphological features. The box with the larvae was checked and cleaned daily and fresh cauliflower was provided to the feeding larvae. After the larval stages, the pupae were kept in an undisturbed state. The period from egg to adult took 24–35 days.

Other pest larvae were also provided suitable conditions including food, moisture and air to grow into an adult. Photographs of all the different stages of the life cycle of the pests above named were taken using CanonPowerShot IXUS 160 Digital Camera.

## Preservation of different stages of life cycle of the pests:

The different stages of the life cycle of the pests, after complete morphological study, were preserved carefully.

- The different larval stages and pupal stages were preserved in 70% alcohol in small transparent vials.
- The residual cocoons were preserved in well sanitised boxes and vials.
- The adults were pinned after being exposed to Ethyl acetate.

### Study of the insect pests on vegetables:

Host Vegetable: *Cauliflower*:

Pest: *Plutella xylostella* (Diamondback moth):

#### About the host vegetable cauliflower:

Cauliflower (*Brassica oleracea*) is a Cruciferous vegetable (cole crops), one of the most abundantly consumed vegetables, belong to the mustard (*Brassica*) family including cabbage, khol, radish, etc. The main loss in the production of these vegetables is due to attack of insect pests.

The plant grows best in cool daytime temperatures 21–29°C, with plentiful sun, and moist soil conditions high in organic matter and sandy soils. In tropical regions, it grows in China and India.

#### About the pest *Plutella xylostella* :

*Distribution*:

This pest is distributed worldwide. *P. xylostella* originated in Europe but now has a global distribution and found in Europe, America, Australia, New Zealand, Africa and Asia including India.

#### Identification:

The adult moth has wingspan of 15 mm, 8-12 mm body length, narrow brownish grey forewings with creamy coloured stripes anteriorly and diamond-like white patches dorsally. When full-grown, the larvae measure about 8mm in length and are pale yellowish green with fine black hair scattered all over the body.

#### Life cycle:

The diamondback moth (DBM), is major destructive pest of crucifer vegetables like cabbage, cauliflower and Chinese cabbage all around the world including Asia [3]. The severity of this pest increases due to climatic changes in many regions.

#### Eggs:

Female may deposit yellowish eggs of the size of pin-heads singly or in batches of 2-40 on the undersurface

of leaves along the veins. Flattened oval egg is about 0.45 mm long and 0.25 mm wide, light yellow-greenish in colour which later turns to dark with maturity. Incubation period is 4–5 days.

#### Larvae:

The larval period is 18–21 days. Colorless larva has short black hairs in first instar and then becomes pale or light green in the later stages. The newly hatched caterpillars bore into the tissue from the underside of the leaves and feed in these tunnels. Third and fourth instar larvae feed from the underside of the leaves, leaving intact parchment-like transparent cuticular layer on the dorsal surface.

#### Pupa:

It pupates in a thin loose mesh of silken cocoon which is open at both the ends and is attached to the lower surface of the leaf surface. The pupal period lasts for 7–8 days. Pupa is yellowish in colour and 6–9 mm long.

#### Adult:

The lifespan averages three to four weeks for females, but less for males.[2] These moths are weak fliers, seldom rising more than 2 m above the ground and not flying long distances. The period from egg to adult takes 24–35 days.

#### Nature of Damage. Skeletonization and defoliation:

The larvae bite holes in the leaves, leaving the leaf epidermis intact, which cause blisters on the leaves. The presence of larvae in florets can result significant losses to crop. The vegetables rendered unfit for human consumption.

#### Host vegetable: Okra:

Pest : *Earias vittella*

#### About the host vegetable okra:

Okra (*Abelmoschus esculentus*) is an important vegetable crop of the Malvaceae grown throughout the country. It is attacked by a large number of insect pests among which shoot and fruit borers and cotton leafhoppers are the most important pests. However from Alliaceae family, onion and garlic are the important cash crops, which are damaged by a large number of pests particularly onion thrips and onion maggots.

### About the pest *Earias vittella*:

#### *Distribution:*

It is active throughout the year, prefers high temperature and has country wide distribution. It is more abundant in North Africa, northern India and is also found in Pakistan, Bangladesh, Sri Lanka, Indonesia, Myanmar, New Guinea and Fiji.

#### *Diagnostic Features:*

Wedge-shaped green band in the middle on the forewings of adult. The moths are yellow green and measure about 2.5cm across the wings. *E. vittella* moths are of the same size and have narrow light longitudinal green bands in the middle of the forewing. The full-grown dull-green caterpillars are 2cm long having tiny stout bristles and a series of longitudinal black spots on the body.

#### *Life Cycle:*

Okra fruit and shoot borer is widely distributed pest [4]. It usually occurs during humid conditions and causes up to 69% marketable loss in yield [5]. After 2–3 days of emergence, mating occurs and then females oviposit within 1–5 days.

#### *Eggs:*

The female lays 200–400 sculptured with 26–32 longitudinal ridges about half mm in diameter and sky blue-colored eggs singly on flower buds and tender leaves of okra plants. The eggs hatch in 3–4 days.

#### *Larva:*

Larva is pale yellowish on ventral side and brown with white streaks dorsally. The caterpillars pass through 6 stages and become fully grown in 10–16 days.

#### *Pupa:*

Pupal periods last for 8–12 days. They pupate in a brownish boat-shaped cocoon either on the plants or among the fallen leaves.

#### *Adult:*

The single life cycle is completed in 17–29 days, extending up to 74 days during winter.

### **Damage symptoms:**

- Drying and drooping of terminal shoots during pre-flowering stage.
- Side shoots are given out.

- Shedding of squares, young bolls, flaring up of squares during square formation
- Entrance hole on boll is plugged with excreta.
- Affected bolls drop off in early stage and bad boll opening is seen.

Host Vegetable: Pea

PEST: *Etiella zinckenella* Treitschke

#### About the Host Vegetable Pea

A pea (*Pisum sativum*) is a most commonly green, occasionally golden yellow, or infrequently purple podshaped vegetable, widely grown as a cool season vegetable crop. Peas have both low-growing and vining cultivars. The vining cultivars grow thin tendrils from leaves that coil around any available support and can climb to be 1–2 m high. A traditional approach to supporting climbing peas is to thrust branches pruned from trees or other woody plants upright into the soil, providing a lattice for the peas to climb. Branches used in this fashion are sometimes called pea brush. Metal fences, twine, or netting supported by a frame are used for the same purpose. In dense plantings, peas give each other some measure of mutual support. Pea plants can self-pollinate.

#### About the pest *Etiella zinckenella*

*Etiella zinckenella*, the pulse pod borer moth, is a moth of the family Pyralidae. It is found in southern and eastern Europe and in the tropics and subtropics of Africa and Asia. They have also been introduced to North America and Australia. It is usually a minor pest for many legumes, but can be a serious pest. The wingspan is 22–26 mm.

### **Diagnostic Features.**

Brownish grey adult with orange prothorax and has white stripe along the anterior margin of forewings. The moths are grey with a wing span of 25mm. The forewings have dark marginal lines and are interspersed with ochreous scales. The full-grown larvae are rosy, with a purplish tinge.

**Distribution.** *Etiella* is a pest of tropics and subtropics throughout the world, spread in India, China, Korea, Japan, North Africa, western and southern Europe, Southern Ukraine, Moldavia, Kazakhstan and also in Australia and America. The pest is widely distributed in India, particularly in Assam, Orissa, Bihar, Uttar

Pradesh, Karnataka, Andhra Pradesh and Tamil Nadu.

**Life Cycle.** It is found damaging wide range of host plants including leguminous Vegetables[7].

**Eggs.** The eggs are laid both singly and in clusters on various parts of the plant, including the pods. Fecundity of female is about 600 eggs. Egg is oval and white when deposited, but turns grey before hatching. Development of egg lasts 4–21 days.

**Larva.** The larva is about 15–17 mm long and greenish but turns pink before pupation, bearing five black spots on prothorax. Development of larva lasts 19–40 days. The newly emerged larva feeds on floral parts and subsequently, they bore into the pods to feed on the seeds.

**Pupa.** Pupation takes place in the soil at a depth of 2–4 cm. The pupa is fine punctured and brown about 7–10 mm in length. Development of pupa lasts 12–18 days.

**Adult.** The entire life cycle is completed in 35–79 days depending on temperature. Life span of adult is 20 days. There are 2–3 generations annually depending on available hosts and temperature.

**Nature of Damage** The larva of *E. zinckenella* causes the damage to crops. The larva feeds initially fresh seeds and subsequently on surface of the seed. In the advanced stages of larval development, 2–4 pods were webbed together [8] Infested older pods are with a brown spot from where larva enters. Dropping of flowers and young pods reduces grain yield and causes economic losses to crops. The reduction in yield is about 5%.

Host Vegetable: Coriander

PEST: *Thysanoplusia orichalcea*

About the host Coriander

**Coriander** (*Coriandrum sativum*) is an annual herb in the family Apiaceae. It is also known as Chinese parsley, and in the United States the stems and leaves are usually called cilantro. All parts of the plant are edible, but the fresh leaves and the dried seeds (as a spice) are the parts most traditionally used in cooking.

**Coriander**, *Coriandrum sativum*, is an erect annual herb in the family Apiaceae. The leaves of the

plant are variable in shape, broadly lobed at the base of the plant, and slender and feathery higher on the flowering stems. It is a soft, hairless plant. The flowers are produced in small umbels and are white or very pale pink in color with the petals pointing away from the centre of the umbel longer than those pointing towards it. The plant produces an oval shaped fruit which is yellow-brown in color and contains two seeds. Coriander is an annual plant, surviving only one growing season and reaches up to 50 cm (19.7 in). Coriander may also be referred to as cilantro, chinese parsley or dhanian and originates from the Near East.

About the pest *Thysanoplusia orichalcea* Fabricius 1775

*Thysanoplusia orichalcea*, the slender burnished brass, is a moth of the family Noctuidae. The species was first described by Johan Christian Fabricius in 1775. It is a polyphagous pest of vegetable crops that originated in Indonesia, from where it spread to Europe, South Asia, India, Sri Lanka, Africa, Australia and New Zealand. In northern Europe it is a migrant species.

Identification Marks.

Head, collar and vertex of thorax reddish orange; tegulae and fore wing pale redbrown; abdomen pale brown. Fore wings with the subbasal, antemedial and postmedial wavy lines very indistinct, fine and white; the submarginal line irregularly lunulate; the orbicular and reniform with fine white outlines; the whole of the outer area except the inner margin occupied by a brassy golden patch which extends towards the base below median nervure. Hind wings are pale at base and the outer area fuscous.

**Host plants.** The caterpillar lives polyphagous on mostly herbaceous plants. The larvae feed on various herbaceous plants, including crops such as sunflower, Coreopsis, potato and soybean.

**Habitat.** *Thysanoplusia orichalcea* inhabits especially farmland, gardens, ravines (barrancos), coastal areas, herb edges and residential areas in warm regions.

**Life cycle.** *Thysanoplusia orichalcea* (Fab.) reveals the maximum activity of the pest from mid of April till end of May. Four overlapping generations occurs during March to June.

**Eggs.** The female lays the eggs on the host plant leaf in the favourable season. An individual female laid 113 to 228 eggs mostly on the lower surface of the leaves. The spherical eggs hatched within 2.5 to 3.5 days

**Larvae.** The larval duration ranged from 11.0 to 15.5 days and their survival varied from 39.9 to 74.7 per cent in different months.

**Pupa.** The larvae pupated in the leaf-fold and pupal period lasted from 7.0 to 11.0 days; the survival being 26.7 to 74.0 per cent during different months.

**Adult.** The longevity of the mated males and females varied from 3.5 to 10.0 days and 4.0 to 12.5 days, respectively. The total life cycle was completed in 25-32 days in different months.

**Nature of Damage.** The damage is caused by both the larva and adults by sucking the saps from the leaves. Therefore, in severe infestation, the plants not only become weak, but the larva interferes with the normal photosynthesis resulting in the poor yield. It is known to transmit a number of diseases including the leaf curl, and the vein clearing disease.

After complete study of the pests' life cycle, the following data was prepared:

## RESULTS AND DISCUSSION

The life cycle studied was found to be as such:

The samples of fresh and affected vegetables were collected from market and identified various pests like diamondback moth, the spotted bollworm, pulse pod borer and coriander leaf pest by morphological method. These pests cause changes in the vegetable plants and affect crop production.

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