



## Research Article

## Biology and feeding potential of *Galerucella placida* Baly (Coleoptera: Chrysomelidae), a weed biocontrol agent for *Polygonum hydropiper* Linn.

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**ABSTRACT:** *Galerucella placida* Baly is a small leaf beetle belonging to the family Chrysomelidae. which feeds on aquatic weed *Polygonum hydropiper* Linn. The insect was reported from various regions of India during 1910-1936. Investigation on some biological parameters of *G. placida* and feeding of the *P. hydropiper* by *G. placida* was conducted in laboratory. The results indicated the fecundity of *G. placida* was 710-1210 eggs per female. Eggs were markedly bright yellow, pyriform basally rounded and oval at tip. It measured 0.67 mm in length and 0.46 mm in width. Average incubation period was 3.80 days. Larvae of *G. placida* underwent three moults. The first instar larva was yellow in colour and measured 1.26 mm in length and 0.40 mm in width. The second instar was yellowish in colour but after an hour of feeding, the colour of the grub changes to blackish brown from yellow. It measured 2.64 mm in length and 0.77 mm in width. The third instar measured 5.59 mm in length and 1.96 mm in width. The average total larval duration of *G. placida* was 13.30 days. The fully developed pupa looked black in colour and measured 4.58 mm in length and 2.37 mm in width. Adult 4.50 days. The adult female was bigger than male. The adult male measured 5.60 mm in length and 2.35 mm in width and adult female measured 6.25 mm in length and 2.50 mm in width. Longevity of adult male was 35.40 days and while female was 40.40 days. Total life cycle duration of *G. placida* was completed in 21.60 days from egg to adult emergence. The damage was caused by both adult as well as grubs. At high population densities of adults and grubs, complete defoliation was seen. The average leaf area scrapped by larva and adult was 511.61 sq. cm and 866.35 sq. cm respectively.

**KEY WORDS:** *Galerucella placida*, *Polygonum hydropiper*, biology, feeding

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### INTRODUCTION

*Polygonum hydropiper* (L.) or commonly known as smartweed is a warm, wet season annual herb, occurring wherever there is moist soil or standing water. It grows on poorly drained agricultural land along creek, river, canal and stream banks, in marshes and swamps in poorly drained hollows and in seasonally flooded areas. *Polygonum hydropiper* is a competitive weed in great many crops, especially in irrigated crops, with rice and in other crops grown on poorly drained soils (Holm *et al.*, 1997). Chemical control of the weed is costly and requires long term application and has detrimental effects on non target wetland plants. In contrast, biological control is the human manipulation of non-native plant's predator in order to manage its population. Lefroy (1909) reported a chrysomelid beetle, *Galerucella placida* Baly feeding on *P. hydropiper* from India. *Galerucella placida* was noticed to feed on *P. hydro-*

*piper* voraciously killing a large population of the plant in Manipur state of India bordering Myanmar in 2011-2012 indicating its potentiality as an effective biocontrol agent (Indranisana, 2014).

### MATERIALS AND METHODS

The experiment was carried out in Central Agricultural University, Imphal during 2014 - 2015. Larva of *G. placida* feeding on *P. hydropiper* collected from unprotected field (no plant protection measures were taken up) were reared on host leaves in glass Petriplates in the laboratory for pupation upto emergence of adult beetle. The emerged adults were paired and released in potted plants in insect cages for mating and oviposition. The egg masses laid were kept in Petriplates over moist filter paper for hatching. On hatching, 20-25 neonate larvae were transferred to *P. hydropiper* leaves in glass Petriplates using a fine camel hair

brush. The leaves of *P. hydropiper* were changed every alternate day with fresh leaves till pupation. The larvae were observed daily for moulting. Pupae formed were separated out and kept in a glass Petriplates over moist filter paper till adult emergence. The adult emerged were paired and released on potted plants in insect cages for mating and oviposition. Observations were recorded for total larval duration, pupal duration, total life cycle duration (egg to adult emergence and egg to death of adult), adult longevity and fecundity from the second generation reared in laboratory. Size of egg, larva, pupa and adult of the beetle were measured under Stereoscopic binocular microscope (Karl Zeiss Stemi 2000-C). Observation on feeding were recorded by placing each leaf over a 10 x 10 grid of 2.5 cm graph paper and the number of squares eaten by larva and adult from the leaf were counted.

## RESULTS AND DISCUSSION

The eggs of *G. placida* were markedly bright yellow and pyriform (Plate-A). Their length was 0.67 mm with a range of 0.60-0.70 mm and 0.46 mm width with a range of 0.45-0.50 mm. The females laid eggs almost exclusively on the abaxial face of the leaves always in mass. The incubation period was 3.80 days with a range of 3.0-4.0 days which was found considerably shorter than those of *G. lineola* which takes about two weeks as reported by Urban (2007a & b). The fecundity of *G. placida* was very high ranging from 710-1210 eggs with an average of 911 eggs per female. Similarly, Urban (2007a & b) also reported a very high fecundity of 122-887 egg in case of chrysomelid beetle *G. lineola* F. which is similar to *G. placida*. The larvae of *G. placida* underwent three moults during their development which is similar to *G. lineola*, a related species as reported by Sadeghi *et al.* (2004). The first instar larva was light yellow in colour and head capsule was brownish (Plate-B). The first instar larva measured 1.26 mm in length and 0.40 mm in width. The second instar larva was yellow-

ish in colour in the beginning and later changed to blackish brown after feeding on the host leaf (Plate-C). The second instar larva measured 2.64 mm in length and 0.77 mm in width. The third instar larva was light yellowish in colour and became dark yellowish before pupating (Plate-D). The third instar larva measured 5.59 mm in length and 1.96 mm in width. The total larval duration was 13.30 days with a range of 13.0 -14.0 days. The fully developed pupa looked black in colour (Plate-E). The pupa measured 4.58 mm in length with a range of 4.50 mm - 4.70 mm and 2.37 mm in width with a range of 2.25-2.50 mm. Pupa was C-shaped with pupal duration of 4.50 days with a range of 4.0-5.0 days which is similar to those of *G. californiensis* L. which is 4 days (Matos and Obrycki, 2007) but comparatively less than the pupal duration of *G. lineola* which was 7-9 days (Sadeghi *et al.*, 2004). The adult female was slightly larger than the male and her body was slightly broader. The male adult measured 5.60 mm in length with a range of 5.55-5.65 mm and 2.35 mm in width with a range of 2.20-2.50 mm (Plate-F). The female adult measured 6.25 mm in length with a range of 6.00-6.50 mm and 2.50 mm in width with a range of 2.45-2.60 mm (Plate-G). Similarly, Maulik (1936) also reported length of adult beetle of *G. placida* was 5.00 mm and width of 2.5 mm. The total life cycle duration from egg to adult emergence took 21.60 days with a range of 20.50-22.50 days. The total life cycle duration from laying of egg to the death of adult male was 57.00 days and for adult female it was 62.01 days. The longevity of the adults of *G. placida* was considerably long. The adult female lived longer than those of male counterpart. The average female longevity was 40.40 days with a range of 29.0-44.0 days, while the average male longevity was 35.40 days with a range of 28.0-49.0 days. Similarly, longer longevity of female (28 days) male (17 days) of *G. birmanica* was as reported by Yadav and Gargav (1992).

The damage is caused by both adult as well as grub. The adult feed by scrapping the green tissue from the leaves

**Table 1. Biology of *Galerucella placida* on *Polygonum hydropiper***

Parameters	Mean (days) ± S.D	Range
Incubation Period (in days)	003.80 ± 000.62	03.00 – 04.00
Larval Period ( in days)	013.30 ± 000.42	13.00 – 14.00
Pupal Period ( in days)	004.50 ± 000.35	04.00 – 05.00
Total life cycle duration (Egg to adult emergence) in days	021.60 ± 00.69	20.50 – 22.50
Adult longevity (in days)		
Male	035.40 ± 007.50	28.00 – 49.00
Female	040.40 ± 008.86	29.00 – 44.00
Total life cycle duration (Egg to death of adult) in days		
Male	057.00 ± 007.26	49.00 – 71.00
Female	062.01 ± 008.68	51.50 – 79.00
Fecundity	911.30 ± 137.97	710 – 1210

Data based on 10 individuals.

from upper side and leave the epidermis. The remaining tissue soon dies, dries and falls from the plant, producing a hole. When beetles are abundant, all leaf tissue may be riddled with holes, such leaves becomes dry and turns brownish, killing the entire plant. The grub also scraps the green tissue from the leaf generally from upper surface leaving the lower epidermis. The epidermis dries up and produces holes of irregular shape (Plate-H). When the grub population is very high, the entire leaf is scrapped which later

dries up and turns brownish (Plate-I). When the population of grub is high, it causes complete drying of the plant. The number of leaf area scrapped by the larva was 511.61 sq. cm with a range of 501.12-522.10 sq. cm. However, the leaf area scrapped by the adult beetle was 866.35 sq. cm with a range of 656.00-981.50 sq. cm. during entire larval and adult period. Schooler and Mc Evoy (2006) also reported that consumption by the adult beetles of *G. pusilla* (Duft.) per day was 78 mm<sup>2</sup> when insect fed on *L. salicaria*.

**Table 2. Egg, larval, pupal and adult size of *Galerucella placida* on *Polygonum hydropiper***

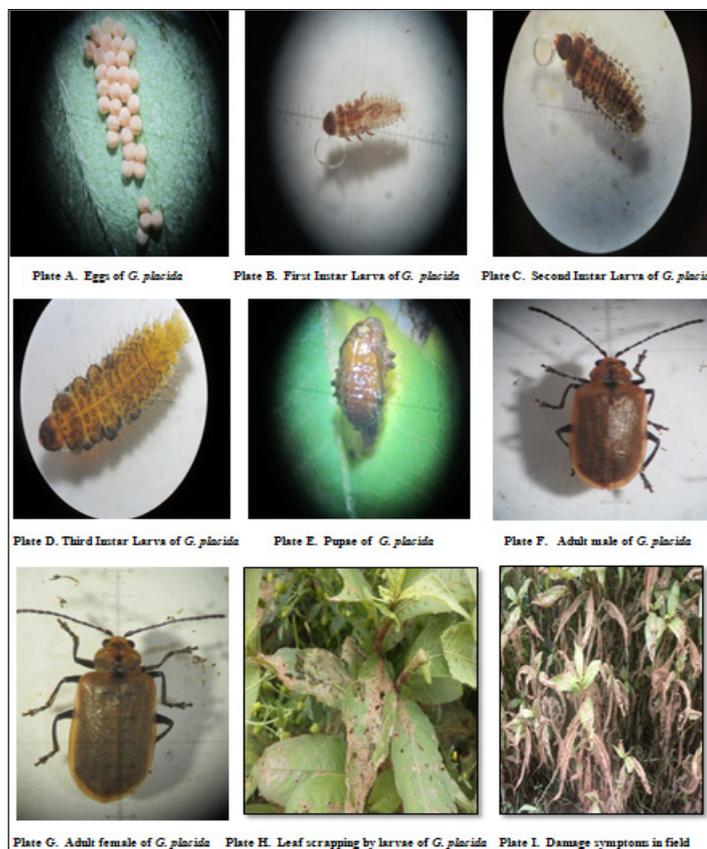
Parameters	Size in mm (Mean ± S.D)			
	Average Length	Range	Average Width	Range
Egg	0.67 ± 0.04	0.60-0.70	0.46 ± 0.02	0.45-0.50
Larva				
Instar I	1.26 ± 0.08	1.15-1.35	0.40 ± 0.06	0.30-0.49
Instar II	2.64 ± 0.27	2.25-3.00	0.77 ± 0.02	0.75-0.80
Instar III	5.59 ± 0.23	5.35-6.00	1.96 ± 0.19	1.75-2.20
Pupa	4.58 ± 0.07	4.50-4.70	2.37 ± 0.09	2.25-2.50
Adult Male	5.60 ± 0.03	5.55-5.65	2.35 ± 0.10	2.20-2.50
Adult Female	6.25 ± 0.17	6.00-6.50	2.50 ± 0.06	2.45-2.60

Data based on 10 individuals

**Table 3. Feeding response of *Galerucella placida* larva and adult on *Polygonum hydropiper***

Parameters	Mean ± S.D	Range
Leaf area scrapped by larva (in sq. cm)	511.61 ± 009.89	501.12 – 522.10
Leaf area scrapped by adult (in sq. cm)	866.35 ± 152.83	656.00 – 981.50

Data based on 10 individuals.



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