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Rearing and identification of *Callosobruchus maculatus* (Bruchidae: Coleoptera) in Chickpea

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Abstract

To study the rearing and identification of *Callosobruchus maculatus* (Bruchidae: Coleoptera) in chickpea, the present research work was carried out at the Entomology Research Laboratory of The University of Agriculture, Peshawar, during 2014. *C. maculatus*, (Bruchidae: Coleoptera) is an important stored grain insect pest distributed in Asia and Africa, ranging from tropical to subtropical world. It has been reported that the favorite hosts for *C. maculatus* are cowpea and chickpea but it also feed on other legumes as well. Grains were collected from various godowns of village Maneri (Swabi) and were brought to the Research Laboratory of The University of Agriculture Peshawar. Grains were kept in jars at 28 ± 2 °C and $65 \pm 5\%$ Relative humidity (RH) and covered with muslin cloth in order to supply adequate humidity to the grains. To establish the stock culture of *C. maculatus* chickpea was used as a host. Grains of Chickpea were kept in the jars and the jars were covered with muslin cloth and placed at 28.5 °C and 67.25 RH. The parasitoid from the culture of *C. maculatus* was collected with the help of aspirator and was then preserved in 70% alcohol. The parasitoid was identified with the help of literature and specimens present in the Insect museum of the Department of Entomology, The University of Agriculture, Peshawar. Both the pest and the collected parasitoid were properly mounted and labeled for demonstration purposes and were then deposited in the Insect museum of the Department of Entomology, The University of Agriculture, Peshawar.

Keywords: *Callosobruchus maculatus*, chickpea, legumes, stock culture, aspirator and parasitoid.

1. Introduction

Pests are a major problem both in the field and store houses. They cause losses of more than half of the expected yield [1]. Presently, pest control measures in storage rely on the use of synthetic insecticides and fumigants, which is the quickest method of pest control [2]. During storage, food commodities are attacked by the number of insect pest like *Sitophilus granarius*, *Rhyzopertha dominica*, *Callosobruchus chinensis* and *Callosobruchus maculatus*. Among them, *Callosobruchus maculatus*, (Bruchidae: Coleoptera) is an important stored grain insect pest distributed in Asia and Africa, ranges from tropical to subtropical world. It has been reported that the favorite hosts for *C. maculatus* are cowpea and chickpea but it also feed on other legumes as well [3]. Bruchid attack of pulses initially begins in the field and rapidly builds up during storage. Bruchid can cause an infestation from 60 to 100% during three to six months storage. Life cycle of *C. maculatus* is typically adapted to development in mature legume seeds. The larvae upon hatching enter into the cotyledons and spend the entire larval stage within the seeds. [4] As the larvae of these beetles are unable to migrate between seeds, the oviposition behavior of the female parent is crucial in determining the survival prospect of the progeny [5]. Recent studies have documented sample evidence to suggest that natural selection has molded the oviposition behavior and related life history traits such as fecundity, adult production etc. of these insects in a way that maximizes the individual fitness. The larvae of *C. maculatus* is totally dependent on the seed of legumes but the adults of this pest do not require water and feed but instead spend their limited life on mating and laying eggs. The eggs are being laid by an adult female on the surface of seed which are attached on its surface as if glued on the surface of seed at $30-35$ °C and $70-90\%$ R.H, are considered as ideal conditions for the oviposition and hatching takes place after 6 days of oviposition. Adults emerge within 3-4 weeks under favorable conditions [6]. *C. maculatus* males and females both have an average life time of 7 days under laboratory conditions and only few of them can survive more than 2 weeks [7, 8]. Both male and female can mate soon after their emergence and both can mate sever Times during their life time.

Oviposition rates are being adjusted by the females in order to handle the changes in host availability and thus laying few eggs when host availability is low. Sometimes female continue laying eggs on unsuitable substrates during host dispossession [9, 10]. Biological control has not been widely used against *Callosobruchus* species, although natural populations of *C. maculatus* are often subject to high levels of parasitism, particularly in West Africa. Mass rearing techniques for parasitoids have been developed and procedures for control by inoculation of parasitoids have been suggested. The objective of this study is to identify the pest insects and their natural enemies occurring in the Chickpea collected from various godowns of Maneri (Swabi) and to rear the collected pests in the same host as to establish stock culture for future use.

2. Materials and Method

The rearing of *C. maculatus* was carried out at the Entomology Research Laboratory of The University of Agriculture, Peshawar, during 2014.

2.1 Collection of Grains

Grains were collected from various godowns of village Maneri (Swabi) and were brought to the Research Laboratory of The University of Agriculture Peshawar. Grains were kept in jars at $28 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ Relative humidity (RH) and covered with muslin cloth in order to supply adequate humidity to the grains. The jars were examined after one week for the insect infestation. The insects were collected with the help of aspirator in a separate jar.

2.2 Establishment of stock culture of *C. maculatus*

To establish the stock culture of *C. maculatus* chickpea was used as a host. Grains of Chickpea were kept in the jars and were covered with muslin cloth and placed at 28.5°C and 67.25 RH. The culture was observed regularly for the presence of *C. maculatus* and any other insects, particularly predators and parasitoids. After one week of the establishment of stock culture an insect parasitoid was observed emerging from the infested grains. The parasitoid from the culture of *C. maculatus* was collected with the help of aspirator and was then preserved in 70% alcohol. The parasitoid was identified with the help of literature and specimens present in the Insect museum of the Department of Entomology, The University of Agriculture, Peshawar. The stock culture was maintained by providing host and optimum laboratory conditions for further research studies.

2.3 Mounting

Both the pest and the collected parasitoid were properly mounted and labeled for demonstration purposes and were then deposited in the Insect museum of the Department of Entomology, The University of Agriculture, Peshawar.

3. Results and Discussion

The insect pest found in chickpea, collected from different areas of District Swabi was identified as *C. maculatus*. It belongs to family Bruchidae, order Coleoptera, genus *Callosobruchus*.

C. maculatus species can be easily distinguished by general appearance. The most distinguishing characteristic is the coloration on the plate covering the end of the abdomen. In the female (Fig 1b), the plate is enlarged and is darkly colored on both sides. In the male (Fig 1a), the plate is smaller and lack stripes. Generally, females are larger in size than males, but there is much variation. In some strains, females are black

in coloration and males are brown, but in others both sexes are brown.

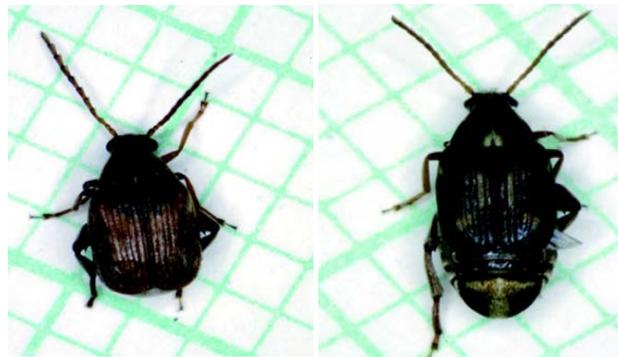


Fig 1a

Fig 1b

3.1 Morphological Description of Family Bruchidae

The members of Bruchidae family are granivores and typically infest various kinds of seeds or beans, living for most of their lives inside a single seed. The family includes about 1,350 species found worldwide. Bean weevils are generally compact and oval in shape, with small heads somewhat bent under. Sizes range from 1 to 22 mm for some tropical species. Colors are usually black or brown, often with mottled patterns. Although their mandibles may be elongated, they do not have the long snouts characteristic of true weevils. Adults deposit eggs on seeds, then the larvae chew their way into the seed. When ready to pupate, the larvae typically cut an exit hole, then return to their feeding chamber. Adult weevils have a habit of feigning death and dropping from a plant when disturbed.

3.2 Differences among *maculatus* and other species of genus *Callosobruchus*:

C. maculatus

Inner carina of hind femur smooth; inner tooth typically as long as, or very slightly longer than, outer tooth. Pronotum of mature specimens with black cuticle, and with golden setae, except on the basal median gibbosities, which extend well beyond the posterior margin and are covered with white scale-like setae. Eyes very deeply emarginate, prominent and bulbous. Male genitalia distinctive: median lobe with two longitudinal sclerotized denticulate areas near its middle; parameres rather stout and broadly spatulate.

C. chinensis

Male antennae pectinate, segments 4-10 conspicuously expanded antero-laterally; female antennae serrate; antennae of both sexes usually with segments 4-11 dark brown (rarely yellow-brown). Pygidium of female (and male) covered with white or silver setae. Inner tooth of hind femur with sides more or less parallel, converging near apex. Male genitalia: median lobe more elongate, apex with exophallic valve spearhead-shaped, and base with two sclerotized plates; parameres normal and rather broadly spatulate.

C. analis

Inner carina of hind femur with numerous irregularly-spaced small denticles along its proximal two-thirds; inner tooth rather shorter than, or as long as, outer tooth. Pronotum with uniformly reddish-brown cuticle, and with sparse golden setae, except on the basal median gibbosities, which extend only slightly beyond the posterior margin and have sparse white setae. Eyes less deeply emarginate, rather flattened and

less prominent. Male genitalia: median lobe without sclerotized areas near its middle; parameres rather slender and only narrowly spatulate.

C. udemptus

Inner tooth of hind femur conspicuously longer than the short blunt outer tooth. Body cuticle black, with a pattern of grey, black and brassy setae on the dorsum. Length 2.75-3.0 mm.

C. subinnotatus

Body cuticle uniformly black or very dark brown, occasionally with dark reddish highlights on legs and antennae; setae grey or brown, never forming a distinct pattern on the elytra, but usually with a vague pattern of whitish setae on the elytra of females. Length is 4.0-5.5 mm.

3.3 Parasitoid of *C. maculatus* (*Anisopteromalus calandrae*)

The parasitoid which was observed during rearing of *C. maculatus* was identified as *Anisopteromalus calandrae* and it is a larval parasitoid. It parasitizes mainly stored-product pests of coleopteran families Bruchidae and Curculionidae. *A. calandrae* is widely used as a biological control agent against these pests. Female adults locate *C. maculatus* inside grain kernels. Female lays eggs inside grain kernel on *C. maculatus* larvae. It can also attack larvae external to grain. This parasitoid has been demonstrated to reduce populations of the maize weevil in stored corn. Its distribution is worldwide and it is not injurious to stored grains.

A. calandrae belongs to class insecta, order Hymenoptera, family Pteromalidae, genus *Anisopteromalus* and specie *Calandrae*.

3.3.1 Family Pteromalidae

The Pteromalidae represent one of the largest "families" of the Chalcidoidea, consisting of about 2800 world species and 550 genera of morphologically and biologically diverse habits.

3.3.2 Sub-families of Pteromalidae

Spalangiinae: Black, ant-like wasps, dorso-ventrally compressed with forward projecting head and antennae attached at sides of mouth. The metasoma is petiolate, the thorax and head are usually covered with punctures, and the notauli are complete.

Cleonyminae: In general, with the eyes diverging ventrally and the pronotum often relatively long (from anterior to posterior margin, generally as long as wide). Notauli may or may not be present. Some species have the hindfemur enlarged but without ventral denticles and the tibia straight, but the Chalcedectini have enlarged hind femora with ventral denticles and an arched hind tibia (chalcidid-like). In some species the fore femur may be enlarged with 1 or more ventral denticles.

3.3.3 Species of genus *Anisopteromalus*

Anisopteromalus apivorous and *Anisopteromalus caryedophagus* are described from the Ivory Coast, where they parasitize seed-eating insects (especially Apionidae and Bruchidae) that attack legumes. They are potential biological control agents against *Piezotrachelus* infesting stored cowpeas (*Vigna unguiculata*) and *Caryedon serratus* in stored groundnuts.

4. Conclusion and Recommendation

Callosobruchus maculatus, (Bruchidae; Coleoptera) is an important stored grain insect pest. Life cycle of *C. maculatus* is typically adapted to development in mature legume seeds. The eggs are being laid by an adult female on the surface of seed which are attached on its surface as if glued on the surface of seed at 30-35 °C and 70-90% R.H, are considered as ideal conditions for the oviposition and hatching takes place after 6 days of oviposition. Adults emerge within 3-4 weeks under favorable conditions. *C. maculatus* males and females both have an average life time of 7 days under laboratory conditions and only few of them can survive more than 2 weeks. It belongs to family Bruchidae of the order Coleoptera, genus *Callosobruchus*. *C. maculatus* species can be easily distinguished by general appearance. The most distinguishing characteristic is the coloration on the plate covering the end of the abdomen. In the female, the plate is enlarged and is darkly colored on both sides. In the male, the plate is smaller and lack stripes. Generally, females are larger in size than males, but there is much variation. In some strains, females are black in coloration and males are brown, but in others both sexes are brown. *Anisopteromalus calandrae* is a larval parasitoid of *Callosobruchus maculatus*. It parasitizes mainly stored-product pests of coleopteran families Bruchidae and Curculionidae. *A. calandrae* is widely used as a biological control agent against these pests. More study is required on the control of *C. maculatus* in chickpea and other legumes by this parasitoid.

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