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Biosystematics and Biocontrol of *Bruchidius flavovirens* Arora (Coleoptera: Bruchidae)

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ABSTRACT: Order Coleoptera of class Insecta has the largest number of described species worldwide and family Bruchidae (Coleoptera: Chrysomeloidea) is a small but economically important possessing about 2000 known species worldwide. Bruchids are seed borers and attack on wild leguminous hosts in field and the edible legumes in stores. All the known beetles of family Bruchidae feed on seeds of 34 families of kingdom Plantae and about 80% of them feed on the seeds belonging to family Fabaceae. Bruchids attacking green pods of wild legumes are usually univoltine, has specific but long developmental period and life span. These are generally referred as field bruchids and their larvae grew and molted inside the host seeds. Adult bruchids emerged out after cutting a circular window in the testa of seeds and rendering them nonviable. Under the present investigation *Bruchidius flavovirens* Arora has been found associated with *Albizzia procera* Roxb. in different parts of Himachal Pradesh, India.

Keywords: Pine *Bruchidius flavovirens; Albizzia procera;* taxonomy; entomophagous and control.

INTRODUCTION: In class Insecta, order Coleoptera has the largest number of described species worldwide. Family Bruchidae of order Coleoptera is a small but important economically. Bruchidae belongs to the super family Chrysomeloidae which includes Cerambycidae and Chrysomelidae and is characterized by pseudotetramerous tarsi. Bruchids are small sized mostly dimorphic insects but most of them are injurious pests of green pods, ripe pods and stored seeds of family Leguminousae. Bruchidae comprises a small family having seventy genera under five sub families viz. Amblycerinae, Bruchinae, Eubaptinae, Kytorhininae, Pachymerinae and subfamily Bruchinae is the largest among all. Many bruchid species have obvious economic importance because they breed on grain legumes and consume valuable proteins that would otherwise be eaten by human beings. Family Bruchidae of order Coleoptera is a small but economically important possessing about 2000 known species worldwide[6]. Several genera like *Bruchidius, Callosobruchus, Caryedon, Conicobruchus* infest wide range of host plants and *Bruchus, Bruchidius, Sulcobruchus, Conicobruchus* and *Specularis* are univoltine and attack the green pods of edible and wild legumes. *A. procera* is medicinally an important plant, and widely distributed throughout the greater part of India except the most humid, cold and the driest region. Under the present investigation *B. flavovirens* Arora has been found associated with *Albizzia procera* (L.F.) Roxb. in different regions of Himachal Pradesh. Along with the emergence of adult bruchids, some larval and egg hymenopteran parasitoid have been observed. A larval parasitoid, *Entedon albiziarum* Rasplus (Hymenoptera: Entedontinae: Eulophidae) has been identified. There are about 170 described species of genus *Entedon* globally but only five species viz. *E. gunturensis* Shafee and Rigvi, *E. longicorpus* Khan and Shafee, *E. pempheridis* Ferriere, *E. thoubalensis* Chisti & Shafee and *E. albiziarum* has been recorded so far. *E. albiziarum* has been found parasitizing the larval stages of *B. flavovirens* and play an important role in biological control.

MATERIALS AND METHODS:

Collection of pods: Pods of *A. procera* infested with *B. flavovirens* were collected from the different regions of Himachal Pradesh from an altitude 350 to 1600 meters above mean sea level. The pods were carried from the field to the laboratory in wire mess cages. The wire mess cages were kept in the BOD in laboratory at 25˚C and 65% relative humidity.

Slide preparation: The sacrificed adult specimens were treated with hot 10% KOH, and then washed with distilled water for four or five times. Taxonomical useful parts were treated different grades of alcohol and finally mounted in DPX. But host and parasitoid were identified after running the specimen in dichotomous taxonomic keys.

Illustrations: Illustrations were drawn with the help of graph eyepiece fitted in stereoscopic binocular

microscope. Photographs of insect and pods both in field and laboratory were taken with help of Nikon D-80 and Olympus camera fitted on stereoscopic trinocular zoom microscope.

Measurements: Measurements were taken by standardizing the micrometer with eyepiece micrometer fitted in microscope. Scale line of 0.1 mm for genitalia and 1.0 mm for morphological characters were taken.

RESULTS AND DISCUSSION:

Bruchidius Schilsky

Bruchidius Schilsky, 1905, *Kaef. Eur*., 41**:**8. Type species: *B quinqueguttatus* (Ol.).

Pronotum is sub conical, antennae are long, surpassing the base of pronotum. Hind femur canaliculate below, with a minute preapical tooth on the inner carina ventrally, not accompanied by smaller teeth.

Bruchidius flavovirens Arora

Bruchidius flavovirens Arora, 1977, *Oriental Insects Suppl.*, **7**: 1:32.

Holotype♂*, allotype*♀, India: Himachal Pradesh: Palampur, xi. 1964 collected from *Albizzia procera* (Roxb). Benth (Kala *Sarin*) (Family: Leguminosae).
The *B. flavovirens* has been found associated with *A. procera* in different regions of Himachal Pradesh causes serious damage to its seeds thus reduces the natural propagation of this important plant in Himachal Pradesh, India. The bruchid species attacking green pods of wild legumes are usually univolitine, host specific and have long developmental period and life span. The present work has been done to explore the nature of association of *B. flavovirens* with *A. procera*. Studies were also included on the ecological status of the pest species and to know the parasitoid species associated with host insect.

Material studied: *Paratypes:* 5 ♂, 4 ♀, Himachal Pradesh: Hamirpur: Kudhar, v. 2014. *Paratypes*: 6 ♂, 3 ♀, Himachal Pradesh: Bilaspur: Karloti, iii. 2014. *Paratypes*: 4 ♂, 2 ♀, Himachal Pradesh: Kangra: Dhameta, iv. 2014. *Paratypes*: 5 ♂, 7 ♀, Himachal Pradesh: Una: Lathiani, v. 2014. *Paratypes*: 6 ♂, 4 ♀, Himachal Pradesh: Solan: Chamakripul, xi. 2014.

Morphological characters: Male and female are not morphologically differentiated. Length and width of male and female adult is about 3.30 to 4.00 mm and 3.60 to 3.76 mm respectively (Figure 1). Head is black broader and constricted at posterior end. Frons is carinate. Head surface is covered over with white setae is weakly raised. Eyes are small, bulging and emerginate. Canthus is shallow and narrow and also covered with white setae. Clypeus is trapezoidal. Labrum is small and semicircular movable flape like structure. Antennae are short not surpassing the pronotum. They are subserrate, testaceous, 11 segmented and margin blackish in colour. Antennae do not reaching middle of elytra; antennal segments 1-4 cylindrical, 5- 11 broad dark brown. Segment 1 is about twice as long as segment 2, segment 3 is slightly shorter than segment 2, segment 4 is shorter and little wider than segment 3, segments 4 - 10 becoming steadily wider. Pronotum is a prominent plate like structure that covers small part of thorax. Pronotum is black, subconical, its surface is uniformly covered with fennel coloured setae. Scutellum is the quadrangular, broader than long and bifid posteriorly. Its surface is adorned with fennel coloured setae. Elytra are light brown to dark brown, elongated. Each elytron is having a pair of tubercles one at the bases of 3rd and 4th striae, striae 4 and 5 stopping short of others. Elytra surface is uniformly covered over with fennel coloured setae (Figure 2). Pygidium is the last abdominal segment. It is exposed beyond the apices of the elytra and sclerotized. Colour is light brown, oblique in both sexes and uniformly covered with pale to golden setae (Figure 3). All the three pairs of legs are yellowish, tips of tarsi black and hind leg is larger than middle and foreleg. Fore and middle legs are testaceous and Hind femur is bicarinate below, inner carina is with a pre – apical tooth (Figure 4).

Figure 1: Adult female of *B. flavovirens.*

Figure 2: Elytra of *B. flavovirens.*

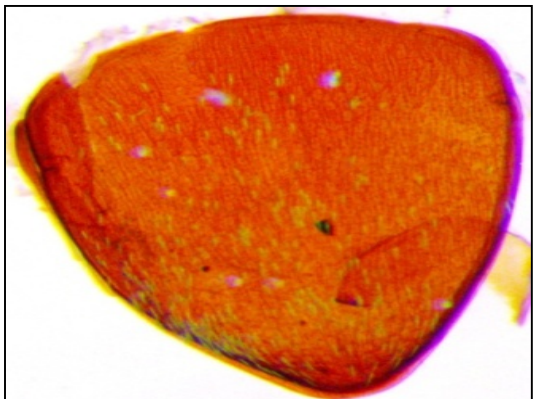

Figure 3: Pygidium of *B. flavovirens.*

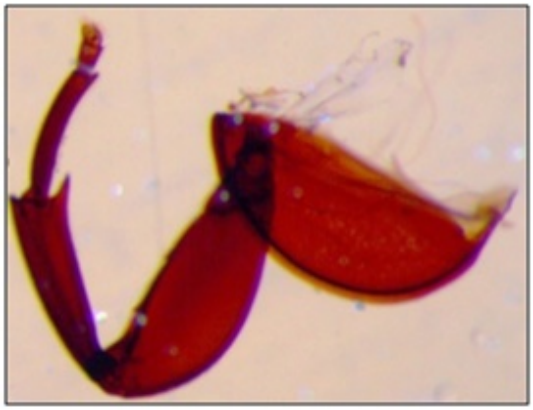

Figure 4: Hind leg of *B. flavovirens.*

Male genitalia: Phallus is thick bilobed and about 0.66 mm. long. Parameres (lateral lobes) are fused at their base up to 1/3rd of their total length, tips of parameres are flattened each carrying about 5-6 setae; the basal piece surrounds the middle of the median lobe and is attached to the ventral rim of the basal orfice by a sclerotised membrane. Median lobe is sclerotised tube. Surface of Endophallus is uniformally beset with minute tubercles; exophalic valve is broadly conical (Figure 5 A). Spermatheca is species specific; two lobes of spermatheca are typically bilobed with the two lobes more or less similar (Figure 5 B).

Measurement: Length of male genitalia is 0.66 mm.
Width of male genitalia is 0.18 mm.

B. flavovirens is a univolitine species and lays eggs on the green mature pods of *Albizzia procera.* There is no sexual dimorphism and male generally mates once time in the life cycle. Egg laying starts in the end of February and during the beginning of March. Eggs are laid on the green and mature pods of host, *A. procera.* Eggs are laid singly on the outgrowth of the seed in the pod and one egg is deposited and manipulated in about 30 – 45 seconds. First instar larva penetrate into the seed and start eating of the cotyledons and embryo of seeds. Whole seed is damaged or consumed by the larval stages of the pest and made unfit for propagation of the plant.

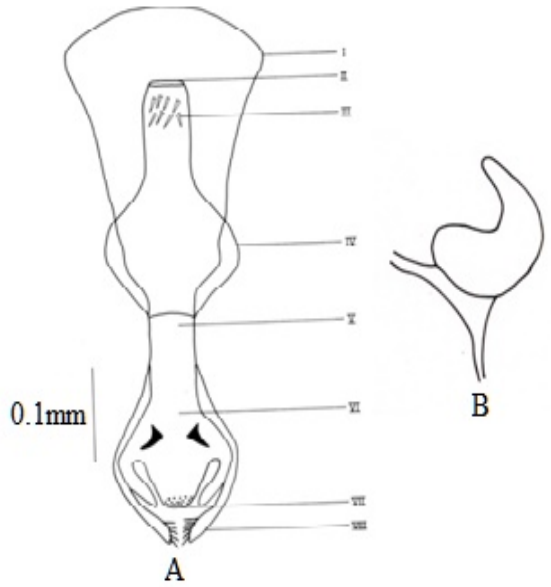

Figure 5: (A) Male genital organ of *Bruchidius flavovirens* (I-Epimere, II- Hypomere, III-Endophalic plates, IV- Exophallic apodeme, V-Phallobase, VI- Exophallus, VII- Paramere, VIII-Exophalic valve), Figure 5 (B) Spermetheca of *B. flavovirens.*

Emergence of adults starts after winter generally during month of February. Maximum emergence of adults occurs in month of March and April due to the favorable environmental conditions. Adults make a circular whole in the pod wall after completing their life cycle (Figure 7). Adults were strong flier and remained active most of the time. They were frequently seen to feign death when disturbed, retracted their legs and antennae but resumed normal activity after a short while. Male searched for female to inseminate and female store viable sperm in spermatheca. Along with the emergence of adult bruchids, a larval parasitoid *E. albiziarum* Rasplus belonging to subfamily Entedontinae, family Eulophidae has also been recorded (Figures 8A & 8B). This bio-controlling agent plays an important role in the suppression of the pest population in the field. Larval parasitoids, *E. albiziarum* infested and grew inside the larvae of host insect (Figure 6A). This parasitoid destroyed the developing stages of bruchid thus controlling the propagation of pest. Along with the emergence of pest some larval parasitoids were emerged after completing their larval cycle on the host larvae. Parasitoids emerged by making a minute circular hole in the developing seeds and pods of *A. procera* (Figure 6B, Figure 7).

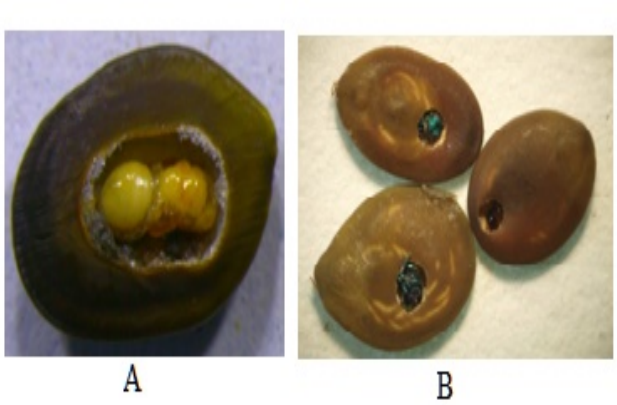

Figure 6: (A) Developing parasitoid on larva of *B. flavovirens* in the seed of *A. procera* and (B) Emerging Parasitoids from seeds of *A. procera*.

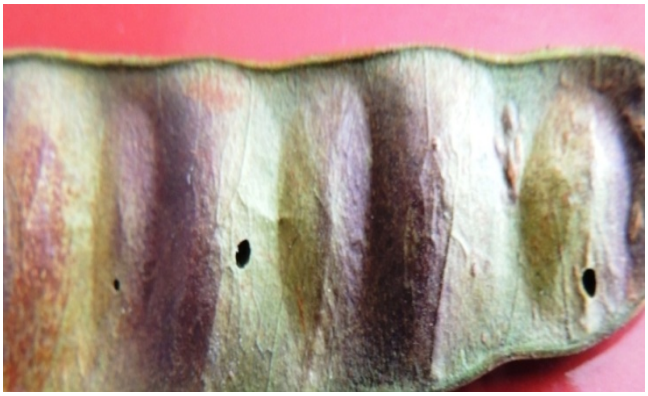

Figure 7: Small hole made by emerging parasitoids and large hole made by emerging adult of *B. flavovirens* on the pods of *A. procera.*

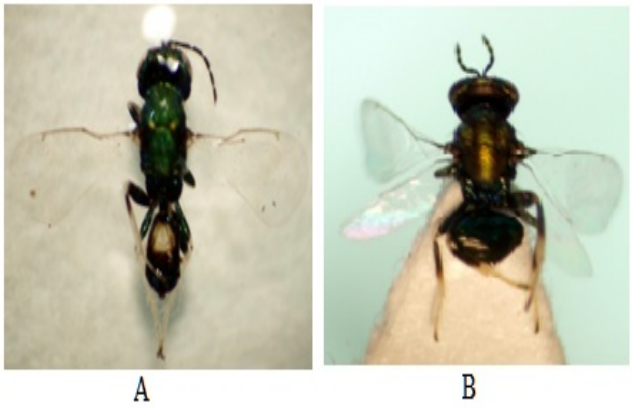

Figure 8: Adults of *Entedon albiziarum;* A-male, B-female.

The present investigation will help to know the infestation level of *A. procera* by bruchid species and biological control of pest. Under the present investigation *B. flavovirens* has been reported on the seeds of *A. procera* from different parts of the Himachal Pradesh. 48 species of bruchids belonging to different genera has been reported from North West India out of which 23 species belong to genus *Bruchidius*, 8 to *Caryedon*, 5 to *Callosobruchus*, 4 to *Spermophagus*, 2 each to *Bruchus, Specularis* and *Sulcobruchus* [2]. In India, 96 species of bruchids referable to 10 genera including *Bruchidius* under 3 sub- families viz. Pachymerinae, Bruchinae and Amblycerinae has been reported in 2002[6]. The head capsule of *B. flavovirens* was broader and constricted at posterior end testaceus, hypognathus and slightly larger than broad.[2-12] The external morphology of head capsule of the adults of 39 bruchids species belonging to 9 genera and 3 subfamilies, viz. Bruchinae, Amblycerinae and Pachymerinae and characters of species belonging to genus *Bruchidius* were comparable with *B. flavovirens*. Antennae of *B. flavovirens* were short not surpassing the pronotum, subserrate, testaceous, 11 segmented and margin blackish in colour. Similarly results were seen while describing the taxonomy of *Bruchidius* species from different area[1 & 2]. Hind femur of *B. flavovirens* was bicarinate below, inner carina was with a pre – apical tooth. [9-12] Description of two new species of genus *Bruchidius* Schilsky gave the related morphological characters; fore and middle legs testaceus with tips of tarsi and claws black, hind legs entirely black, hind femur bicarinate below and its inner carina with small preapical tooth. In male genitalia of *B. flavovirens*, Phallus was thick bilobed and about 0.66 mm. long. Parameres (lateral lobes) were fused at their base up to 1/3rd of their total length, tips of parameres were flattened each carrying about 5-6 setae; the basal piece surrounded the middle of the median lobe and was attached to the ventral rim of the basal orfice by a sclerotised membrane. Median lobe was sclerotised tube. Surface of Endophallus was uniformally beset with minute tubercles; exophalic valve was broadly conical.[1-4] Description of male genitalia is required in family Bruchidae for taxonomic importance. *B. maglorensis* and *B. brunneus* were segregated on the basis of their different male genitalial structures[9]. On the basis of male genital characters a new species of genus *Bruchidius* was erected from *Albizzia* plant from Northern Thailand[8-10]. Seasonal abundance of adult *B. flavovirens* was recorded maximum in the month of March and April. It decreased as the temperature decreases and found lowest in the month of December and January. Seasonal abundance of *B. villosus* was recorded in North Carolina and noticed that adult weevil could be found on host plants from early April to the end of August[2-11]. Bruchids were parasitized by many hymenopteran parasitoids and use of these parasitoids for the control of insect pests seems very useful. Under present investigation, *E. albiziarum* has been found parasitizing the *B. flavovirens* larvae. Same description of parasitoid - host association of *Entedon costalis* has been recorded with weevil *Glocianus punctiger* (Gyllehal)[3].

CONCLUSION: The present investigation will help to know the infestation level of pest on *A. procera*. Investigations also highlight and gave the importance of parasitoid for the biological control of pest which is biological safe, economically feasible and ecological viable and not only reduce the load of hazardous chemicals but also useful to maintain the ecological balance in the nature.

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