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Biology of cabbage butterfly (*Pieris brassicae* L.) on cauliflower leaves under laboratory condition

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Abstract

The study about the biology of cabbage butterfly was conducted on the Entomology laboratory of Abhilashi University, Mandi during 2021. Average duration of incubation period of egg was recorded about 4.88 ± 0.07 days. It had five larval instars. The mean duration of the first, second, third, fourth and fifth larval instar was 2.94 ± 0.03 days, 3.33 ± 0.02 days, 3.94 ± 0.03 days, 4.38 ± 0.01 days and 4.1 ± 0.03 days respectively. The mean pupal period was 11.22 ± 0.03 days and the total development period (from egg to adult emergence) was 34.71 ± 0.09 days, respectively.

Keywords: Cabbage butterfly, biology, *Pieris brassicae* L. Adult emergence

Introduction

Cauliflower (*Brassica oleracea* var. botrytis) is a most favorable winter vegetable in the India it belongs to family Brassicaceae (Singh and Sandhu 2016) [8]. India secures rank second in vegetable production after china contributing 11.4% of world's total vegetable production (Kumar *et al.* 2020) [7]. India having 452.6 thousand ha. Area under cauliflower with a production of 8668.2 thousand MT (Anonymous, 2017-2018). In India, cauliflower is commercially produced in the winter season. In Himachal Pradesh cauliflower is grown as an off season vegetable. In Himachal Pradesh total area under cauliflower is 5.56 thousand ha. With a production of 131.01 thousand MT (Anonymous 2017-2018). There are some factors which affects the production and quality of cauliflower crop i.e Insect, pest and disease. *Pieris brassicae* Linnaeus (Lepidoptera: Pieridae) is commonly known as the large white butterfly is a major pest of cauliflower (Chahil and Kular 2013) [4]. Among all the pests cabbage butterfly cause 40% loss in vegetable yield (Ali and Rizvi 2007) [2]. The freshly laid eggs were yellow in colour but slightly converted into dark yellow colour and finally turn into greyish at the time of hatching. The eggs of *P. brassicae* (L.) looks like that of maize cob. Eggs are fix to the leaf surface by brownish secretions made by the female (Bhowmik and Gupta 2017) [3]. Neonate Larvae first feed on own egg shell after that start feeding on the leaves of host plant (Singh and Sandhu 2016) [8]. Early instar larvae of cabbage butterfly feed gregariously on plant leaves but disperse out near maturity (Hasan *et al.* 2008) [35].

The adults of cabbage caterpillar are butterflies pale white in colour. The wings were white with dark brown tips on the forewings in case of both males and females. One pair of brownish black spots was present on dorsal side of each forewing of females while absent in males. Two black circular spots found on dorsal side of each forewing of female (Kumar *et al.* 2020) [7].

Material and Method

Maintenance of stock culture

The stock culture of *Pieris brassicae* (L.) was maintained in the laboratory condition on cauliflower plant grown in pots and different development stages of the pest were evaluated by the use of methodology given below:

Collection and rearing of larvae

To maintain the insect culture, grown up larvae collected from the infested fields in the nearby areas. The larvae were reared on cauliflower leaves in petri - plates. The leaves were changed daily till the larvae enter into pre-pupal stage pupation occurs on lid or walls of the petriplates. Petri - plates were cleaned daily to avoid the bacterial infection.

Rearing of adults

After pupation adults emerged was released in rearing cages containing 4-5 leaf stages of cauliflower plant grown in plastic pots for oviposition. The cotton swab dipped in (20%) sugar solution was provided as a food for adults to promote egg laying. For maintain the regular supply of the food the cotton swab was replace daily with fresh cotton swab. The egg laying of adult was observed daily on cauliflower plant till the death of the adults. Plant leaves containing the egg masses of *Pieris brassicae* (L.) were kept in petriplates over a moist filter paper for hatching and after hatching neonate larvae were provided with leaves as food. Neonate larvae were reared in plastic jars till adult formation for studying the life cycle of the pest.

Biology of cabbage butterfly (*Pieris brassicae* L.)

Different biological aspect of cabbage butterfly (*Pieris brassicae* L.) was studied in the laboratory condition on cauliflower plant at room temperature and prevailing humidity.

Duration of various stages

Observation on different development stages *i.e.* egg, larva, pupa and adult were recording by as per the detail given below:

Incubation period

Cluster of more than 50 eggs were kept under petri-plates upon the moist filter paper to prevent the eggs from desiccation. Observed the eggs cluster daily till their hatching. The period between the egg laying and their hatching was recorded as an incubation period.

Duration of each instar and total larval period

Newly hatched larvae of *P. brassicae* (L.) were reared in petri-plates 10 larvae as per replication. Cauliflower leaves provided as food for the larvae and the leaves was replaced daily with the fresh leaves. To record the different instar duration, moulting of larvae were observe daily. The duration of first instar was recorded by taken the time period between the egg hatching and the first moulting of the larvae and other instars duration was find out by taken the time between the two moults of the larvae. The total larval was period found by taking the time period between the egg hatching and the pre-pupal period.

Pre-Pupal and pupal duration

Pre-Pupal period was considered a period between the larvae stop feeding to the formation of pupa. The pupal duration was the gap between the formations of pupa to the emergence of adult.

Duration of pre oviposition, oviposition and post oviposition

Time period between the emergence of adult to the first egg laying. Oviposition period was a stage during female lays egg. Time period between the last eggs laying to the death of the female was taken as the post oviposition period.

Fecundity

Fecundity was recorded by counted the number of egg laid by the female in their life cycle.

Adult longevity and total life span: The adult longevity was recorded by taken the duration from the day in which adult emerge to their death. The period from egg laying the death of the adult was considered as total life span.

Statistical analysis

Data of each experiment were subjected to suitable statistical methods of analysis. The statistical methods followed in the experiments are Analysis of Variance (ANOVA) technique Transformation of data was done wherever necessary.

Result and Discussion

Biology of cabbage butterfly was studied under the laboratory condition on cauliflower leaves. Result obtained from laboratory experiments *i.e.*, biology of *P. brassicae* (L.) have been presented in table and discussed below:

Egg

The female cabbage butterfly laid eggs in masses both upper and lower side of leaves. The freshly laid eggs were yellowish in colour but gradually turned to dark yellow and finally greyish at the time of hatching. The shape colour eggs were sculptured like that of maize cob. Eggs were glued to the leaf surface by brownish colour secretions made by the female. The average incubation period of eggs was 4.88 ± 0.07 days which ranged from 3 to 7 days. These studies find support from the findings of Singh and Sandhu (2016) [8] reported that the incubation period was varied from 3-7 days. Bhowmik and Gupta (2017) [3] died the biology of *P. brassicae* (L.) under laboratory conditions on cabbage and reported that the incubation period varied from 3-7 days.

Larva

Immediately after hatching, the first instar larvae fed on the content of their own egg shell and then started feeding on the leaf. The developing larvae were light yellow in colour with distinct shiny black heads. The second instar larvae were greenish yellow in colour with black head and body was covered with short hairs. The third instar larvae were greenish in colour with black heads. The body was covered with black hairs on raised tubercles. There were three longitudinal yellowish lines; one dorsally and two laterally on each side. The fourth instar larvae were similar to those of the third instar larvae in appearance. The fifth instar larvae were cylindrical, robust and elongated, yellow in colour with bright colouration on their abdomen and thorax. The head was black. The longitudinal lines on the body were similar to the fourth instar larva. The body was covered with black hairs on raised tubercles.

The mean duration of the first, second, third, fourth and fifth larval instar was 2.94 ± 0.03 days, 3.33 ± 0.02 days, 3.94 ± 0.03 days, 4.38 ± 0.01 days and 4.10 ± 0.03 days which ranges from 2 to 4 days, 3 to 4 days, 3 to 5 days, 4 to 5 days and 3 to 5 days, respectively. The total duration of the larval period was 18.71 ± 0.06 days which varied from 16-22 days. The present results are partially similar with the result of Bhowmik and Gupta (2017) [3] recorded that the duration of the first, second, third, fourth and fifth in stars were ranged from 4-5 days, 4-5 days, 4-5 days, 45 days and 6-7 days, respectively. Khan and Kumar (2017) reported that the duration of the first, second, third, fourth and fifth instar larva was 3.60 days, 4.00 days, 3.40 days, 4.30 days and 5.40 days, respectively.

Pupa

Pupa was pale green or greyish white and dotted with black and yellow markings. The ventral surface was flattened. Several blunt spikes were also found on the abdomen.

The average pupal period was 11.22 ± 0.03 days which ranges from 11 to 13 days. These studies find support from the findings of Singh and Sandhu (2016) [8] reported that the pupal period was found to vary from 10-18 days. The result of present study was partially similar with the results of Bhowmik and Gupta (2017) [3] reported that the pupal period varied from 11-14 days.

Total development period

The period from egg to emergence of adult was considered as the total developmental period. The total developmental period was 34.71 ± 0.09 days which ranges from 33 to 40 days. Present studies results were similar with the findings of Bhowmik and Gapes (2017) [3] died reported that the total developmental period was found to vary for 32-39 days. Singh and Sandhu (2016) [8] reported that the total developmental period varied from 30.57 days.

Adult

The cabbage butterflies were pale white and had a smoky shade on the dorsal side of the body. The wings were white with black tips on the forewings in case of males and it was augmented in the females (which had a larger black tip) by a pair of black spots with a black smear along the inner margin below the lower spot. The undersides of both sets of wings were pale yellow, dusted with grey except for the centre and base of the forewings were white. In female, the black dots of the forewings also appeared on the undersides. The head, thorax and abdomen were black with grey hair-like scales.

The longevity of the male cabbage butterfly was 6.16 ± 0.01 days which varied from 3 to 7 days while the longevity of the female was 6.77 ± 0.07 days and it ranged from 3 to 8 days.

Ahmad *et al.* (2007) [7] recorded that the range of the male and female longevity was 49 and 6-10 days, respectively on

cabbage crop. Bhowmik and Gupta (2017) [3] reported that the average male and female longevity of cabbage butterfly was 6.80 ± 0.79 days and 6.50 ± 0.53 days, respectively on cabbage crop.

Pre-oviposition period

Adult female after emergence from the pups took some time for egg laying. This period was considered as the pre-oviposition period. The duration of the pre-oviposition period was 1.70 ± 0.01 days which ranged from 1 to 2 days. Ahmad *et al.* (2007) [7] reported that the pre-oviposition period varied from 1-2 days on cauliflower crop respectively.

Oviposition period

It is the period during which the female laid eggs. The average oviposition period was 5.70 ± 0.01 days, which ranged from 3 to 5 days. Ahmad *et al.* (2007) [7] reported that the oviposition period of cabbage butterfly varied from 3-6 days on cauliflower crop respectively.

Post-oviposition period

After completing the oviposition period, females died after few days. The period is known as the post oviposition period. The duration of the post-oviposition period was 3.70 ± 0.01 days which ranged from to 4 days (Table 61). Ahmad *et al.* (2007) [7] reported that the post-oviposition period of cabbage butterfly varied from 1-3 days on cabbage crop respectively.

Fecundity

The total number of eggs laid by female during her life time is known as the total fecundity. A female on an average laid 154.70 ± 183.00 eggs during its life span on cauliflower which ranged from 46 to 313 eggs/female Singh and Sandhu (2016) [8] reported that the fecundity/female cauliflower ranged from 114-125 eggs Bhowmik and Gupta (2017) [3] reported that a single egg mass consisted of 116 eggs on cabbage crop.

Table 1: Duration of different development stages and Reproductive parameters of *P. brassicae* L.

Stages		Range Duration (in days)	Mean±S.E
Incubation period		3-7	4.88±0.07
Duration of each instar	1 st Instar	2-4	2.94±0.03
	2 nd Instar	3-4	3.33±0.02
	3 rd Instar	3-5	3.94±0.03
	4 th Instar	4-5	4.38±0.01
	5 th Instar	3-5	4.1±0.03
Total larval period		16-22	18.71±0.06
Pupal period		11-13	11.22±0.03
Pre-oviposition period		1-2	1.7±0.01
Oviposition period		3-6	5.7±0.01
Fecundity (eggs per female per day)		46-313	154.7±183.0
Post-oviposition period		1-4	3.7±0.0
Total development period		33-40	34.71±0.09
Adult longevity	Male	3-7	6.16±0.01
	Female	3-8	6.77±0.07

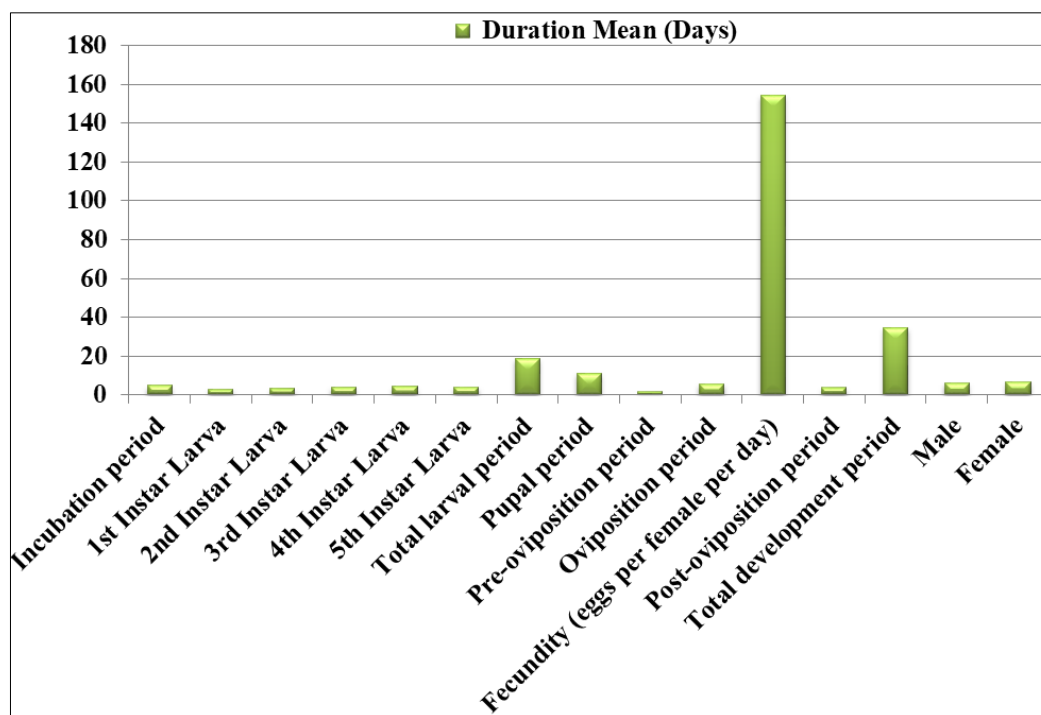


Fig 1: Duration of different development stages and Reproductive parameters of *P. brassicae* L.

Summary and conclusion

The present studies on the "Biology of cabbage butterfly (*Pieris brassica* L.) on cauliflower crop was carried out in the Laboratory of entomology in School of Agriculture Abhilashi University Chail Chowk Mandi 2021-2022. The eggs were laid in cluster, mostly on the lower surface of leaves. Freshly laid eggs were yellowish in colour. Just before hatching, the eggs turned greyish brown in colour. The incubation period was 4.88 ± 0.07 days. The newly emerged larvae were light yellow in colour with distinct shiny black heads. The second instar larvae were greenish yellow in colour with black head and the body was covered with short hairs. The third instar larvae were greenish in colour with black heads. The body was covered with black hairs on raised tubercles. The fourth instar larvae were similar to those of the third instar larvae in appearance. The fifth instar larvae were cylindrical, robust and elongated, yellow in colour with bright colouration on their abdomen and thorax. Body was covered with black hairs on raised tubercles. The duration of the first, second, third, fourth and fifth instar larvae was 2.94 ± 0.03 days, 3.33 ± 0.02 days, 3.94 ± 0.03 days, 4.38 ± 0.01 days and 4.1 ± 0.03 days, respectively. After full fed, the larvae turned into pupae. The pupa was pale green or greyish white and dotted with black and yellow markings. The duration of the pupal period was 11.22 ± 0.03 days whereas the total developmental period was 34.71 ± 0.09 days. The longevity of male and female was 6.16 ± 0.01 days and 6.77 ± 0.07 days, respectively. The pre-oviposition period was found to be 1.7 ± 0.01 days whereas the duration of oviposition and post-oviposition period was 5.7 ± 0.01 days and 3.7 ± 0.0 days, respectively.

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