

Indian Journal of Entomology Online published Ref. No. e23060

BIOLOGY OF PIERIS BRASSICAE (L.) ON CAULIFLOWER

D SHIKHA^{1*}, S K KATARIA¹ AND R S CHANDI¹

¹Department of Entomology, Punjab Agricultural University, Ludhiana 141004, Punjab, India *Email: deepshikha161198@gmail.com (corresponding author): ORICD ID 0000-0002-5873-0677

ABSTRACT

Biology of *Pieris brassicae* (L.) was studied on cauliflower under screen house conditions on main and late season crops during 2021-22 in PAU, Ludhiana, Punjab. The total lifecycle was maximum for both male (50.11 ± 1.30) and female (52.24 ± 1.27) in the main season crop and minimum in the late season crop. Survival was maximum ($27.67\pm0.04\%$) in main season crop than (25.46 ± 0.06) in late season crop due to colder climatic conditions. The maximum growth index was observed in late season crop (1.54 ± 0.14) as compared to main season crop (1.13 ± 0.09) which indicated that *P. brassicae* developed better on late season crops.

Key words: Development, *Pieris brassicae*, lifecycle, survival, main season, late season, larval survival, adult longevity, growth index, cauliflower

The large cabbage white butterfly Pieris brassicae (Lepidoptera: Pieridae) is a devastating pest on plants of the family Brassicaceae (Paul and Sohkhlet, 2012). It causes damage by feeding on all crop growth stages (Sachan and Gangwar, 1980; Lal and Ram, 2004; Khan and Kumar, 2017). It lay eggs in cluster and neonate after hatching feed gregariously but prior to feeding on leaf tissue they feed on their own egg shell (Geiselhardt et al., 2013). Among all cole crops, cauliflower (Brassica oleracea var. botrytis L.) is one of the most popular winter vegetables with yield of 19.17 mt/ ha (Anonymous, 2022). In Punjab, it was cultivated on an area of 14.97 thousand ha with a production of 279.67 mt and with an yield of 18.68 mt/ ha (Anonymous, 2022). Larvae of P. brassicae feed on all parts of plant including seeds, twigs, leaves and fruits of cauliflower (Siraj, 1999) and causes more than 40% yield loss annually in India (Ali and Rizvi, 2007). It was first recorded from Delhi in February 1996. Its high incidence is very infrequent and it is primarily a pest in mountainous regions (Bhalla et al., 1997). In severe infested crops, larvae often strip growing shoots particularly final instar and only major leaf veins are left out. Several studies on biology of P. brassicae had been carried out under diverse environmental conditions (Chahil and Kular, 2013; Ahmad et al., 2007; Aslam and Suleman, 1999; Chandel et al., 1998). These had reported that the lifecycles varied mainly depending upon the temperature, relative humidity and the host plant. However, information on biological parameters of P. brassicae on cauliflower in agroclimatic conditions of Punjab is scanty, and hence the present study.

MATERIALS AND METHODS

The life table studies of P. brassicae on cauliflower was carried out at the Entomological Research Farm, Department of Entomology, Punjab Agricultural University, Ludhiana during 2021-22. The seedlings of cauliflower were raised for natural food in the field at the spacing of 45 x 45 cm as per recommended practices (Anonymous, 2021). The collected larvae from an unsprayed field of cauliflower were reared on petri dishes (90 mm dia) containing fresh leaves which are changed or replaced every morning until pupation. When the larvae of the fifth instar were ready to pupate, they were transferred to cages which are covered properly to note the pupal survival. The individual male and female pupae were released in a cage $(60 \times 40 \text{ cm})$ with a plant in a pot for mating and egg laying. For feeding the adults, a cotton swab dipped in a 5% honey was also hung in the cage. The freshly laid eggs were collected daily. Studies were conducted on main (September-Mid December) and late season (Mid December-March). The data on mean temperature and relative humidity (RH) of microclimate inside screenhouse were obtained from the Meteorological Observatory of PAU, Ludhiana. These were September, October, November, December was 28.1, 24.3, 18.7, 13.7°C and 71, 61, 61, 62% respectively. Similarly, on late season crop during January, February, March these were 12.8, 14.8, 23.3°C and 83, 71, 63%, respectively.

Eggs collected were examined daily and newly deposited eggs on leaves were kept under observation in four petri dishes, each petri dish lined with filter paper having 25 eggs on leaves treated as one replication, to track the incubation period. Neonates after hatching were further reared in petri dishes containing cauliflower discs (4 cm dia) until pupation. For mating and egglaying, adults that emerged in petri dishes were taken to cages. Adults were given a diet of 5% honey. Similarly, duration of different larval instar duration was recorded by observing moulting daily as exuviae of all instars were easily visible with naked eyes. The observations of total durations of five larval instars, 0-24 hours old larvae were taken. Larvae were kept singly in a petri dish. Food in each petri dish was changed daily. Pupal duration was recorded from time of pupation to adult emergence in different season. The newly emerged adults were separated as female and male on the basis of morphological features for observing adult longevity. For adult longevity studies, five pairs were kept in each cage for mating and observing preoviposition, oviposition and postoviposition periods. Fecundity/ female was recorded daily till the death. The growth index value was calculated using the formula (Zhang et al., 1993). (= larval survival (%) divided by average larval duration).

RESULTS AND DISCUSSION

The biology of *P. brassicae* was studied in two seasons (main and late season) of cauliflower under screen house conditions during 2021-22. The freshly laid eggs were light yellowish but changed to dark yellow before hatching. Mean egg period was maximum for main season $(5.39 \pm 0.08 \text{ days})$ than late season crop $(4.46 \pm 0.01 \text{ days})$ as depicted in Table 1. Hasan and Ansari (2010b) reported that incubation period was 5.00 and 4.66 days on cauliflower and cabbage, respectively. Kumar et al. (2020), Hasan et al. (2008), and Sharma et al. (1999) reported incubation period of 3-6 days on cabbage. In comparison, the minimum duration was recorded on late season crop. Duration of larval stages are given in Table 1 reveal that the first and 100 Kumar et al. (2020) and Mehrkhou and Sarhozaki (2013) also reported more or less same durartion. The pupae were light yellowish having various spots and larvae stops feeding when get fully developed. Kumar et al. (2020) reported that the total pupal period was 10.95 ± 0.75 days. Hasan et al. (2008) reported showed 9.4 days on cabbage. On various Brassica species, the pupal duration ranged from 8.52 to 20.98 days (Chahil and

	Duration of (days)					
Life stage	Main season			Late season		
	Range	Mean± SE	% Survival	Range	Mean± SE	% Survival
Egg	5-6	5.39 ± 0.08	100.01 ± 0.01	4-5	4.46± 0.01	$100.01{\pm}~0.01$
Larvae						
1 st Instar	4-6	$4.95{\pm}~0.07$	$89.36{\pm}~0.06$	3-5	$4.07{\pm}~0.02$	$88.57{\pm}~0.04$
2 nd Instar	3-4	3.46 ± 0.01	$77.27{\pm}~0.04$	2-3	2.48 ± 0.02	75.78 ± 0.05
3 rd Instar	4-5	4.50 ± 0.03	$70.38{\pm}~0.05$	3-4	3.59 ± 0.01	$67.46{\pm}~0.02$
4 th Instar	4-5	$4.52{\pm}~0.09$	$66.83{\pm}0.03$	3-5	$4.04{\pm}~0.04$	$62.57{\pm}~0.06$
5 th Instar	5-6	5.42 ± 0.05	$63.65{\pm}0.06$	4-5	$4.53{\pm}~0.09$	$59.56{\pm}~0.05$
Total larval period	20-26	$22.85{\pm}~0.15$	-	15-23	$18.71{\pm}0.28$	-
Pupa	13-15	14.11 ± 0.10	$59.67{\pm}~0.04$	10-12	11.06 ± 0.12	$54.63{\pm}~0.04$
Total developmental period	38-47	$42.35{\pm}~0.63$	-	29-40	$34.23{\pm}~0.49$	-
Adult Male	7-9	7.76 ± 0.03	$28.46{\pm}~0.03$	6-8	$6.59{\pm}~0.03$	$26.56{\pm}\ 0.03$
Adult Female	8-11	9.89 ± 0.12	$27.67{\pm}~0.04$	7-10	8.22 ± 0.07	$25.46{\pm}~0.06$
Total lifecycle-male	45-56	50.11 ± 1.30	-	35-48	40.82 ± 1.17	-
Total lifecycle-female	46-58	52.24 ± 1.27	-	36-50	$42.45{\pm}1.25$	-
Preoviposition	2-3	2.82 ± 0.06	-	2-3	2.58 ± 0.04	-
Oviposition	4-5	$4.56{\pm}~0.05$	-	3-5	4.08 ± 0.11	-
Postoviposition	2-3	$2.51{\pm}0.03$	-	1-2	1.56 ± 0.05	-
Fecundity	74-166	$119.73{\pm}1.04$	-	97-275	183.59 ± 1.11	-
Growth Index	1.13 ± 0.09		-	1.54 ± 0.14		-

Table 1. Duration life stages of P. brassicae on cauliflower

*Mean of four replications; 25 individuals in each replication; (Mean± SE)

3

Kular, 2013). The pupal period ranged from 13.3-17.5 days on cauliflower, cabbage and broccoli, respectively (Mehrkhou and Sarhozaki, 2013).

The adults of *P. brassicae* are pale white. Both males and females have pale white wings with dark brown tips on the forewings. Unlike males, females have one set of dark brownish patch on the dorsal side of forearm of both wings. During 2021-22, male and female longevity on main season crop was 7.76 ± 0.03 days and $9.89\pm$ 0.12, days ranging from 8-11 days, respectively while it was 6.59 ± 0.03 and 8.22 ± 0.07 days, respectively on late season crop. Similar results were observed by Kumar et al. (2020); Hasan et al. (2008). Hasan and Ansari, (2010a) reported that female starts to oviposit after 1.26 days of the preoviposition period on cabbage and after 2 days on broccoli. The preoviposition and post-oviposition period were observed to be 2-3 days on broccoli and radish, respectively. These results agree with those of Aslam and Suleman (1999). One female could lay eggs between 32-164 eggs overall in the spring and 19 to 73 eggs overall in the winter season (Ahmad et al., 2007). Fecundity varied between 198 and 281 on cauliflower, cabbage and broccoli, respectively (Hasan and Ansari, 2010a; Gupta, 1984); and 164 eggs/ female (Atwal and Dhaliwal, 2015). The total lifecycle of P. brassicae was of maximum duration in the main season as compared to late season. With increase in temperature, the duration of lifecycle decrease. The lifecycle of both male and female was 38.5 and 39.9 days, respectively (Hasan et al., 2008). The total developmental period was significantly maximum on *B. rapa* (69.92 \pm 0.61 days) while minimum on *B*. carinata (61.95 ± 0.45 days) (Singh and Lohani, 2018). The growth index on main season crop was minimum (1.13 ± 0.09) with larval duration of 22.85 ± 0.15 days whereas on late season crop, it was maximum $(1.54\pm$ 0.14) with larval duration of 18.71 ± 0.28 days.

ACKNOWLEDGEMENTS

The authors thank the Professor and Head, Department of Entomology and Dean PGS, College of Agriculture, Punjab Agricultural University, Ludhiana for providing necessary facilities and permissions.

AUTHOR CONTRIBUTION STATEMENT

RSC designed the research. DS conducted experiments, wrote the manuscript and analysed the data, RSC and SSK contributed in writing and editing the manuscript. All authors read and approved the manuscript.

FINANCIAL SUPPORT

No external funding was received.

CONFLICT OF INTEREST

No conflict of interest.

REFERENCES

- Ahmad H, Shankar U, Monobrullah M, Kaul V, Singh S. 2007. Bionomics of cabbage butterfly, *Pieris brassicae* (Linn.) on cabbage. Annals of Plant Protection Sciences 15: 47-52.
- Ali A, Rizvi P Q. 2007. Developmental response of cabbage butterfly, *Pieris brassicae* L. (Lepidoptera: Pieridae) on different cole crops under laboratory and field conditions. Asian Journal of Plant Sciences 6: 1241-1245.
- Anonymous. 2021. Package of practices of cultivation of vegetable crops. Punjab Agricultural University, Ludhiana. pp.1-2.
- Aslam M, Suleman N. 1999. Biology of *Pieris brassicae* (L.) (Lepidoptera: Pieridae) under laboratory conditions. Pakistan Journal of Biological Sciences 2: 199-200.
- Atwal A S, Dhaliwal G S. 2015. Agricultural pests of South Asia and their management. Eighth edition, Kalyani Publishers, Ludhiana. pp. 452.
- Belbase P, Bc L. 2020. Effects of different fertilizers on yield and vitamin C content of cauliflower (*Brassica oleracea* var. *botrytis*) A review. Asian Journal of Agricultural and Horticultural Research 6(4): 37-46.
- Chahil G S, Kular J S. 2013. Biology of *Pieris brassicae* (L.) on different *Brassica* species in the plains of Punjab. Journal of Plant Protection Research 53: 53-59.
- Firake D M, Lytan D, Behere G T, Thakur N S A. 2012. Host plants alter the reproductive behavior of *Pieris brassicae* (Lepidoptera: Pieridae) and its solitary larval endo-parasitoid, *Hyposoter ebeninus* (Hymenoptera: Ichneumonidae) in a cruciferous ecosystem. Florida Entomologist 95: 905-913.
- Geiselhardt S, Yoneya K, Blenn B, Dreschler N, Gershenzon J, Kunze R, Hilker M. 2013. Egg laying of cabbage white butterfly on *Arabidopsis thaliana* affects subsequent performance of the larvae. PLoS One 8(3): e59661.
- Gupta P. 1984. Bionomics of the cabbage butterfly, *Pieris brassicae* (L.) in mid hills of Himachal Pradesh. Himachal Journal of Agricultural Research 10: 49-54.
- Hasan F, Ansari M S. 2010a. Effect of different cole crops on the biological parameters of *Pieris brassicae* (L.) (Lepidoptera: Pieridae) under laboratory conditions. Journal of Crop Sciences and Biotechnology 13(3): 195-202.
- Hasan F, Ansari M S. 2010b. Population growth of *Pieris brassicae* (L.) (Lepidoptera: Pieridae) on different cole crops under laboratory conditions. Journal of Pest Sciences 84: 179-186.
- Hasan W, Gupta A K, Singh C P. 2008. Biology of cabbage butterfly, *Pieris brassicae* (L.) (Lepidoptera: Pieridae) on cabbage and Indian mustard. Journal of Oil Research 25: 104-105.
- Khan H H, Kumar A. 2017. Effect of certain chemicals and bio-pesticide on the third instar larvae of the cabbage butterfly, *P. brassicae* (L.) (Lepidoptera: Pieridae). Journal of Entomology and Zoological Studies 5: 753-755.
- Kumar P, Brar J S, Singh G. 2020. Life cycle of cabbage caterpillar,

Pieris brassicae (Linn.) (Lepidoptera: Pieridae) on cabbage leaves in Talwandi Sabo (Punjab). Journal of Entomology and Zoological Studies 8(4): 766-769.

- Kumar S. 2012. Cotesia glomerata (Hymenoptera: Braconidae): A potential biocontrol agent for large white butterfly, *Pieris brassicae* (Lepidoptera: Pieridae). Journal of Entomology 9: 171-177.
- Lal M N, Ram B. 2004. Cabbage butterfly, *Pieris brassicae*, an upcoming menace for Brassicae oilseed crop in Northern India. Cruciferae Newsletter 25: 83-86.
- Mehrkhou F, Sarhozaki M T. 2013. Life table parameters of large white butterfly *Pieris brassicae* (Lepidoptera: Pieridae) on different cabbage varieties. Archives of Phytopathology and Plant Protection 47: 1444-1453.
- Paul D, Sohkhlet M D. 2012. Anti-feedant, repellent and growth regulatory effects of four plant extracts on *Pieris brassicae* larvae (Lepidoptera: Pieridae). Journal of Entomological Research 36(4): 287-293.

Sachan J N, Gangwar S K. 1980. Vertical distribution of important pest

of cole crop in Meghalaya as influenced by the environment factors. Indian Journal of Entomology 42: 414-421.

- Sharma R, Sheikher C, Sharma K C. 1999. Developmental biology of cabbage butterfly (*Pieris brassicae*) (Lepidoptera: Pieridae). Indian Journal of Agricultural Sciences 69: 755-756.
- Singh M, Lohani H P. 2018. Biology of *Pieris brassicae* on different brassica species in kumaun himalaya. Perspectives of Biodiversity in India 4: 170-172.
- Siraj Q. 1999. Chemical control and estimation of losses caused by *Pieris brassicae* on cauliflower (seed crop) in Swat. M Sc Thesis, NWFP Agriculture University, Peshawar, Pakistan.
- Thakur J, Kumar P, Mohit. 2018. Studies on conjoint application of nutrient sources and PGPR on growth, yield, quality and economics of cauliflower (*Brassica oleracea* var. *botrytis* L.). Journal of Plant Nutrition 41: 1862-1867.
- Zhang M, Chaudhuri S K, Kubo I. 1993. Quantification of insect growth and its use in screening of naturally occurring insect control agents. Journal of Chemical Ecology 19(6): 1109-1118.

(Manuscript Received: January, 2023; Revised: September, 2023; Accepted: September, 2023; Online Published: September, 2023) Online First in www.entosocindia.org and indianentomology.org Ref. No. e23060