

Chapter I
General Introduction

CHAPTER I

INTRODUCTION:

The zoological term coleoptera is used particularly for beetles. The term was first used by Aristotle and then adopted by Linnaeus (1758) and has been universally accepted. Coleoptera is the largest order of insects, not only of insects but also of entire animal kingdom (Imms 1957). This order consists of about 3, 30,000 species of beetles (Richard and Davis, 1994).

Beetles can be recognized by the presence of firm protective sheath elytra which serve as a covering for the hind wings which are use for flight. W.L.Tower (1903) showed that the elytra are the true forewings with the help of demonstration in pupal elytra. The firm forewings or elytra are usually convex alone, with straight hind margins (dorsa) when the elytra are closed. The two hind margins come together along the mid dorsal line of the body, forming a suture. In some ground beetles elytra are fused to form a compact immovable cover over the abdomen, because of which they are unable to fly, while others can fly actively and swim with faster speed.

Beetles are the most successful among insects because they show large number of variation in morphology, physiology, ecology etc. The body size varies from minute to very large .Their physiological factors include strong exoskeleton which protects them. Due to various adaptations like waxy layer of cuticle, closing mechanism of spiracles and methods for reabsorbing water from waste food in the rectum enable beetle to live in dry places. The reproduction rate is found to be very rapid which is one of the reason for beetles to be successful. Beside this the most important factor in their variation in feeding habits. Some beetles feed on various plant parts like leaf beetles, tortoise beetles (Raman and Ganesan,1992), Flower beetles like *Rose chafer*, Fruit

feeders such as Japanese beetle (Zim and Cottam, 1951) Stone weevils of mango (Shukla et.al;1985) are some of them. In addition to this many of the beetles can thrive on food grains and flour such as *Rhizopertha*, *Oryzaephilus*, *Tribolium* (Klomp, 1964). As large number of beetles is found to be harmful some are beneficial also. Scavengers like water scavenger beetle (Little, 1974), Coprophagous beetles (Mittal, 2000), and Ladybird beetles (Agarwala et.al; 1997) are some of the beneficial ones.

The beetles which are stored grain pest included in families like Dermestidae, Bostrychidae, Curculionidae and Tenebrionidae. The stored grain pest beetles are economically important as they disturb the human property directly. A number of extensive work have been published on stored product beetles, the more important of them including those of Lepesme (1944), Hinton (1945), and Aitken (1975).

Crowson (1981) in his book classified “The Biology of Coleoptera” classified in order Coleoptera in to four sub-orders Archostemata, Adephaga, Myxophaga and Polyphaga. The sub order Archostemata includes only one super family and four families, sub-order adephaga includes only one super family and eleven families. Suborder Myxophaga includes only one super family and four families and suborder polyphaga is the largest of all and includes nineteen super families and one hundred forty nine families.

Family Tenebrionidae comes under suborder Polyphaga and it is one of the largest family including stored grain pest showing great diversity and contained more than 15,000 species (Gebein, 1937) of which 300 are recorded from India (Lefroy, 1909). Classification and nomenclature of family – group names was clearly demonstrated by Lawrence and Newton (1995). It is the largest family in subfamily Tenebrionidae which comprises 29 world families in classification. Lawrence and Britton (1944). Beetles belonging to family Tenebrionidae

abundantly found in deserts due to their physiological and behavioural adaptations. (Frances D.Duncan, *et al.* 2002). Some tenebriod beetles show the burying habit (Edney, 1971) to reduce desiccation. Some of well known beetles like *Tenebrio molitor*, *Blaps mortisaga* are flour beetles belongs to tenebrionidae. *Tribolium Ferruginium* and *T. Confusum* are abundantly found in granaries and stores.

Beetles of this family shows sexual dimorphism by erect horns on the head, the dilation of the tarsi and the presence of tuft of hair on the abdomen of the males (Lefroy, 1909).

The beetle *Platynotus belli* Fairmare belongs to Family Tenebrionidae. The systematic position of *P. belli* is as follows

Order	-	Coleoptera
Suborder	-	Polyphaga
Section	-	Heteromera
Family	-	Tenebrionidae
Tribe	-	Platynotini
Genus	-	<i>Platynotus</i>
Species	-	<i>belli</i>

Zoological Name: *Platynotus belli* Fairmaire (1896).

Platynotus belli is a black stout ground beetle mostly found in dry places. They are of moderate size. Many of them are bulk and weight. The body is hard often flattened globular, the elytra fitting closely and soldered together. It is a non flyer.

Platynotini was established by Koch (1953) with type genus *Platynotus Fabricius* (1801). The genera included in this tribe were previously classified with Gonopini, Opatrini and Pedinini. A complete division of Platynotini into sub tribes and generic groups was presented by Koch (1956) in his revision of the sub family Opatrinae. Among all opatrinae, the Platynotini are characterized by the stridulating organ

'gula- prosternum' as well as lacinia which aid male to attract female. Asiatic Platynotini are further classified in two generic groups

- 1) Platynotoid Platynotina
- 2) Opatrinoid Platynotina

Genus *Platynotus* belong to first group, the Platynotoid Platynotina

In 1974, Asiatic Platynotini were revised by Kaszab based on type studies and it is commonly called a "Pengul".

Life cycle of *P.belli*:

In *P.belli* life cycle is complete with 4 stages of development i.e. egg, larva, pupa and adult.

Egg:

The egg laying is carried out by female usually below the surface of soil or it is observed in the culture, eggs are laid in the flour. They are laid singly or in groups of 4-5. Eggs laid in groups are glued together with a sticky substance. Eggs are whitish and shiny when laid but gradually they turn yellowish. They are very soft and delicate, small in size and oval in shape measures about 1.75x1.35mm. The hatching takes place within 5-8days. The rate of egg laying varies as it is higher in the rainy season i.e. from June – September and is reduced in the summer i.e. from March to May.

Larva:

The chorion splits lengthwise and a small first instar larva hatches out. There are 8 larval instars observed in *P.belli*. The first instar larvae is whitish in colour and measures about 3 - 4 mm in length. Feeding is not observed in first instar and it turns to second instar after 1-2 days. The development from first to last instar requires 30 - 45 days.

The fully grown larva is roughly cylindrical as all the segments except head and abdominal segment, are equal. It is yellowish brown in colour. The head, prothorax and last abdominal tergites are darker.

Mesothoracic, metathoracic and 1st to 7th abdominal tergites are with a dark band extending transversely along the posterior margin. These dark areas bear longitudinal striae. In these dark areas, a small white streak extends laterally in pleural and lateral tergal region.

Head:

The head is quadrangular in shape and flattened dorsoventrally. A dark patch is present on the dorsal side which occupies major portion of the head. Anterior to this dark patch is a light zone which bears a pair of frontal bristles. The lateral arms of the Y shaped epicranial suture lie in this region. The middle process of the Y continues upto the posterior end of the first abdominal segment as a middorsal suture. The lateral areas of the head are poorly sclerotised and bears bristles ventrolaterally. Gula is a roughly hexagonal area situated medioventrally on the head capsule. Antennae are three segmented, first two segments are larger than third segment. Mouth parts are typical biting and chewing type and they are directed forwards, consisting of labrum, mandibles, maxillae, labium and hypopharynx.

Thorax:

The thoracic segments bear mid-dorsal line which is in continuation with the epicranial suture. Spiracles are present at the anterodorsal side of mesothoracic and metathoracic segments. The legs are directed forward. The forelegs / prothoracic legs are larger than mesothoracic and metathoracic legs, which bear a very short coxa, a large trochanter, femur is broadened. Trochanter is elongated, tarsus is a single, somewhat triangular segment provided with a claw. Proximal four segments bear bristles.

Abdomen:

There are nine abdominal segments present in larvae. First seven segments are almost equal in length. Eighth segment is shorter and narrower than the seventh. Each segment bears two pairs of bristles on the sternum.

The ninth segment is conical and is darker in colour than other abdominal segments. The tergum bears three pairs of very small darker patches, arranged in somewhat V shape and a medial elongated patch. Two pairs of stout blunt setae are present on the posterior border of the tergum. The ventrolateral region of the segment bears large number of long bristles. A pair of anal prolegs arises from the semi - circular pit on the anterior margin of the ninth sternum. The pit and also the adjacent area of the ninth sternum bear bristles. The anal prolegs are small, membranaceous and act as a sucker- like organ which aid in locomotion.

Spiracles: These are mesothoracic, metathoracic and eight pairs of abdominal spiracles.

Prepupa: The fully mature larva burrows itself into the wet soil and undergoes a quiescent prepupal period of 2-3 days, it builds a round pupal chamber measuring about 20-30mm in diameter and 15-20mm in depth. The larva changes its colour from brown to dark black. After 2-3 days prepupa turns to pupa.

Pupa:

Pupa measures about 23-24mm in length and 10mm in breadth. It is completely whitish in colour. The pupa is of exarate type. The adult parts i.e. antennae, mouthparts and leg tarsi can be very clearly seen in pupal stage. Pronotum is in the form of broad plate. Mouthparts are directed downwards ventrally. All the 3 pairs of legs bend sharply at the femora- tibial joints. The forelegs are shortest and hind legs are longest. The wing buds lie between the mesothoracic and metathoracic legs.

Adult:

Adult beetle that comes out from the pupal chamber is black in colour completely and bears vertical spotted lines present on elytra. Newly formed adult is not matured sexually and smaller in size as compared to matured adult, body is soft externally as cuticle is yet to be hardened. There is abundance of fat body in the body cavity. Sexual dimorphism is shown with the help of fore tibia and protarsus. Male shows ventral depression in fore tibia where as in female fore tibia is rounded dorsally as well as ventrally. In male proximal three tarsal segments are broad and bear thick cushions of hair on the ventral side, female shows slender tarsal segments and have no hair cushions.

Behaviour

P.belli shows very interesting and typical behavioural characteristics which includes; hiding, crowding, noxious secretion, water uptake, feeding, moulting.

Hiding and crowding: *P.belli* is a scavenger and feeds on all sort of decaying material. Adult shows hiding behaviour. Most of the times they get crowded at one place and hide themselves. In culture they hide themselves by climbing on the wall of pot or by inserting their head in the soil. There is no flight activity in these beetles.

Noxious secretion: It seems to be the protective or defencive mechanism of the beetle. When held, it gives out a chocolate coloured liquid with irritating smell from the abdominal tip.

Water uptake: Beetles take water directly from the cotton balls provided, pressing it by mandibles.

Feeding: In nature beetle under study are scavengers but in culture they are provided with wheat flour. Rapid feeding habit was observed.

Moulting: Larval behaviour is rather interesting; they remain buried in the soil, when disturbed with forceps they show wriggling movement.

While moulting, the skin splits at the epicranial suture. The larva twists its body and turns due to which, its head comes out and the 'V' shaped skin of head pushed forward and downwards, and due to the rhythmic expansions and contractions of the body the new larva comes out. Larvae feed on their exuvae.

Death feigning: Beetle shows death feigning behaviour i.e. it remains still when disturbed, this character shows protective behaviour of the beetle from upcoming danger.

Beetle *Platynotus belli* is selected for the present study is rapidly spreading insect and destroys the stored product in larger areas. In order to plan appropriate control measures for this pest it is necessary to study the physiology of this pest particularly digestive and neurophysiology.

Present work includes the following aspects.

1. Study of life cycle.
2. Histomorphology of digestive system which includes study the digestive enzymes like amylase, invertase, trehalase, protease and lipase.
3. Histomorphology of endocrine system.

PLATE: I

Life cycle stages of *Platynotus belli*

- Fig. 1** Eggs of *P. belli*.
- Fig.2** Larval instars of *P. belli*
- Fig.3** Pupa of *P. belli*
- Fig.4** Adult of *P. belli*