



## Outbreak and life cycle of the hook tip moth, *Deroca inconclusa* (Walker, 1856) (Lepidoptera: Drepanidae) on Himalayan Dogwood, *Cornus capitata* Wall. ex Roxb. (Cornaceae) in Garhwal region of Western Himalaya, India

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**ABSTRACT:** During the course of survey carried out in Chakrata hills (Chakrata Forest Division, Dehradun district, Uttarakhand (Western Himalaya), sporadic infestation by the hook tip moth, *Deroca inconclusa* (Walker, 1856) (Lepidoptera: Drepanidae : Drepaninae) was recorded on *Cornus capitata* Wall. ex Roxb. trees in Chakrata Reserve Forest at several locations. Outbreak of the hook tip moth is being reported for the first time from this region along with its life history on *C. capitata* from the Garhwal region of the Western Himalaya. © 2020 Association for Advancement of Entomology

**KEY WORDS:** Antioxidant, tannin, astringent, Moru oak, Ban oak, eggs, larva, pupa

Himalayan Dogwood, *Cornus capitata* Wall. ex Roxb. (Cornaceae) tree is commonly known as 'Bhamora' in Uttarakhand, India and is native to the low-elevation woodlands of the Himalaya in India, Nepal, Bhutan and adjoining countries of SE Asia: Myanmar, Laos, Vietnam and China. It is often grown as an ornamental tree in gardens, valued especially for its summer flowering and late autumn fruits. It has naturalized in parts of Australia and New Zealand. This evergreen tree grows to 12m in height and width and is naturally found in forests and shrubberies between 1200 m and 3000 m altitude along the edges and gaps in oak-mixed forests in the Western Himalayas (Joshi *et al.*, 2018). It is common in secondary forest especially ban-oak-rhododendron from 1500-2400m (Upreti *et al.*, 2010). Flowering occurs in May-July and fruiting takes place in

August-November. The ripe fruits are reddish, fleshy and edible (Fig.1). *C. capitata* fruit has high nutritional and low anti-nutritional content as well as considerable antioxidant and antimicrobial activity with possible nutritional and health implications (Mishra *et al.*, 2017). The bark is used medicinally and is source of tannin which is used as an astringent (<http://temperate.theferns.info/plant/Cornus+capitata>). The young twigs are also used as fodder locally. The dry wood is used mainly as fuel and for making tools (<http://anilkthakur.blogspot.com/2014/09/himalayan-strawberry-tree-cornus.html>).

During the course of surveys carried out in Chakrata hills (Chakrata Forest Division, Dehradun district, Uttarakhand) (Western Himalaya), sporadic infestation by the hook tip moth, *Deroca*

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Table 1. Life cycle of hook tip moth, *Deroca inconclusa* (Walker, 1856) on *Cornus capitata* Wall. ex Roxb. (Cornaceae) during July-August 2020 in Chakrata Forest Division (2100m), Dehradun District, Uttarakhand, India

Life history stages	Duration (days)	Morphological features and habits
Eggs	4-5 days	Eggs are laid in clusters of 80-220 on the abaxial side of leaf. Eggs are 0.5 mm in length, oval in shape, pale yellow when laid; chorion is smooth and has red colour patch in between and turns dark yellow before hatching. (Fig 7 a-b).
Larva		
1 <sup>st</sup> instar larva	3-4 days	Length: 1.5-02mm; head is black along with setae on it and body is pale green; larva has grey markings behind the head on the thorax region and covered with setae all over the body. Feeding takes place by scratching and skeletonizing the upper leaf surface. Several larvae may feed together on a single leaf (Fig.8 a&b).
2 <sup>nd</sup> instar larva	4-5 days	Length : 04-06mm; black head . Two black bands run parallel on the entire dorso-ventral surface. The colour of the dorsal surface between the two parallel lines changes from pale green to grey in the second instar. The last abdominal segment is tailed with numerous setae. Feeding takes place on the leaf tip and margins (Fig.8c).
3 <sup>rd</sup> instar larva	4-5 days	Length: 08-09 mm; The colour of the dorsal surface between the two parallel black lines changes from grey to pale green in the third instar. The abdominal segments now become more distinct and the head capsule turns pale green with black dots on the head region and two black bands running parallel on the dorso-ventral surface of the body. The tail in the last abdominal segment increases in size with numerous black setae on it. The third instar feeds mainly on the leaf margins (Fig8 d).
4 <sup>th</sup> instar larva	5-6 days	Length: 10-12 mm; Larva is now more elongated, pale green having black dots speckled all over the head region. The tail on the last abdominal segment becomes more pointed bearing numerous spine like setae. The larva in this stage feeds more vigorously mainly on the leaf margins and central axis and may consume the entire leaf. (Fig.8e).
5 <sup>th</sup> instar larva	4-5 days	Length: 12-14 mm; Full grown larva is pale green with setae all over the body; abdominal segments are distinct and has two black bands running parallel on the dorso-ventral surface of the body; head possesses setae and black lines on the sides. There are 3 pairs of thoracic legs and 4 pairs of abdominal prolegs which are yellowish brown. The larva now consumes the entire leaf and can move on to other leaves on the same branch for feeding. Just before pupation it stops feeding and fixes itself on the tip or the base of the leaf near the mid rib where it pupates (Fig. 8f & Fig.9 a-f).
Larval Period	20-25 days	Length: 1.5-14 mm (July-August).
Pre- Pupa & Pupa	3-4 days	Pre-pupa: Length 07 mm. ; Before pupation the larva shrinks in size and become stouter in shape and loses the legs and attached itself to the stalk or midrib of the eaten leaf before transforming into pupa (Fig.10). Pupa: Length: 09 mm; Creamish-white with brown markings on it. Has fine hair like setae present on the abdominal region. Cremaster has series of spines. The pupa is generally concealed in dry or curled leaf surface, hanging on the tree itself (Fig.11. a-d).
Adult (Moth)	2-5 Days	Wing Span: 40 mm (Fig19-22). Moths are medium sized, translucent, white having chequered white and black markings all along the margins of both the wings. On the forewing there are two oval grayish spots between the cell and the apex, four spots close to the apex and grayish markings in between the cell and the costa (Fig.12a&b).
<b>Total</b>	<b>27-34 days</b>	<b>July-August</b>

*inconclusa* (Walker, 1856) (Ditrysia: Drepanoidea : Drepanidae : Drepaninae) was recorded on *C. capitata* trees in Chakrata Reserve Forest at several locations (30°43'28".9 N and 77°51'39".7E

between 2079-2264 m) comprising of forest subtypes 12/C1b Moru oak Forest & 12/C1a Ban oak Forest (Champion and Seth, 1968) on 13-17 July, 2020 (21-27 °C and 60-85% RH-day time). The



Fig.1a. *Cornus capitata* fruiting during rainy season 19.vii.2020



Fig. 1b. Ripened fruits during autumn (14.x.2020) in Chakrata Forest Division, Uttarakhand, India



(a)



(b)

Fig. 2 a & b Complete defoliation of *Cornus capitata* trees during rainy season in Chakrata Forest Division Uttarakhand, India (17.vii.2020)



(a)



(b)



(c)



(d)

Fig. 3 a-d. Pattern of defoliation by hook tip moth, *Deroca inconclusa* (Walker, 1856) on *Cornus capitata* foliage and pupae attached to eaten leaf of *Cornus capitata*





Fig 4: Freshly emerged hook tip moth, *Deroca inconclusa* (Walker,1856) and individuals perched on *Coriaria nepalensis*.

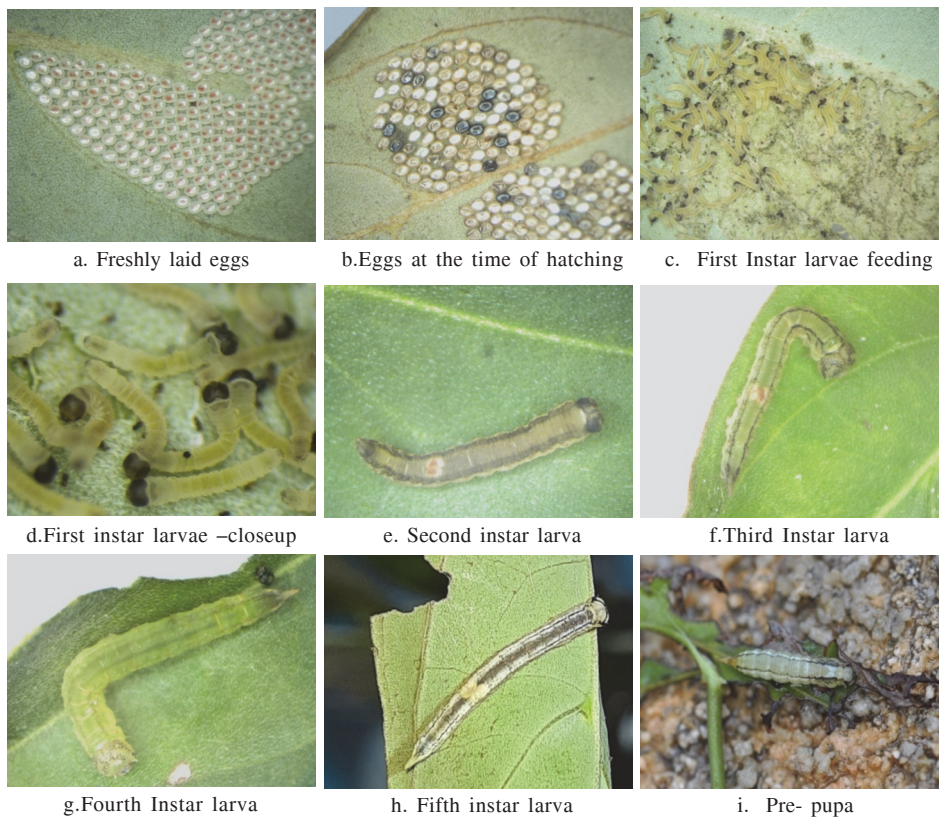


Fig. 5 a-i: Eggs and larval stages of hook tip moth, *Deroca inconclusa* (Walker,1856) on *cornus capitata*

infestation took the shape of an outbreak spreading all over Chakrata Forest Division during August (17-27 August 2020; 18-29°C and 74-90% RH - day time). The infestation started with the onset of rainy season spread over the entire Garhwal region i.e. Chakrata Forest Division, Mussoorie Forest Division (30°45'58.9 N and 77°12'21.5E; 2120 m; 02.ix.2020; 21°C and 90% RH-day time) and near Suwakholi and Buranskhanda Tehri Garhwal, Uttarakhand (30°27'21'.3 N and 78°08'90'.4E;

2168m; 02.ix.2020; 20°C and 87% RH-day time) which continued during the entire rainy season and lasted till the post monsoon season (Sept 2020). Most of the affected trees had practically no green foliage and presented a leafless, dry brownish appearance (Fig. 2 a, b).

The infestation by young larvae starts from the tip of the branches with initiation of feeding on the terminal leaves. Initially the tip of the leaf is

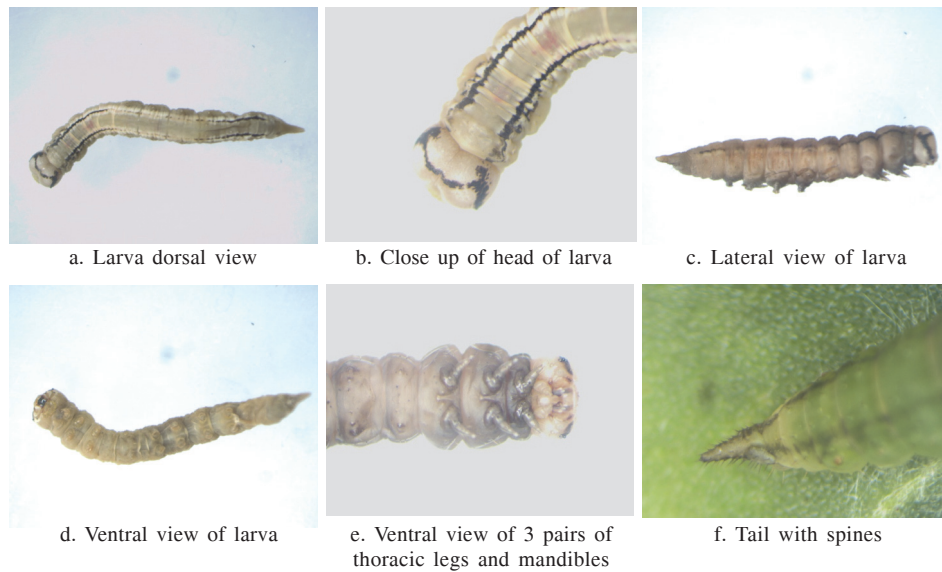


Fig. 6 a-f: Morphological features of 5<sup>th</sup> Instar larva of hook tip moth, *Deroca inconclusa*

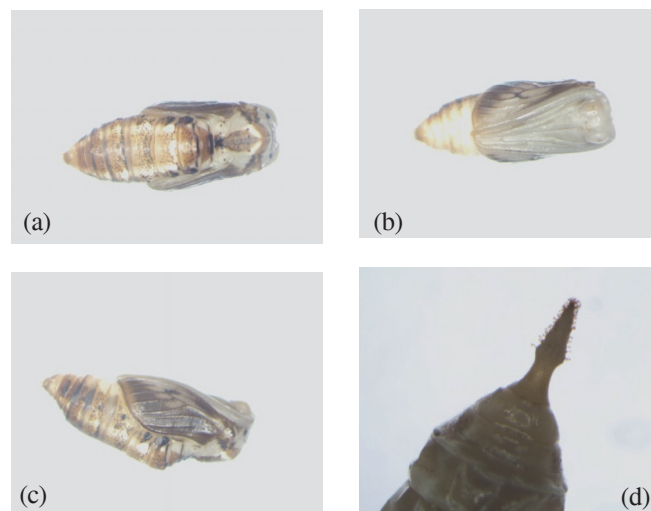


Fig. 7: a-d.: Pupa of hook tip moth, *Deroca inconclusa*:  
a- Dorsal view, b- Ventral view, c-lateral view, d- Spines on the cremaster

devoured by the growing larva which slowly feeds on the entire leaf downwards towards the stalk but leaving the mid rib intact (Fig. 3 a-c) after which, it moves to another leaf. One larva feeds on an average 1-2 leaves and on completion of the larval stage, it pupates on the leaf. Up to 3 pupae may be present on a single leaf (Fig.4). Thus, at on instance there may me many pupae on the same branch of the same generation. Emergence of moth takes place on the tree itself from the hanging pupae and many individuals can be noticed emerging from the pupae simultaneously (Fig. 5). Emergence was

observed during the day time with adults resting on the branches of the tree or on bushes and small nearby trees such as *Coriaria nepalensis*. They fly around and mate during dusk and night (Fig. 6).

The holotype of *D. i. inconclusa* (Walker, 1856) was redescribed from Musoorie, Garhwal, Uttarakhand itself by Watson (1957) and specimens of this moth have been collected during May-July between 1868-1914 at ~2100m. Mathur and Singh (1956) have previously reported the larva of *D. inconclusa* defoliating *C. capitata*, from Gwaldam



a- Male moth



b- Female moth

Fig. 8 a-b: Adult of hook tip moth, *Deroea inconclusa*: a- Male, b- Female

in Almora, Kumaon, Uttarakhand based on 2 specimens collected by J.C.M. Gardner on 16.vi.1937 (National Forest Insect Collection, Forest Research Institute, Dehradun- Accession No. 16618). However, its life cycle has not been studied so far.

Hook tip moth, *D. inconclusa* has distribution in the Himalayan region of northern India through Nepal, Myanmar, China extending up to Taiwan, Korea, Japan in far East (Hampson, 1892; Watson, 1957). Another sub species of *D. inconclusa phasma* Butler, 1878 found in Japan and Korea is known to feed on Japanese Dogwood (Yamabushi), *Cornus kousa* F.buerger ex Hance (Cornaceae) in Japan (Digital Moths of Asia). The current findings are significant as it reports for the first time an outbreak the hook tip moth, *D. inconclusa* (Drepanidae) on Himalayan Dogwood, *C. capitata* (Cornaceae) from the Garhwal region of the Western Himalaya.

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