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## *Charops ganges* (Hymenoptera: Ichneumonidae) as larval parasitoid of *Selepa celtis* Moore (Lepidoptera: Nolidae) rediscovered after about a century from Dehradun, India

**Pooja Singh and AN Singh**

### Abstract

Species of *Charops* Holmgren are known to be koinobiont endoparasitoids of Lepidoptera larvae attacking a wide range of families. *Charops ganges* is amongst the 10 species of *Charops* reported and described from various parts of India. *C. ganges* (Hymenoptera: Ichneumonidae) is one such Indian species, which has been reported to parasitize the larvae of *Selepa celtis*, *Achaea janata* and species under Arctiid and Lymantrid. The *C. ganges* has been rediscovered as a parasite of the *S. celtis* again from Dehradun, Uttarakhand, India after about a century. The photographic evidence of both the parasite and the host has been provided in the present article for the first time. Further studies on the ecology, biology and potential of this insect parasitoid as bio-pesticide have been advocated.

**Keywords:** hymenoptera, ichneumonidae, *Charops ganges*, koinobiont endoparasitoids, *Selepa celtis* caterpillar, bio-pesticide

### Introduction

Species of *Charops* Holmgren are known to be koinobiont endoparasitoids of Lepidoptera larvae attacking a wide range of families i.e. Arctiidae, Dilobidae, Geometridae, Hesperidae, Lycaenidae, Lymantriidae, Noctuidae, Nolidae, Nymphalidae, Papilionidae, Pieridae, Pyralidae, Sphingidae, Tortricidae and Zygaenidae (Yu *et al.* 2016) <sup>[1]</sup>. After killing its host, they construct cocoons (white with black stripes) which usually hang from the underside of the leaves (Gupta and Maheshwary, 1970) <sup>[2]</sup>. The genus *Charops* Holmgren belongs to the tribe Campoplegini of the subfamily Porizontinae. They are medium-sized insects, usually about 9-15 mm long, with a short thorax, elongate petiole and knob-like post petiole. The abdomen is strongly compressed. It is a moderately large genus and almost world-wide in distribution, but the majority of species occur in the tropics. In the Oriental Region it has been reported from almost all parts (Gupta and Maheshwary, 1970) <sup>[2]</sup>.

Till date, 10 species of *Charops* have been reported and described from India by different workers. Out of these, 08 species have been reviewed by Gupta and Maheshwary (1970) <sup>[2]</sup> and 02 species have been reported by Sathe *et al.* (2003) <sup>[3]</sup>. *Charops ganges* (Hymenoptera: Ichneumonidae) is one such Indian species under this genus, which was observed and reared for the first time from the larvae of an Arctiid from Dehradun by Beeson (1916) <sup>[4]</sup>, while working as Forest Zoologist at FRI, Dehradun. Later on, description of this insect as *C. ganges* was made by Cushman (1927) <sup>[5]</sup>. The *C. ganges* was further reported as parasitoid of *Selepa celtis* Moore again from Dehradun, India by Beeson & Chatterjee (1935) <sup>[6]</sup>. Later on, this species was also reported by different workers from other parts of the India i.e. Himachal Pradesh, Bihar, Assam, Mysore and Tamilnadu (Gupta and Maheshwary, 1970) <sup>[2]</sup>. The *C. ganges* has been re-discovered from Forest Research Institute Campus, Dehradun again in the year 2019 as parasitoid of caterpillar of *S. celtis* after about a century of its first observation in the year 1916. Photographic evidence of both the host and parasite has been provided in the present article for the first time.

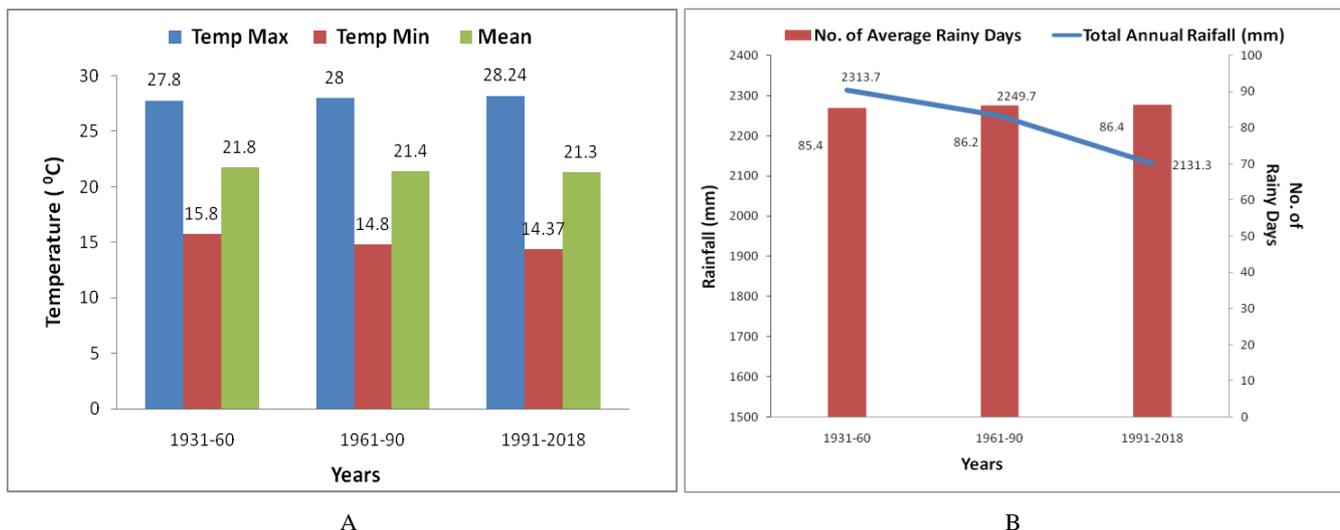
### Materials and Methods

The samples of 4<sup>th</sup> instar larvae of *S. celtis* Moore were taken from the naturally infested fruits of the Indian Rudraksha Plant cultivated in the New Forest Campus (Forest Research Institute), Dehradun during the month of September, 2019.

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For rearing of the pest, infested fruits along with stalks were kept in a plastic bottle of 9.5 cm x 6 cm dimension. The bottle mouth was covered with muslin cloth and was pricked with needle to make multiple holes for aeration. Fresh fruits were provided as and when needed to the larvae of this pest. Observations on the pest were continued till emergence of adult moth of the *S. celtis* and its parasitoid the *Charops ganges*. Identification of the pest and parasitoid were made with the help of appropriate literatures and subject experts from the Forest Entomology Division, Forest Research Institute (FRI), Dehradun. Photographs of the specimen were

taken with the help of Samsung camera (SM-J600G), while the microscopic photographs of the insect specimens were taken with the help of Trinocular Stereozoom Microscope (Olympus SZX-16) facility available in the laboratory of the Forest Entomology Division, FRI, Dehradun. The voucher specimen of the parasitoid (male) has been deposited in the Insect Depository of the Entomology Division, Forest Research Institute, Dehradun. Climatological data of Dehradun for last about one century have been presented in the fig.1 A and B.



**Fig 1:** Trends of annual temperature (A) and pattern of rainfall (B) in New Forest campus, Dehradun

### Observations on the *Charops ganges*

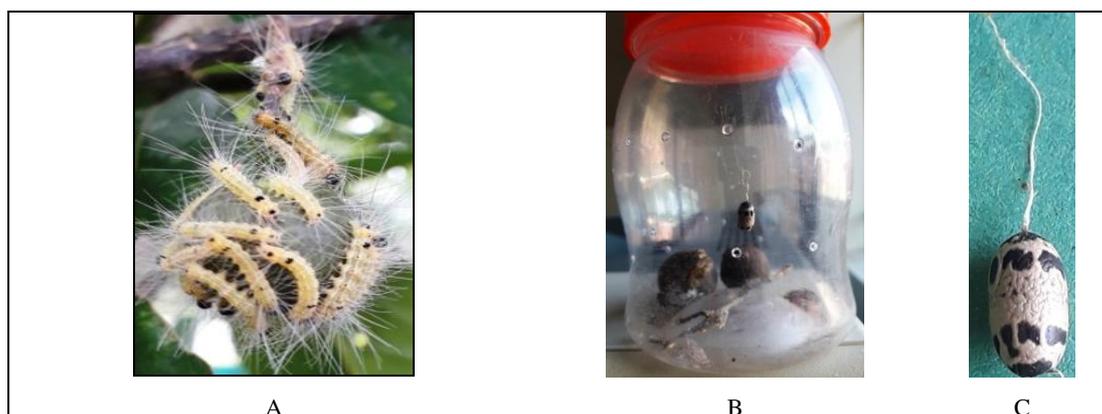
It is observed that the caterpillar of *S. celtis* was parasitized by the *C. ganges* during the months of September- October, 2019. During the period of rearing of the larvae of the *S. celtis* (fig. 2 A), an off white colour cocoon with black stripes hanging in the rearing bottle with a silken thread attached with wall of the rearing bottle was observed (figs. 2B and C). The observations on this cocoon continued till the emergence of adult parasitoid. A parasitoid emerged in about a week of time (first week of October, 2019) by making a small exit hole in the cocoon opposite to the silken thread (fig. 2 D).

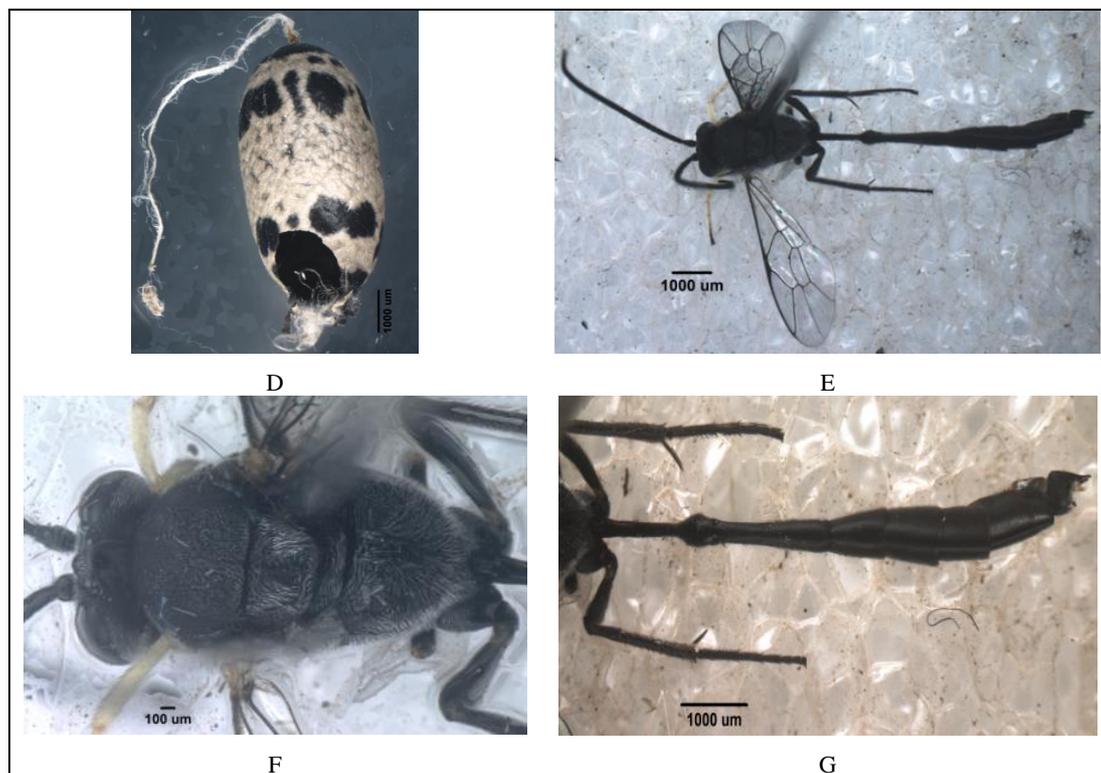
In this experiment, 16 numbers of 4<sup>th</sup> instar larvae of *S. celtis* Moore were reared. Out of these, 04 numbers of larvae died in the larval stage itself during the course of rearing, while remaining 12 larvae went for pupation by formation of loose dome shaped dull brown colour cocoon. Out of these, 06 numbers of adult of *S. celtis* were emerged, while no adults of

*S. celtis* were seen from the remaining 06 numbers of cocoons of *S. celtis*. Further, only single cocoon of the parasite insect was seen in rearing bottle, from which an adult parasitoid insect emerged. The parasite insect was identified as a male of *C. ganges* (fig. 1E). Microphotographs of the male insect, its head, thorax and abdomen have been provided in the figs.2 E-G.

### Characteristics of the Cocoon

As per observations in the present case, it is evident that the cocoon is off white in colour, pendulous and hanging in the rearing bottle with a silken thread attached with side wall of the rearing bottle (fig. 2 B). Shape of the cocoon is oval measuring 11.25 mm in length and 6.0 mm in width (middle of the cocoon). The silken thread attached with anterior portion of the cocoon measures 15.80 mm in length.





**Fig 2:** A. Fruit of *E. ganitrus* infested with larve of *S. celtis*, B. Cocoon of *C. ganges* hanging in the rearing bottle, C. Cocoon of *C. ganges* with silken thread, D. Cocoon of *C. ganges* with exit hole through which adult insect emerged, E. Whole body of parasitoid *C. ganges*, F. Microphotograph of head and thorax of *C. ganges*, G. Microphotograph of hind leg and abdomen of *C. ganges*.

Cocoon anterior and posterior portion are black in colour. Cocoon body surface has two rows of black colour spots (7- 8 numbers) of different shapes and sizes, one row near the anterior and posterior end of the cocoon respectively. Distance in between the two rows of black spots measures about 1.7 mm -1.9 mm.

Apart from the black spots, few oval shaped pits are also present in the row in between the black spots. Outer surface of the cocoon, other than black spots, is off whitish and silken in appearance. The mature insect has made an exit hole measuring 3.75 mm x 3.41 mm dimension near the posterior end of the cocoon for its emergence (fig. 2 D). It is evident from the broken portion of the cocoon that the internal surface of the cocoon is also lined with whitish silken threads/hairs.

#### Characteristics of the adult Male *C. ganges*

This species is distinguished by having the tegula black and the mesopleurum rugoso-reticulate. The male and female are reported essentially as similar in appearance and sculpture (Cushman, 1927<sup>[5]</sup>; Gupta and Maheshwary, 1970)<sup>[2]</sup>.

As per observations in the present case, the entire body colour of the male insect (Fig. 2 E) is black in appearance. However, the fore legs pale yellow with coxa and femur having dark brown marks on the underside.

The middle and hind legs black. Abdomen slender and mostly black. Wings hyaline and venation dark. Antenna black in colour. Face rugulosities, frons irregular and rugose, vertex smooth, ocellar triangle smoother, gena granulose, mesoscutum rugoso punctate, rugosities weak in the median area, mesopleurum rugoso-reticulate, speculum with parallel carinae, metapleurum reticulate, juxta-coxal area with a few striations, propodeum rugoso-reticulate, median carinae distinct, diverging basally and subapically. Measurements of the body parts of male insect are provided in the table 1.

**Table 1:** Dimensions of the body parts of male *C. ganges*

SN.	Body parts	Measurement (mm)
1.	Insect body length	9.75
2.	Head	0.83 Wx1.2 L
3.	Thorax	2.50 Lx 1.5 W
4.	Abdomen	6.75
5.	Antenna	5.0
6.	Fore leg	2.08
7.	Hind leg	4.33
8.	Fore wing	4.75Lx1.66W

L-length, W-width

#### Discussion

The *C. ganges* was observed and reared for the first time by Beeson in 1916 from the larvae of an Arctiid (Lepidoptera) from Dehradun, India. *C. ganges* was later on reported as parasitoid of *Selepa celtis* Moore again from Dehradun by Cushman (1927)<sup>[5]</sup> and further reported and described by Beeson and Chatterjee (1935)<sup>[6]</sup> and Townes, *et al.*, (1961)<sup>[7]</sup>. During later years, this species was also reported by different workers from other parts of India as well i. e. Himachal Pradesh, Bihar, Assam, Mysore and Tamilnadu (Gupta and Maheshwary, 1970)<sup>[2]</sup>. Apart from parasitizing the larvae of Arctiid species and caterpillar of *S. celtis* (Lepidoptera: Nolidae), *C. ganges* has also been reported as parasite of the larvae of semi-looper caterpillar *Achaea janata* (Lepidoptera:Noctuidae) from Mysore in Karnataka and larvae of Lymantrid species (Lepidoptera) on ber plant (*Ziziphussp.*) from Ranchi (as per review by Gupta and Maheshwary, 1970)<sup>[2]</sup>. Except from India, *C. ganges* has not been reported from any other country of the world.

In the present case, the *C. ganges* has been recorded again in Dehradun parasitizing the caterpillar of *S. celtis*, while the host was feeding on the fruits of the Indian Rudraksha plant

(*E. ganitrus* Roxb. ex G. Don) during the months of September-October, 2019. *S. celtis* has been recently reported as a pest of fruits of the Indian Rudraksha plant (*E. ganitrus* Roxb. ex G. Don) by Singh *et al.* (2021) [8]. *S. celtis* is reported to complete its 5-6 generations in a year (Beeson and Chatterjee, 1935). This has been reported as voracious defoliator of many forestry species by various workers, as is evident from a recent publication (Singh *et al.*, 2021) [8].

The continuation of the presence of the host (*S. celtis*) and in turn the population of parasitoid (*C. ganges*) is being ensured due to prevailing conducive climatic conditions. Climatological data of last about 90 years (year 1931-2018) from New Forest Campus, Dehradun indicate that average annual temperature remained around 21-22 °C while the number of annual rainy days remained 85-86 days. However, very slight decreases in annual rainfall have been recorded during the later years (Figs 1 A-B). As such, there are no significant changes in the annual patterns of the temperatures, rain fall and number of rainy day during the last about one century in the New Forest campus, Dehradun, as is evident from the climatological data of the New Forest Campus, Dehradun (FRI, 2018) [9]. Moreover, the availability of forest tree species like *Albizia* spp., *Bischofia javanica*, *Careya arborea*, *Duabanga grandiflora*, *Elaeodendron glaucum*, *Ficus glomerata*, *Gmelina arborea*, *lagerstroemia speciosa*, *Lannea coromandelica*, *Mangifera indica*, *Schleichera trifuga*, *Shorea robusta*, *Syzygium cuminii*, *Terminalia bellerica*, *T. catappa*, *T. chebula*, *T. myriocarpa*, *T. tomentosa* and *Xylia dolbriformia*, etc. in the FRI Campus (FRI Publication, 2019) [10], where *S. celtis* is reported to feed upon as a pest, is also a reason for the presence of population of *S. celtis* and in turn the population of its natural enemy, the *C. ganges*.

As per preliminary studies in the present case, only single male parasitoid insect emerged by killing of a single larvae of *S. celtis*, as has also been reported by Beeson and Chatterjee (1935) [6]. Further, it is also evident that 10 numbers of larvae/pupae of *S. celtis* were found dead during the stage of rearing. However, death of these larvae/pupae is due to parasitisation by *C. ganges* could not be said with conformity, as mortality of larvae may also be due to other reasons.

In the present case, the pupation period of *C. ganges* was of about 2 weeks time, which is in conformity with the observations by Beeson and Chatterjee (1935) [6], where pupation period of *C. ganges* had been reported to be 2-3 weeks of time. Elaborate descriptions of pupa with photographic evidence are being provided by the authors for the first time, as such descriptions are not available in any of the publications on the *C. ganges*.

Detailed works on the ecology and biology of *C. ganges* have not yet been carried out, therefore, such works need to be carried out on priority. Moreover, the potential of *C. ganges* as biological control agent (bio-pesticide) towards the management of *S. celtis* (Nolidae) and other similar group of insect pests of forestry and agriculture need to be tried.

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