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Biology of Castor Semilooper *Achaea janata* Linn. on Different Genotypes of Castor with Different Blooms

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ABSTRACT

A laboratory experiment was conducted during kharif, 2017 at Insectary, Department of Entomology, Agricultural college to study the biology of castor semilooper A. janata on castor varieties with different blooms. The Longest larval duration, adult longevity, total life cycle with more larval weights and fecundity of A. janata were observed when reared on DPC-9 (14.42 ±0.87 days; 13.15±0.93 days; 40.77 ± 01.52 days and 1.253 ± 0.129 g; 316.5 ± 20.07 eggs, respectively), indicating DPC-9 as the most preferred variety for growth and multiplication of A. janata followed by DCH-177 (14.25 ±0.81 days; 13.00 ±0.72 days; 40.70 ±01.17 days and 1.202 ± 0.090 g; 276.5 ± 35.19 eggs, respectively). The Shortest larval duration, adult longevity, total life cycle with less larval weight and fecundity of A. janata were observed when reared on GCH-4 (12.42 ±0.81 days; 12.75 ±0.73 days; 36.47 ±03.21 days and 0.925 ± 0.218 g; 234.25 ±20.27 eggs, respectively) followed by DCH-519 (12.50 ±0.58 days; 12.65 ±0.58 days; 37.15 ±01.25 days and 1.191 ± 0.095 g; 231.0 ± 13.16 eggs, respectively), indicating least preferred hosts for growth and multiplication of A. janata. The present investigation revealed that triple bloom varieties viz., DCH-59 (Green triple bloom) and GCH-4 (Red triple bloom) could be ranked as poor or non-preferred host for growth and multiplication of A. janata. Whereas, DPC-9 (Green zero bloom) and DCH-177 (Red single bloom) could be ranked as good or preferred host for growth and multiplication of A. janata.

***Key words**: Biology, Castor semilooper, Achaea janata*

INTRODUCTION

Castor is one of the most important commercial crops of the country. At present, Gujarat alone contributes around 80 per cent of area and production of castor in the country. In Gujarat, castor occupied about 5.65 lakh ha area in 2016-17 and production was estimated about 8.61 lakh million tonnes against 7.81 lakh ha area and 11.73 lakh million tonnes production in 2015-16 (castor seed market analysis and outlook, 2017). The other major castor growing states are Andhra Pradesh, Rajasthan, Tamilnadu, Maharastra, Karnataka and Orissa (DOR, 2003).

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Cultivation of high yielding varieties of this crop under input-intensive conditions resulted in increased vulnerability to a multitude of insect pests at all phenological stages which includes seedling pests, foliage feeders and inflorescence pests. The defoliators includes Red hairy caterpillar, *Amsacta albistriga* (Walker) in endemic areas, castor semilooper, *Achaea janata* (Linnaeus); tobacco caterpillar, *Spodoptera litura* (Fabricius) and other hairy caterpillars, and sucking pests, such as jassid, *Amrasca biguttula biguttula* (Ishida); whitefly, *Trialeurodes ricini* (Misra); thrips, *Retithrips syriacus* (Mayet) and mites, *Tetranychus telarius* (Linnaeus) cause huge damage to castor crop. Yield loss estimates indicate a reduction of seed yield up to 35-50 per cent depending on the crop growth stage and the pest outbreak (Sujatha *et al*., 2011).

Castor semilooper, *A. janata* is an endemic and key defoliator pest of castor in different countries and is distributed from India to Hawaii and Eastern Island and from Formosa to New Zealand. It is a problematic pest of castor in the rainfed castor belts of Southern India and is also known to occur regularly throughout the country wherever the crop is grown. It acts as defoliator and under severe infestations completely devour the green foliage, leaving only the veins and enforce the farmers to re-sow the crop. It causes yield reduction to the extent of 20 to 23 per cent (Gaikwad and Balipate, 1992; Basappa and Lingappa, 2001).

The chemical control of insect pests is often expensive and prohibitive to majority of the farmers. Use of resistant varieties is the most economical approach and would become inexpensive in the long run. Incorporation of resistant plant genotypes into integrated pest control system minimizes the number of insecticide applications and conserves the natural enemies besides preserving the environmental safety. Keeping this point in a view an attempt is made to study the biology of *A. janata* on different varieties of castor with different blooms inorder to evaluate the resistance genotypes/varieties.

MATERIAL AND METHODS

Host plants

The biology of *A. janata* was studied on six varieties of castor with different blooms *viz*., DPC-9 (Green zero), DCH-177 (Red single), PCH-111 (Green double), 48-1 (Red double), DCH-519 (Green triple), GCH-4 (Red triple) during *kharif* 2016 from August onwards under laboratory conditions at 28 ± 2˚C temperature and 75-80 per cent RH. A total of four replications were maintained in all six castor varieties throughout the biology studies. Leaves from these castor varieties at peak vegetative stage were used in the experiments. Staggered planting of castor varieties was done for continuous supply of leaves during the period of experimentation. The second or third opened fresh leaves in all castor varieties at peak vegetative stage were used to study the biology of *A. janata*.

Insect culture

The stock culture of *A. janata* was maintained in the Insectary, Department of Entomology, S.V. Agricultural College, ANGRAU, Tirupati, Andhra Pradesh. Adults of *A. janata* were collected from nearby fields and released into oviposition cages of size 46 x 46 x 70 cm and provided with castor leaves regularly and old leaves were replaced with fresh leaves for every 12 hours. The leaves with the eggs were collected and kept in separate rearing boxes of size 24.5 x 24.5 x 24.5 cm. Once the larvae hatched fresh leaves were provided as and when required and the boxes were cleaned regularly to keep a healthy stock culture. Pupae formed from the stock culture were collected and kept in separate boxes. Adults emerging from these pupae were released into oviposition cages and provided with leaves of castor leaves for oviposition. The first instars emerging from these stock culture were used for all the experiments in the present investigation.

Experimentation

Fresh leaves were taken in glass Petri plates of 9 cm diameter lined with moist blotting paper. The neonate larvae at the rate of one per Petri plate was released. Thus a total of 20 larvae were released for each variety. Fresh leaves were provided regularly for every 12 hours. All the developmental characters of *A. janata* were studied under binocular microscope (MAGNUS Stereoscopic binocular microscope Model MS 24 Alpha with objective (2x & 4x) and eyepiece 10x having with in-built Light Stand (Incident: 6v15W Lamp/ Transmitted: 5W Fluorescence Lamp). Observations were taken at every 12 hours, on moulting, change in instars, larval durations, pupal duration, adult longevity and adult fecundity. The mean of all the records of four replicates were taken during the entire period of observation on each variety were considered for statistical analysis.

RESULTS AND DISCUSSION

The observations on numbers of larval instars, their durations and larval period are presented in the Table-1. It revealed that larval stages of *A. janata* passed through five instars, before transforming to pupal stage. The first instar took 2.0 days to become second instar on all castor varieties with different blooms (Table-1).

The duration of second instar larva ranged from 2.00 to 2.07 days. The longest duration was observed on DCH-177 (2.07± 0.18 days) followed by PCH-111 (2.05±0.15 days) and the shortest duration was observed on DPC-9 followed by 48-1, DCH-519 and GCH-4 (2.00 ±0.00 days) (Table-1).

The duration of third instar of *A.janata* varied from 2.07 to 2.42 days. The longest duration was observed on 48-1 (2.42 ±0.18 days) followed by DPC-9 (2.40 ± 0.20 days) and shortest duration was observed on DCH-519 (2.07 ±0.18 days) followed by GCH-4 (2.12 ±0.22 days), DCH-177 (2.17 ±0.24 days), PCH-111(2.2 ±0.25 days) (Table-1).

The duration of fourth instar of *A. janata* varied from 1.95 to 2.45 days. The longest duration was observed on DCH-177 (2.47 ±0.45 days) followed by DPC-9 (2.37 ±0.66 days), 48-1 (2.37 ±0.66 days) and PCH-111 (2.32 ±0.54 days) and the shortest durations were observed on GCH-4 (1.95 ±0.35 days) followed by DCH-519 (1.97 ±037 days) (Table-1).

The duration of fifth larval instar varied from 2.35 -3.65 days. Longest durations were observed on DPC-9 (3.65 ±0.48 days) followed by DCH-177 (3.55 ±0.51 days), PCH-111 (3.35 ±0.48 days) and 48-1 (2.55 ±0.51 days) and the shortest durations were observed on GCH-4 (2.35 ±0.48 days) followed by DCH-519 (2.45 ±0.51 days) (Table-1).

The total larval duration of *A. janata* in the present investigation ranged from 12.42 to 14.42 days. The longest total larval duration was observed on DPC-9 (14.42 ±0.87 days) followed by DCH-177 (14.25 ±0.81 days) and PCH-111 (13.92 ±0.78 days), 48-1 (13.35 ±1.13 days) and the shortest durations were observed on GCH-4 (12.42 ±0.81 days) followed by DCH-519 (12.50 ±0.58 days) (Table-1).

Tabe 1. Larval developmental periods (days) of *A. janata* reared on excised leaves of castor varieties with different blooms.

Genotypes	First instar (Mean± SD)	Second instar (Mean± SD)	Third instar (Mean± SD)	Fourth instar (Mean± SD)	Fifth instar (Mean± SD)	Total larval durations (Mean± SD)
DPC-9	$2.00^{a} \pm 0.00$	$2.00^{b} \pm 0.00$	$2.40^{a} \pm 0.20$	$2.37^{a} \pm 0.66$	$3.65^{a} \pm 0.48$	$14.42^{a} \pm 0.87$
DCH-177	$2.00^{a} \pm 0.00$	$2.07^{a} \pm 0.18$	$2.17^{b} \pm 0.24$	$2.45^{a} \pm 0.45$	$3.55^{a} \pm 0.51$	$14.25^{a} \pm 0.81$
PCH-111	$2.00^{a} \pm 0.00$	$2.05^{ab} \pm 0.15$	$2.20^{b} \pm 0.25$	$2.32^{a} \pm 0.54$	$3.35^{a} \pm 0.48$	$13.92^{a} \pm 0.78$
48-1	$2.00^{a} \pm 0.00$	$2.00^{b} \pm 0.00$	$2.42^{a} \pm 0.18$	$2.37^{a} \pm 0.66$	$2.55^{b} \pm 0.51$	$13.35^{b} \pm 1.13$
DCH-519	$2.00^{a} \pm 0.00$	$2.00^{b} \pm 0.00$	$2.07^{b} \pm 0.18$	$1.97^{b} \pm 0.37$	$2.45^{b} \pm 0.51$	$12.50^{c} \pm 0.58$
GCH-4	$2.00^{a} \pm 0.00$	$2.00^{b} \pm 0.00$	$2.12^{b} \pm 0.22$	$1.95^{b} \pm 0.35$	$2.35^{b} \pm 0.48$	$12.42^{c} \pm 0.81$
LSD at 0.05 %	0.00	0.066	0.147	0.357	0.339	0.577

- Values followed by same letter are not significantly different at 0.05 level as per LSD
- Values in the parenthesis are angular transformed value

The significant differences were found in pupal durations and weights of *A. janata* reared on all six castor varieties. The longest pupal period was observed on DCH-177 (13.45 ±0.68 days) followed by DPC-9 (13.20 ±0.69 days), PCH-111(12.85 ±0.81 days) and 48-1(12.60 ±0.94 days) and the shortest durations were observed on GCH-4 (11.94 ±0.84 days) and DCH-519 (12.00 ±0.79 days). Whereas, the weight of pupae was more on DPC-9 (0.838±0.033 gm) followed by DCH-177 (0.827±0.023 gm), PCH-111 (0.825±0.060 gm) and 48-1 (0.801±0.025 gm) and the least weight of pupa was observed on GCH-4 (0.778±0.055 gm) followed by DCH-519 (0.781±0.036 gm) (Table-2).

During post-larval developmental periods, the adult longevity of *A. janata* varied from 12.65 to 13.15 days. The longest adult longevity was observed on DPC-9 (13.15±0.93 days) followed by DCH-177 (13.00±0.72 days), PCH-111 (12.95 ±0.88 days) and the shortest durations were observed on 48-1 (12.65 ±0.58 days), DCH-519 (12.65 ±0.58 days) followed by GCH-4 (12.75 ±0.73 days). Whereas total life cycle ranged from 37.15 to 40.77 days, the longest total life cycle duration was observed on DPC-9 (40.77 ±1.52 days) followed by DCH-177 (40.70 ±1.17 days) PCH-111 (39.72 ±1.62 days),48-1 (38.6 ± 1.78 days) and the shortest duration of total life cycle was observed on GCH-4 (36.47 ±3.21 days) followed by DCH-519 (37.15 ±1.25 days) (Table-2).

Tabe 2. Post larval developmental periods (days) and pupal weight (g) of *A. janata* reared on excised leaves of castor varieties with different blooms

Genotypes	Pupal period (days) (Mean± SD)	Pupal weight (g) (Mean± SD)	Adult longevity (days) (Mean± SD)	Total life cycle (days) (Mean± SD)
DPC-9	$13.20^{ab} \pm 0.69$	$0.839^{a} \pm 0.033$	$13.15^{a} \pm 0.93$	$40.77^{a} \pm 1.52$
DCH-177	$13.45^{a} \pm 0.68$	$0.828^{a} \pm 0.023$	$13.00^{ab} \pm 0.72$	$40.70^{a} \pm 1.17$
PCH-111	$12.85^{bc} \pm 0.81$	$0.825^{ab} \pm 0.060$	$12.95^{ab} \pm 0.88$	$39.72^{ab} \pm 1.62$
48-1	$12.60^{c} \pm 0.94$	$0.801^{abc} \pm 0.025$	$12.65^{b} \pm 0.58$	$38.60^{b} \pm 1.78$
DCH-519	$12.00^{d} \pm 0.79$	$0.781^{bc} \pm 0.036$	$12.65^{b} \pm 0.58$	$37.15^{c} \pm 1.25$
GCH-4	$11.94^{de} \pm 0.84$	$0.778^{c} \pm 0.055$	$12.70^{ab} \pm 0.73$	$36.47^{cd} \pm 3.21$
LSD at 0.05 %	0.543	0.047	0.511	1.28

Fecundity experimentation of *A. janata*

The adults of *A. janata* laid eggs singly on the abaxial and adaxial surfaces of castor leaves. The eggs were small, spherical beautifully sculptured, with a greenish colour, convex on the dorsal side with ridges and furrows on the surface radiating from a circular depression at the apex and concave on the ventral side. In our studies, fecundity of *A. janata* adult ranged from 231.0 to 316.5 eggs when reared on castor varieties with different blooms. The highest fecundity was recorded on DPC-9 (316.5 ± 20.07 eggs) followed by PCH-111 (277.55 ± 22.91 eggs), DCH-177 (276.5 ± 35.19 eggs) and 48-1 (252.75 ± 16.25 eggs) and the lowest fecundity was observed on DCH-519 (231.0±13.16 eggs) followed by GCH-4 (234.25±20.27 eggs) (Table-3).

Table 3. Fecundity of *A. janata* adult reared on castor varieties with different blooms.

Genotypes	**Fecundity (Mean± SD)**
DPC-9	316.50[ea] ± 20.07
DCH-177	276.50[b] ± 35.19
PCH-111	277.55[b] ± 22.91
48-1	252.75[bcd] ± 16.25
DCH-519	231.00[d] ± 13.16
GCH-4	234.25[cd] ± 20.27
LSD at 0.05 %	34.00

In our studies, total larval duration, pupal duration, adult longevity and total life cycle was short when reared on GCH-4 (Red triple bloom) and DCH-519 (Green triple bloom) varieties as compared to DPC-9 (Green zero bloom), DCH-177 (Red single bloom), PCH-111 (Green double bloom) and 48-1 (Red double bloom). However, on GCH-4 and DCH-519 pupal weights were much lower, resulting in low fecundity, but on DPC-9, DCH-177, PCH-111 and 48-1 the pupal weights were more (long life cycle) with higher fecundity as the presence of bloom on red and green triple bloom varieties must have interfered with the larval feeding and forcing the larvae to enter into pupation much earlier and resulting in less weight of pupae and consequently low number of eggs, but DPC-9 and DCH-177 are zero and single bloom varieties where bloom was present only on stem and not on leaves. So larvae fed on them without any interference and hence longer larval duration, heavier pupae and more number of eggs were observed. The presence of powdery particles could be the one of the causes of non-preference for consumption by defoliators resulting in lower population record and lower defoliation (Sarma *et al*., 2006).

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