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Life history of *Eurema laeta* (Boisduval, 1836) (Lepidoptera: Pieridae) from Solan, Himachal Pradesh, India

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ABSTRACT: The life cycle of *Eurema laeta* (Boisduval, 1836) has been studied for the first time in details at Solan, Himachal Pradesh. The larvae of the species are found on the plant *Cassia pumila* Lamk. (Fabaceae: Caesalpiniaceae). The species occurs in two distinct seasonal forms. The durations and dimensions of various life history stages have been discussed besides studying the different behaviours including mating, ovipositing and mud puddling.

Keywords: *Eurema laeta*, Pieridae, life history, seasonal dimorphism, behaviour.

INTRODUCTION

Eurema laeta (Boisduval, 1836), commonly called spotless grass yellow, is a species of hills as well as plains and distributed in all over India, Nepal, Bhutan, Bangladesh, Pakistan, Sri Lanka, Myanmar (Bell, 1909; Evans, 1932; Wynter-Blyth, 1957; Varshney, 1993; Kunte, 2005; Kehimker, 2008; Singh, 2011). *Eurema laeta* has two subspecies in India: *E. laeta laeta* Boisduval, 1836 distributed in Northwestern part and *E. laeta sikkima* Moore, 1906 in eastern part of Indian Himalaya. Although, the distributional record of this species is almost known but the data on their life cycle and larval food plants has been very less described so far. Presently, this species is studied for the first time from Solan, Himachal Pradesh where its larvae have been observed to infest the *Cassia pumila* (*Chamaecrista pumila*) Lamk. (Fabaceae: Caesalpiniaceae). It is a perennial herb that is widespread in the grasslands. The detailed account of various life history stages, seasonal variations and their behaviours have been observed in the field as well as in the laboratory conditions is as below:

OBSERVATIONS ON LIFE-HISTORY STAGES

Egg (Fig. 1-b): Incubation period: 4.20 ± 0.40 days.
Length 2.12 ± 0.26 mm, width 0.46 ± 0.06 mm; spindle-shaped; singly laid in upright position on leaflet; white to light yellow in colour, later turns orangish in colour; chorion with evenly placed diffused vertical ridges; micropylar end present at the tip of the standing egg; before hatching surface of eggs turns blackish in colour.

Larva: Number of instars: 5
Larval duration: 21.5± 1.0 days
First instar (Fig. 1-c): Duration: 4.80 ± 0.08 days.
Head: Width 0.31 ± 0.04 mm; light brown in colour; hypognathous; ocelli present laterally; epicranial suture distinct; head surface smooth with long primary setae.
Body: Length 1.94 ± 0.71 mm, width 1 ± 0.02 mm; pale white to pale yellow in colour, later with time turns yellowish green in colour; slender in shape with dark green coloured alimentary canal visible through skin on dorsal side; segmentation prominent on lateral side; dorsal and lateral rows of tubercles bear long primary setae with liquid droplets at the tip.
Second instar: Duration: 4.80 ± 0.08 days.
Head: Width 1.70 ± 0.21 mm; yellowish-brown with secondary setae.
Body: Length 6.18 ± 2.11 mm, width 2.34 ± 0.34 mm; yellowish- green in appearance; thicker and wider than the first instar bearing numerous primary and secondary setae; well segmented white to yellow colour bands run laterally on the body; a mid-dorsal stripe present throughout the length of the body.
Third instar: Duration: 4.4 ± 0.37 days.
Head: Width 2.52 ± 0.02; yellowish brown to green in colour; setae shorter.
Body: Length 10.64 ± 0.90 mm, width 2.66 ± 0.30 mm; yellowish green in colour, wider with thick skin having diffused dorsal line; more number of short tertiary setae; whitish-yellow lateral bands turns broader; spiracles also distinct.

Fig. 1. *Eurema laeta*: a) Ovipositing behaviour of female on host plant b) Singly laid egg c) First instar d) Fifth instar e) Prepupa f) Pupa- one day old g) 12 days old Pupa.

Fourth instar: Duration: 5.20 ± 0.20 days.
Head: Width 3.30 ± 0.70 mm; brown to dark green in colour; rest as above.
Body: Length 13.54 ± 1.02 mm, width 3.50 ± 0.16 mm; dark leathery green in colour, more cylindrical in shape with prominent white coloured lateral bands; dispersed conical tubercles in head and body bearing short white setae.
Fifth instar (Fig. 1-d): Duration: 5.20 ± 0.20 days.
Head: Width 3.80 ± 0.14 mm; same as above.
Body: Length 16.58 ± 0.08 mm, width 3.98 ± 0.11 mm; fifth instar closely resembles to fourth instar caterpillars, same as above.
Pupa (Fig. 1-f, g): Duration 12.4 + 0.50 days.
Length 20.68 + 0.48 mm, width 5.74 + 0.4; flattened laterally with tapering head and tail; green in colour with a yellowish spiracular line, sometimes with brown or black dots; bears a loose mid girdle or band on the thorax region providing supportive function to the body; a grey coloured mid dorsal line running throughout the body; before eclosion, pupa changes its colouration from green to yellow-black.
Adult longevity: 11 + 0.89 days.
Male and female: Wings dorsally bright yellow in both sexes. Forewing apex is pointed in dry season form but round in wet season form. Wings with dark border on upperside, the inner edges of forewing border are unevenly rounded, not completely reaches to dorsum. Hindwing border narrow and reduced. Male bear brands on both the sides of hindwing. Female same as above except broader borders and brands absent.
Wing expanse: 30-45 mm
Larval host plant: *Cassia pumila* synonym *Chamaecrista pumila* Lamk. (Fabaceae: Caesalpiniaceae)

BEHAVIOUR

Ovipositing behaviour (Fig. 1-a): The female deposits an egg singly on upper surface of young leaf in mid rib region. In the months of May to October, the ovipositing is immense in the field. Before ovipositing an egg, the female slowly hovers around the host plant to find a suitable place. At times, she lands on leaf surface and touches it with abdominal tip to inspect its suitability. On finding a proper leaf, she remains on upper surface of the leaf and bends her abdomen to deposit an egg on the upper surface. Many individuals are seen egg laying at Shamti and Saproon area of Solan around 10.30 A.M. up to 3.00 P.M. It takes a few seconds to lay the eggs, within 2 minutes she laid 6-8 eggs.

Larval behaviour: Before hatching, the first instars inside the egg forms a hole at the top side of the egg so that it can easily emerge out. After hatching, the first instar larva eats the egg shell as its first meal and after that move towards the young leaf of the host plant. The caterpillars feed only on the younger leaves by making small holes on them and sometimes it eats only on the fringes of the leaflet. It has been also observed that when they do not eat the food, they remain motionless on the leaf. A few days before moulting, larva stops feeding and remains in stationary stage. During moulting time, larva casts off its skin and grows bigger in size. In each moult, they change their coloration i.e. from light green to dark green. The second and third instars feed on the apical region of the leaf including midrib whereas the fourth and fifth instar larvae eats whole of the leaf. Thus, the extent of damage to the leaves is also higher in progressing instars. In this stage the larvae consume so much food and store energy for their future development in pupal stage. To defend themselves, the larvae adopt various mechanisms for their protection from predators. They camouflage themselves with the host plant or sometimes hang by a silken thread. They also curls their body when touch with a brush or needle in laboratory conditions.
Pupation: Pupation takes place on the stem or petiolar region of the leaf. Before pupation, the caterpillar stops wandering, comes out of the leaf and remains quiescent in stage to turn into prepupa. It adopts a comma shape or 'C' shape position by weaving a silk pad around it (Fig. 1-e). At the end, the pupal body is covered with the hard covering and marked with numerous black spots all over. The whole process of changing from prepupa to pupa takes 24 hours to 30 hours. With the progressing days, pupa changes its colouration from green to yellow-black. After 12-13 days, eclosion takes place and the adult butterfly emerges from the pupal case. It has been observed that the eclosion process takes place during late morning time (10.30 A.M.) and within 25 to 45 minutes it complete the process.
Adult behaviour: The adults are weak fliers, mostly flutter closer to the ground among grasses, herbs and low bushes type of habitats. They are most active during morning time (10.30 A.M.) up to late afternoon till 3 P.M. They occasionally fly to the top of the trees. The adults were seen nectaring on small plant species of Asteraceae, Solanaceae and Fabaceae family. For thermoregulation, they adopt lateral basking. They rest by their wings folded over their backs and bask by exposing their underside wings to the sun.

In this way, they get maximum heat from the sun. The mating behaviour of male and female has also been noticed in the field in grasses at Shamti, Saproon and Ochhghat area of Solan during the month of August and September when temperature/humidity ranges between 22˚C/76% to 26˚C/ 69%. The males adopt a patrolling strategy for searching the females. After finding a suitable mate, they remain paired for more than 1 hour and after that female starts egg laying on the plant. They mostly mate in sunny time around 12 P.M. to 2 P.M. The species breed mostly in the post-monsoon season. In dry season, the females generally stop reproducing. Thus, they completed their life cycle annually. The males also show mud puddling behaviour where they gather in groups of 2-3 during to puddle, as has been observed at Shamti on 14 September (2.00 P.M., 23.4˚C/67%) and Ochhghat on 7th October (11.00 A.M., 21.7˚C/62%) respectively. During puddling, they kept their wings closed.

Seasonal variations (Fig. 2, A-D): In the present studies, the species has been found to occur in dimorphic forms. The species reared in the month of August and September from Shamti (Solan) (where temperature and humidity ranges between 22˚C/76% to 26˚C/69%) have rounded forewings with broad black termen. Inner edges of the marginal border unevenly rounded.

Fig. 2. Seasonal dimorphism in *Eurema laeta* (Boisduval, 1836). (a) Upperside wet seasonal form (b) Underside wet seasonal form (c) Upperside dry seasonal form (d) Underside dry seasonal form.

Upper hindwing have narrow terminal black border throughout its length. Underside of the forewing has a small spot at end cell. On the other hand, the species reared in late October month have pointed forewings with less broader black apex. Outer margins are sharply cut and straight. Upper hindwing have reduced border while in underside of the hindwing have two oblique brown/ pale yellow or pink coloured darker lines. The reason behind this that Solan has a temperate climate, where temperature and humidity decreases during October month (19˚C/52%) and climate becomes dry (Autumn season).

DISCUSSION

Earlier, Moore (1905-1910) had made the brief account on the immature stages of this species from India. Further, van der Poorten and van der Poorten (2013) had described its life cycle along with *Chamaecrista kleinii* and *C. mimosides* as its food plant from Sri Lanka. Although, different authors have suggested its food plant as *Cassia* sp. of Leguminosae /Fabaceae/ Papilionaceae (Moore, 1905-1910; Wynter-Blyth, 1957; Kunte, 2005; Singh, 2011) but Kehimker (2008) recorded the host plant *Cassia pumila* (Fabaceae: Caesalpiniaceae) of this species. Presently, the species *Eurema laeta* has been studied in detail for the first time from Solan on the same food plant i.e. *Cassia pumila*.

It is pertinent to record here that the species *Eurema laeta* (Boisduval, 1836) has previously been recorded as very common from hills of North-western India (Evans, 1932; Wynter-Blyth, 1957) but during present studies it has been observed that the species is not common in Solan area and its status is declining considerably. Hence, the present observations made on the life cycle, behaviour, food plant and habitat of this species will help in great way for its conservation and protecting its population from further deterioration.

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