

STUDIES ON FOOD PREFERENCE, CONSUMPTION AND UTILIZATION OF COLE CROPS BY *PIERIS BRASSICAE* LINNAEUS

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ABSTRACT

The cabbage butterfly, *Peiris brassicae* Linnaeus, is a predominant pest of cole crops. Observations on the relative acceptability of cole crops viz., cabbage, cauliflower and knolkol revealed that cabbage was a better host in terms of nutrition and relative growth. Based on consumption index, growth rate, efficiency of conversion of ingested food and approximate digestibility, cauliflower appeared to be more acceptable than the other two cole crops, but cabbage appeared to be preferred based on susceptibility and extent of damage.

INTRODUCTION

The cabbage butterfly, *Pieris brassicae* Linnaeus, is a serious pest of cruciferous crops and is widely distributed in many parts of the world. This is the most destructive pest of cole crops (cabbage, cauliflower and knoll-knol) in the entire north eastern hill region of India and causes 20 to 100% damages to these crops (Sachan and Gangwar 1990). Since the cabbage butterfly has a wide host range, it is essential to know its' food preferences.

MATERIALS AND METHODS

An experiment was conducted during 1995 and 1996 at ICAR Complex, Entomology Division, Barapani to study food preference, freshly laid eggs were collected from the field and held with leaves in sterilized petri dishes (9.5 x 1 cm) in the laboratory for egg hatch. Neonate caterpillars were used for experiments with food plants, each having five replications. The duration of larval, pupal and adult stages was recorded. Neonate caterpillars to be tested on indicated host plants were weighed on Sartorius balance (Electronic top loaders, Model 1264 MP, 1265 MP, Germany). Larvae were provided, with pre-weighed fresh and tender leaves of cabbage, cauliflower and knol-knol to feed *ad libitum*. The weight of leaves provided and weight of the uneaten portion was recorded to estimate the ration of food consumed. Leaf area before and after feeding was measured with the help of a leaf are meter (Model CI-251, USA) to determine leaf tissue consumed by a single larva. The parameters of consumption and utilization were calculated using methods of Waldbauer (1968).

Consumption Index (C1) = $C1 = F / TA$

F = Fresh weight of food eaten

T = Duration of feeding period (Days)

A = Mean fresh weight of animal during feeding period.

Growth rate (GR) or the relative growth rate

$$GR = G / TA$$

G = Fresh weight gain of animal during feeding period

T = Duration of feeding period (Days)

A = Mean fresh weight of animal during the feeding period.

Conversion of ingested food or the efficiency of conversion of ingested food to body substance (ECI)

$$ECI = \text{Wt. Gained} / \text{Wt. Food ingested}$$

$$ECI = G. R. / C. I.$$

Digestibility or the approximate digestibility (A.D.)

$$AD = \frac{\text{Wt. of food ingested} - \text{Wt of feces}}{\text{Wt. of food ingested.}} \times 100$$

The loss in plant tissue weight due to desiccation was also taken into account by holding fresh leaves separately without larvae.

$$\text{Corrected Wt. of food eaten} = [1a / 2] [W - (L + b1)]$$

W = Wt. of food introduced

L = Wt. of food uneaten

Natural loss of food was obtained by correction factor as ratio to the food of the aliquot (a) and as the ratio of loss to the final weight of aliquot (b) after consumption.

RESULTS AND DISCUSSION

The total larval developmental period was 21.1 days on cabbage, 20.1 days on knoll-khol and 19.5 days on cauliflower. Larval weight, length and width were 499 mg, and 39.9 mm 5.8 mm, respectively. The weight, length and breadth larvae reared on cabbage were 489 mg, 39.9 mm and 5.6 mm when feed cauliflower, and 454 mg, 39.2 mm and 5.6 mm when fed on knoll-khol. Average weight of leaves consumed and average leaf area consumed larvae were 36.1 g and 88.6 cm² respectively, for cabbage 36.1 g and 80.9 cm² for cauliflower and 3.5g and 7.5 g and 75.8 cm² for knoll-khol (Table 1).

The mean consumption indices (CI) of *P. brassicae* calculated for the five instars on cabbage, cauliflower and knoll-khol were 1.20, 1.21 and 1.09, respectively indicating the greater feeding rate on cauliflower followed by cabbage and knoll-khol (Table 2). The growth rates (GR) the larvae fed on cabbage, cauliflower and knoll-khol were almost similar.

Efficiency of conversion of ingested food (ECI) appeared to fluctuate based on approximate AD. The mean ECI was highest (53.8) for larvae fed on Cauliflower and was lowest (51.6) on knoll-khol. Accordingly, AD was higher (31.0) for insect fed on cauliflower and lowest (27.2) for insect fed on knoll-khol.

Adults, from larvae fed on cabbage were heavier (62.2 mg) than those from knoll-khol

(68.8mg) and cauliflower (66.6 mg). Similarly, the pupae obtained from cabbage were heavier (498.6 mg) compared to those emerged from cauliflower (488.8 mg) whereas the pupae obtained from knoll-khol fed larvae were lightest (454 mg). Similarly, the length and width of adult *Pieris brassicae* were observed to be larger when fed on cabbage and smaller when fed on cauliflower. The adults were found to be smallest in size when larvae were fed on knoll-khol.

In general, there was a decline in CI and GR from first to fifth instars, whereas there was gradual increase in ECI and AD from first to fourth instars. A decline in ECI and AD values was recorded in the last instars on each food host. The results indicate that the cabbage crop is a better host in terms of nutrition and relative growth to *Pieris brassicae* larvae than cauliflower and knoll-khol. *P. brassicae* larvae that were reared on cabbage took 21.1 days and 19.5 days on cauliflower for development. But the total development in terms of weight, length and width was found higher (498 mg 39.9 mm and 58 mm, respectively) when fed on cabbage and it was lowest (454 mg, 39.2 and 58mm) when fed on knoll-khol plants.

Johanson (1951) reported that *P. brassicae* larvae preferred cabbage to the other plant.

It was observed that a single caterpillar could consume the maximum weight (36.1 g) and area (80.9 cm²) of cauliflower leaves throughout its life time followed by cabbage (36.1 g and 88.6 cm²) and the lowest (33.5 g and 75.8 cm²) knoll-khol. Contrary to these findings, Moiseeva (1984) reported that a single larva consumed 74-80 cm² of cabbage leaf tissue of which 85.9% being eaten in the fifth instar alone. These findings were in close conformity with the present results of 80.9 cm² cauliflower leaf tissue eaten by single larva of which 40.1% being eaten in the fifth instar alone. Lu et al. (1986) estimated that the cauliflower leaf area consumed by a single larva in its life time was about 50.6 cm², of which the average leaf area eaten by the fifth instar larvae was about 85%. It was clear that maximum nutritional need of a larval life was during the fourth and fifth instars but it was also observed that cabbage was the best nutritious food crop under hill conditions.

In the present investigation, the consumption index (CI) for the total larval period was found to be 5.98, 6.03, and 5.47 in I, II & III, respectively. Gangwar and Singh (1989) reported CI 5.99 and 6.63 in I & II, respectively, which were in conformity with the present study. The CI during the larval instars found decreased in the third and fourth instar but slightly increased in the fifth instar in all three food plants on which *Pieris* larvae were reared in laboratory conditions and these results were similar to the studies of Gangwar and Singh (1989).

Relative growth rate (GR) of *Pieris* larvae recorded was 0.98, 1.04 and 0.92 on I, II & III, respectively while within the larval instars it was found that GR gradually decreased from first to fifth instar. However, within the larval instars it was found that ECI increased from first to fourth instars but decreased in the fifth instar on all the three crops studies. The approximate digestibility (AD) was observed to be 149.51 on cabbage, 155.02 on cauliflower and 135.80 on knoll-khol leaves, while within the larval instars in all the three crops. AD was increased from I-IV instars and then decreased at the end of fifth instar larval stage. CI was found slightly increased in the fifth instar. These observations were also supported by the findings of Gangwar and Singh (1987). In the present study, the GR was found decreased in the subsequent instars while ECI and AD increased from I-IV instars and decreased in the fifth instar. Gangwar and Singh (1980) pointed out that GR was higher (0.27 mg) on cauliflower than cabbage (0.20) which was similar to the present findings of 0.21 and 0.20 mg. Gupta and Maleyvar (1981)

determined that CI and GR declined with age but EI and AD increased in early instars but decreased in the latter instars. This was in close conformity with the findings of the present work. Therefore, it could be concluded that in terms of ECI, CI, GR and AD estimation, the higher acceptability although appeared to be towards cauliflower but from susceptibility and extent of damage points of view cabbage appeared to be preferred crop over the two other cole crops studies.

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Table : 1. Food preference and feeding rate of various larval instars of *P. brassicae* on cabbage (1).
Cauliflower (II) and knol-khol (III) at Barapani

Stages	Duration (days)			*Av. Larval Weight (mg)			Av. Larval length (mm)			Av. Larval width (mm)			Av. Leaf Consumption/ larva (g)			Av. Leaf consumed per larvae (cm ²)		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Hatching	6.2	6.5	6.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Period	-	-	-	0.2	0.2	0.2	2.98	2.95	2.90	0.35	0.40	0.42	-	-	-	-	-	-
Neonates	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Instars	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I	4.8	4.5	4.6	0.5	0.5	0.5	3.7	3.4	3.5	0.6	0.6	0.6	0.9	0.9	0.8	1.8	1.6	1.2
II	4.6	4.2	4.4	2.6	2.5	2.4	7.3	6.2	4.9	1.1	1.0	0.7	1.6	1.5	1.4	4.7	4.3	3.9
III	4.2	4.0	4.1	2.92	2.81	2.60	16.9	16.1	16.5	2.3	2.3	2.2	5.8	5.8	5.6	18.2	16.6	15.0
IV	4.3	3.8	4.0	3.08.3	2.98.5	2.23.3	32.5	31.9	32.1	4.4	4.2	4.1	13.9	13.5	13.4	30.9	27.9	26.8
V	3.2	3.0	3.0	4.98.6	4.88.8	4.54.0	39.91	39.9	39.2	6.8.8	5.6	5.6	14.4	14.3	14.2	32.9	29.4	28.8
Larval	21.1	19.5	20.1	-	-	-	-	-	-	-	-	-	39.1	36.1	33.5	88.6	80.9	75.8
Period	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pupal period	15.7	16.1	15.9	4.28.4	4.2.8	4.20.5	2.63	2.5.8	2.5.9	6.9	6.7	6.8	-	-	-	-	-	-
Total	43.0	42.1	42.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Life Cycle Imagos	0	-	-	6.92	6.6.6	6.8.8	22.5	22.1*	22.3	6.8.9	6.8.4	6.9.2**	-	-	-	-	-	-
	+	-	-	6.94	6.7.1	6.9.1	23.1	22.8	22.9.8	7.0.9	7.1.1	7.0.7	-	-	-	-	-	-

Sex ratio 1.0 : 1.04

● Average based on 50 larvae,

* Body length of adult,

** Width across the wings of adult

Table 2. Consumption and utilization of cabbage (1), cauliflower (ii), and knoll-khol (iii) by *P. brassicae* (L) Larvae.

Growth parameter	Larval instars					Total	Mean
	I	II	III	IV	V		
Consumption Index							
I	1.59	1.23	1.05	0.98	1.14	5.98	1.20
II	1.37	1.29	1.16	0.98	1.23	6.06	1.21
III	1.33	1.15	1.01	0.97	0.01	5.47	1.09
Growth Rate (GR)							
I	0.23	0.22	0.28	0.18	0.13	0.98	0.20
II	0.24	.23	0.22	0.19	0.16	1.04	0.21
III	0.21	0.20	0.21	0.18	0.13	0.92	0.19
Efficiency of							
I	15.07	36.55	53.60	83.40	72.40	261.02	52.2
II	18.77	37.31	55.20	84.10	72.60	268.99	53.80
III	14.63	35.68	53.20	83.00	71.00	257.99	51.60
Conversion ingested							
I	13.25	15.07	19.91	55.60	45.68	149.51	29.90
II	13.46	18.77	20.28	55.20	47.31	150.02	31.00
III	12.09	14.63	19.33	53.20	36.55	135.80	27.20
Digestibility (AD)							