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# *Uscana femoralis*, an egg endoparasitoid for biocontrol of *Callosobruchus theobromae* (Coleoptera: Bruchidae)

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**ABSTRACT.** *Uscana femoralis*, recorded for the first time from the eggs of *Conicobruchus albopubens* is also reported from the eggs of *Callosobruchus theobromae.* The parasitoid deposited its eggs inside the eggs of the host insect by puncturing the egg chorion with its ovipositor. Host eggs 0-84 hours old were accepted for parasitization. Parasitoid eggs hatched inside the host eggs and further development was completed inside at the cost of host egg ooplasm. Adult parasitoids came out after 9.4 ± 0.46 days by making a circular cut from inside the eggshell of the host insect. Of the total number of eggs of the host insect deposited on seeds of the host plant, 22% were destroyed by the parasitoid thus resulting in even percent biocontrol of the host insect.

**KEY WORDS:** *Callosobruchus theobromae*, *Uscana femoralis,* egg-parasitoid, bio-control, life cycle.

## INTRODUCTION

*Uscana femoralis* (Trichogrammatidae: Hymenoptera) reported from the eggs of *Conicobruchus albopubens* (PIC.), a pest of *Cymopsis psoraloides* DC. (PAJNI & SOOD 1999) is also an egg endoparasitoid for biological control of *Callosobruchus theobromae* (L.) (Bruchidae: Coleoptera), a pest of *Glycine max* (MERR.) (soybean) and *Dolichos lab lab* (L.) (sem) (THAKUR & BANYAL 2004). Genus *Uscana* (GIRAULT) includes 16 species, which are differentially associated with eggs of different species of Bruchids (HUIS et al. 1991). From the Indian region 3 species namely *mukerji*(MANI) , *indica* (PAJNI et TIWARI)

and *femoralis* (PAJNI et SOOD) have been recorded from the eggs of store bruchids so far. Eggs of *C. analis* (F.), *C. chinensis* (L.) and *C. maculatus* (L.) were attacked by *U. mukerjii* (MANI), a potential egg parasitoid of bruchids (PAJNI et al. 1996). Another egg endoparasitoid, *U. semifumipennis* (GIRAULT) has been reared from the eggs of bruchid beetles and its importance as a biocontrolling agent for legume pests has been emphasized by BOE & MC DANIEL (1991). Parasitization of *C. maculatus*, *C. analis* and *Z. subfaciatus* eggs by *U. femoralis* has been reported by TIWARI et al. (2003) but parasitization and enlarged scale destruction of *C. theobromae* eggs by this parasitoid have been reported for the first time. Not only the parasitization but life cycle, susceptible age of host eggs, mating behaviour , number of eggs laid and percent biocontrol of host insect have also been explored through the present investigations.

Control of bruchids by chemical means or through harmful radiations is not very appropriate for resource-poor farmers. Therefore simpler, environmentally innocuous, self-regulatory, long lasting and relatively inexpensive mode to suppress the pest population and retain their population below economic injury level is by introducing parasitoids and predators in their culture. Thus the main aims of the present study are to assess the potential of the parasitoid in regulating or eliminating the active population of *C. theobromae* and to evaluate the effectiveness of *U. femoralis* among the host insect's eggs of different ages.

## MATERIAL AND METHODS

Pods of *D. lab lab* were collected during the months of March and April to observe the emergence of adult insects of *C. theobromae*. Adult bruchids thus emerged after passing the winter as hibernated larvae were allowed to lay eggs on the seeds and pods of the host plant in nine-cm diameter disposable plastic petridishes. Adults of *U. femoralis* also emerged in the culture from the eggs of host insects which were already parasitized in the field. Females of *U. femoralis* were allowed to lay eggs by supplying the host eggs of different ages. Numbers of eggs laid by a female parasitoid were observed microscopically. Development of the parasitoid egg inside the host egg and emergence of the adult parasitoid were recorded carefully. Room temperature and relative humidity were also noted.

## RESULTS

*Uscana femoralis,* (Trichogrammatidae: Hymenoptera) is a minute egg endoparasitoid wasp measuring female 0.467 – 0.548 mm and male 0.414 – 0.524 mm in length. Gravid females were found to parasitize 0-84 hours old eggs of *C. theobromae*. Maximum population of the parasitoid was observed in the month of April under natural atmospheric conditions of temperature 23°C – 31°C and relative humidity 53% – 82%. Adults of *U. femoralis* were active, kept on moving from one place to another, flew often and kept moving their antennae continuously. Adult parasitoids were sexually dimorphic and male wasps could be

easily distinguished morphologically from their female counterparts by having big, rounded and thick hind femur hence the name of the species (Fig. 1). Before the successful coition, the male wasp sensed the presence of the female with the help of its continuously moving antennae, which were directed towards the female wasp. The male ran after the female to mount on her but she flew away during the initial moments. However, a receptive female stands still and bears the chasing attempts of an amorous male. The male wasp with fluttering wings clings on the back of the female wasp and holds her firmly with his legs resulting in successful coition. Mating lasted for 4-5 seconds only.

The female wasp of *U. femoralis* starts egg laying 22-48 minutes after copulation and single female laid 50.9 ± 3.07 eggs under ordinary laboratory conditions. Before depositing an egg, the female of *U. femoralis* carefully examines the host eggs by tapping them with her antennae. The female then moves a little further, lowers her abdomen and ovipositor to make a hole in the host egg chorion and thus deposits her eggs inside the host egg. Development was completed inside the host egg at the cost of its ooplasm till the formation of adult parasitoid (Fig. 2). Preference to host eggs decreases with increase in their age. Host eggs of 0 – 24 hours were widely accepted for egg laying whereas, eggs of 72 – 84 hours old were least preferred. Fecundity of the parasitoid eggs laid in 24 – 48 hours old host eggs was higher compared to other eggs of different ages. Larval development of the parasitoid took place inside the host egg and adults emerged by cutting an irregular circular window in the host eggshell (Fig. 3). *U. femoralis* completes its life cycle in 9.4 ± 0.96 days. The sex ratio of male to female parasitoids developed inside 0-24 hours old host eggs was 1:3.2, while in 24 – 48 hours old eggs it was 1:2.5 and in 48 – 72 hours old eggs 1:3.4. The parasitoid eggs laid in 72-84 hours old host eggs produced only female parasitoids (Table 1).

**Table 1.** *Uscana femoralis* showing oviposition preference to differently aged host eggs, number of eggs laid per female, fecundity and sex ratio (means ± standard deviation).

| Sr. No. | Age of host eggs (hrs.) | No. of eggs laid/female | T test value* | Fecundity (%) | Sex-ratio (Male: Female) |
|---|---|---|---|---|---|
| 1 | 0-24 | 21.05 ± 2.72 | 2.90 | 93.11 | 1:3.2 |
| 2 | 24-48 | 17.50 ± 3.47 | 5.09 | 95.42 | 1:2.5 |
| 3 | 48-72 | 11.70 ± 2.81 | 17.19 | 83.33 | 1:3.4 |
| 4 | 72-84 | 0.65 ± 0.58 | — | 33.33 | ** |

* Significant at 0.05 level of significance.

**All females.

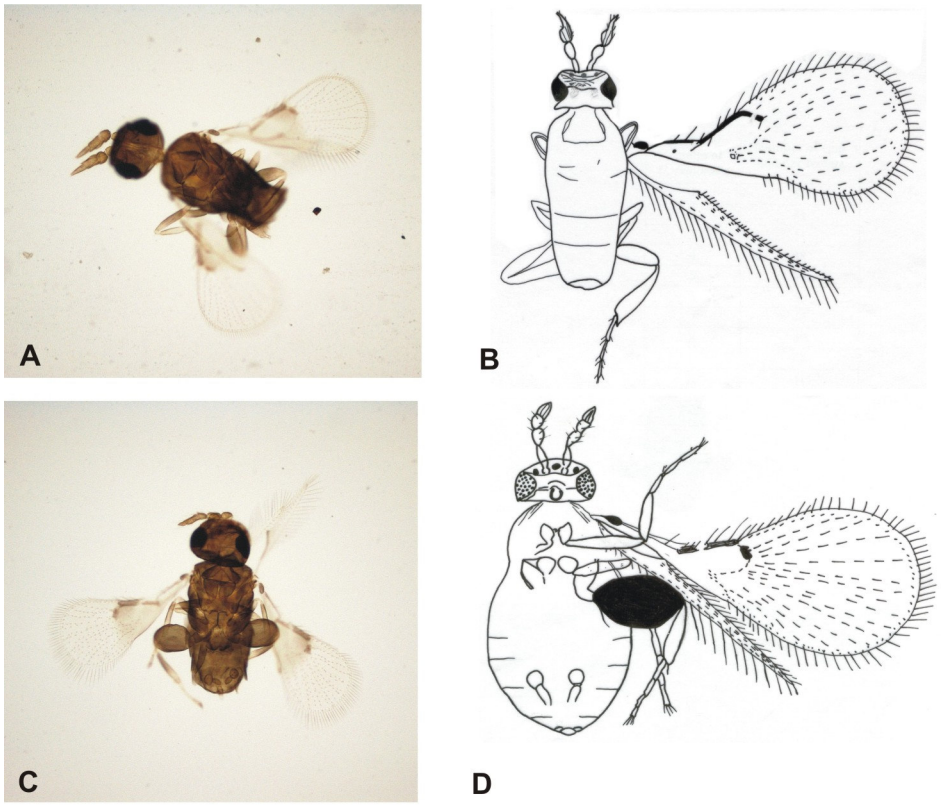


**Fig. 1.** Adults of *Uscana femoralis*, an egg endoparasitoid of *Callosobruchus theobromae*. A–B – female (0.467- 0.548 mm long), C–D – male in ventral view (0.414- 0.524 mm).

It has further been observed in the present study that of the total number of eggs laid by female bruchids 22% were parasitized and destroyed by *U. femoralis.* The ooplasm of infested *C. theobromae* eggs was completely consumed by the developing parasitoid and such eggs did not produce any bruchids. Thus destruction of 22% of eggs which results in suppression of equivalent population potential of *C. theobromae* is practically important for biocontrol of this insect pest.

The present observation ot the parasitoid reveals that the high rate of egg laying by the parasitoid, destruction of the host eggs before they hatch into larvae and very short life cycle is practically useful to include this biological method in "Integrated Pest Management" (IPM) of *C. theobromae*. However, more information is required before applying this parasitoid as a potential bio-controlling agent.


**Fig. 2**. Eggs of *C. theobromae* parasitized by *U. femoralis*.

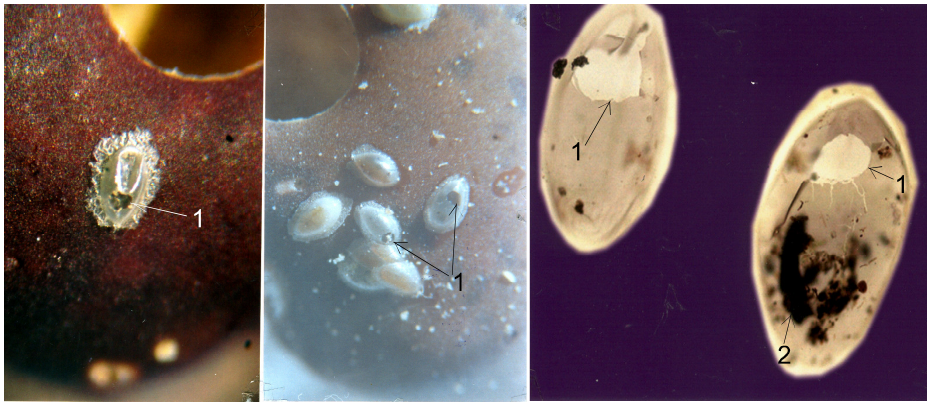


**Fig. 3.** Circular window in the egg - shell of *C. theobromae* cut by adults of *U. femoralis* to emerge (A - C). 1 – emergence holes; 2 – pupal moult of *U. femoralis* inside host egg.

## DISCUSSION

Genus *Uscana* (GIRAULT) contains 25 described species distributed all over the world and known hosts of these parasitoids are eggs of bruchid or buprstid beetles (STOLK, 2002). *U. femoralis* a minute parasitoid measuring: female 0.467 – 0.548 mm and male 0.414 – 0.524 mm in length, destroyed 22% host eggs and resulted in even percent biocontrol of insect pest. PAJNI & SOOD (1999) have recorded almost similar dimensions of female and male *U. femoralis*. *U. lariophaga,* a congeneric species of *Uscana* measuring 0.4 - 0.5 mm

is a solitary endoparasitoid of eggs of *C. maculatus* (F.) and *Bruchidis atrolineatus* (PIC.) that can be employed as a potential biocontrolling agent for *C. maculatus* a serious pest of cow pea, *Vigna unguiculata* (STOLK 2002). The size of *U. femoralis* was similar to that of *U. lariophaga*, while mating duration and pre and post coition behavior of the parasitoid under the present study resembled that of *U. mukerjii* (STOLK 2002, PAJNI et al. 1996). A species of *Uscana* has parasitized 21% eggs of *Bruchidis atrolineatus* and 60% eggs of *C. maculatus* in the fields from Niger (ALZOUMA 1987) and parasitization level of 18% has been recorded in *Acanthoscelides obtectus* (SCHMALE et al. 2002). *Dinarmus basalis,* a larval pupal parasitoid of large number of bruchids suppressed 72.3 ± 2.3 to 100% of the population of *C. chinensis* in the months of April – March and 68.7 ± 1.7 to 100% of the population in July – August by subsequent introduction of five to fifty pairs of parasitoids in the culture (ISLAM & KABIR 1995). Under ordinary conditions of temperature and relative humidity the life cycle of *U. femoralis* was completed in 9.4 ± 0.96 days while developmental duration of *U. lariophaga* was 8-11 days (STOLK 2002) and in *U. mukerjii* it was 6 days in summer and 18 days in winter (PAJNI et al. 1996). In the present study on *U. femoralis* mating was observed for 4 -5 seconds similar to that of *U. mukerjii* in which mating lasts for 4-6 seconds in summer and 7-11 seconds in winters (PAJNI et al. 1996). Hatching of parasitoid eggs, development of larval instars and their metamorphosis into adult insects took place inside the host egg.The egg endoparasitoid completed its development inside the host egg and the adult emerged by cutting a circular window in the host eggshell (THAKUR & BANYAL 2003). The sex ratio of male to female in *U. femoralis* was about 1: 3 similar to *U. lariophaga* (HUIS et al. 1991). Thus the results of the present study are comparable to the related work on other parasitoid species of *Uscana*.

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