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COMMUNICATION

New record of the sphingid moth *Acherontia styx* Westwood, its parasitoid *Trichogramma achaeae* in Jasmine *Jasminum sambac* L., and its bioecology

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Abstract: The sphingid moth larvae are voracious defoliators of several crops. The present study was conducted to investigate damage of *Acherontia styx* on Jasmine, their seasonal incidence, and bioecology. Larval instars fed on jasmine leaves and flowers, with the highest defoliation being 35% and highest flower damage 47% during September. The lifecycle consisted of egg, five larval instars, pupal, and adult stages. The eggs were pearly white in colour and emerged larvae were cylindrical with a prominent anal horn. In subsequent moults the larvae continued to feed and become larger until they turned a reddish colour and ceased feeding prior to pupating in the soil. Adult moths were robust and swift fliers. The total life cycle from egg to adult was 56 days for males and 59 days for females. *Trichogramma achaeae* Nagaraja & Nagarkatti was noticed and documented as a potential egg parasitoid of the sphingid moth, a new record. A natural parasitization of eggs was noticed under field conditions, with changed colour of eggs to deep black from which a tiny parasitic wasp emerged, identified as *T. achaea.*

Keywords: Bioecology, egg parasitoid, flower damage, hawk moth, larval instars, lifecycle, seasonal incidence.

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Competing interests: The author declares no competing interests.

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INTRODUCTION

The sphingid moth *Acherontia styx* Westwood (Sphingidae: Lepidoptera) is newly recorded as a predator of *Jasminum sambac* L. in the present study. Sphingids are among the largest, most easily recognized, and best known among Lepidopterans. Their streamlined body, narrow wings, and rapid flight are reminiscent of hawks, hence the common name hawk moth. They hover in flight among flowers, hence they are also referred to as hummingbird moths. Most species are nocturnal, extremely strong fliers, and well known as long distance migrants (Bruce et al. 2017). They have a well-developed proboscis longer than the body to imbibe nectar. Sphingid larvae are easily recognized by their fleshy caudal horn or button, and 6–8 annulets on each body segment (Akito et al. 2009).

The present investigations on the nature and extent of damage, seasonal incidence and the bioecology of hawk moth, *A. styx* and a new record of an egg parasitoid are reported in this paper.

MATERIALS AND METHODS

Studies on the feeding damage, seasonal incidence, and exploration of natural parasitization of hawk moth, *A. styx* were undertaken in the field in ambient conditions during June 2015–May 2016 at the botanical garden premises, Tamil Nadu Agricultural University, Coimbatore. The bionomics of the pest was investigated under laboratory conditions.

Nature of damage: Field investigations were carried out to assess the seasonal fluctuation or temporal variation of jasmine hawk moth with local variety of jasmine 'Ramnad Local'. The damage of hawk moth on jasmine plants was assessed by counting total number of defoliated leaves and flowers per plant and expressed as percent damage of leaves and flowers. The total number of larvae present was also counted per plant.

Seasonal incidence: The hawkmoth incidence was recorded on five randomly selected plants per plot at fortnightly intervals, continuously for one year (March 2016–February 2017). The per cent incidence of hawkmoth was calculated by counting the total number of leaves and buds and the defoliated leaves and bored buds. The mean population of hawkmoth of jasmine was correlated with the following weather parameters, viz., maximum and minimum temperature, sunshine hours, rainfall, relative humidity, and wind velocity. The weather data of Coimbatore was collected from the meteorological observatory of Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore.

Natural parasitization: The eggs laid by adult moth on leaves and buds were monitored under field conditions. Eggs with changed colour (slight ash colour) were identified as parasitized and brought to the laboratory along with leaves and buds in air tight bags. Parasitized eggs were placed in plastic containers with lids covered tightly by muslin cloth and monitored for any emergence of the parasitoid.

Bioecology: For laboratory experiments, field collected eggs were placed over fresh leaves inside an oviposition cage. The neonate larvae after hatching were allowed to feed on the fresh jasmine leaves placed in the trays. The trays were cleaned on daily basis to remove the frass. As the larvae were voracious feeders on the leaves of jasmine, care was taken to ensure daily supply of fresh leaves for the developing larvae. During the pre-pupal stage, the larva was transferred to plastic containers filled with sand. These containers were placed in a rearing cage. The moths on emergence from the pupae were fed with ten percent sugar solution in cotton swabs, provided in penicillin vials as feed. The sexes were examined by different morphological characters and moths were kept under constant watch for studying mating, oviposition, and egg laying behaviour. Five pairs of adults were allowed for oviposition in another oviposition cage with a 250 ml conical flask with fresh jasmine branches. Leaves with the eggs were collected on daily basis and placed over fresh leaves and the biology was studied.

RESULTS

Nature of Damage: The adult moth laid pearly white eggs on the upper and lower surface of leaves and the outer surface of flower buds. The neonate larva hatched from the eggs, defoliated the young leaves and also the flowers. The larva exhaustively defoliated the leaves and also fed on the flowers. In the early stage of infestation, the plant slowly dried and died without producing any branch or shoot. The matured larva preferred to feed on the flowers than leaves causing severe damage to the plant. In the later stages of attack, infested shoots stop growing with only veins seen in the whole plant and the plant gradually died (Image 1).

Extent of damage: The percentage damage of leaves and flowers by *A. styx* was tabulated in Table 1. Maximum percentage damage to leaves caused by larvae of *A. styx* was 35.3% during September followed by 29.4 %

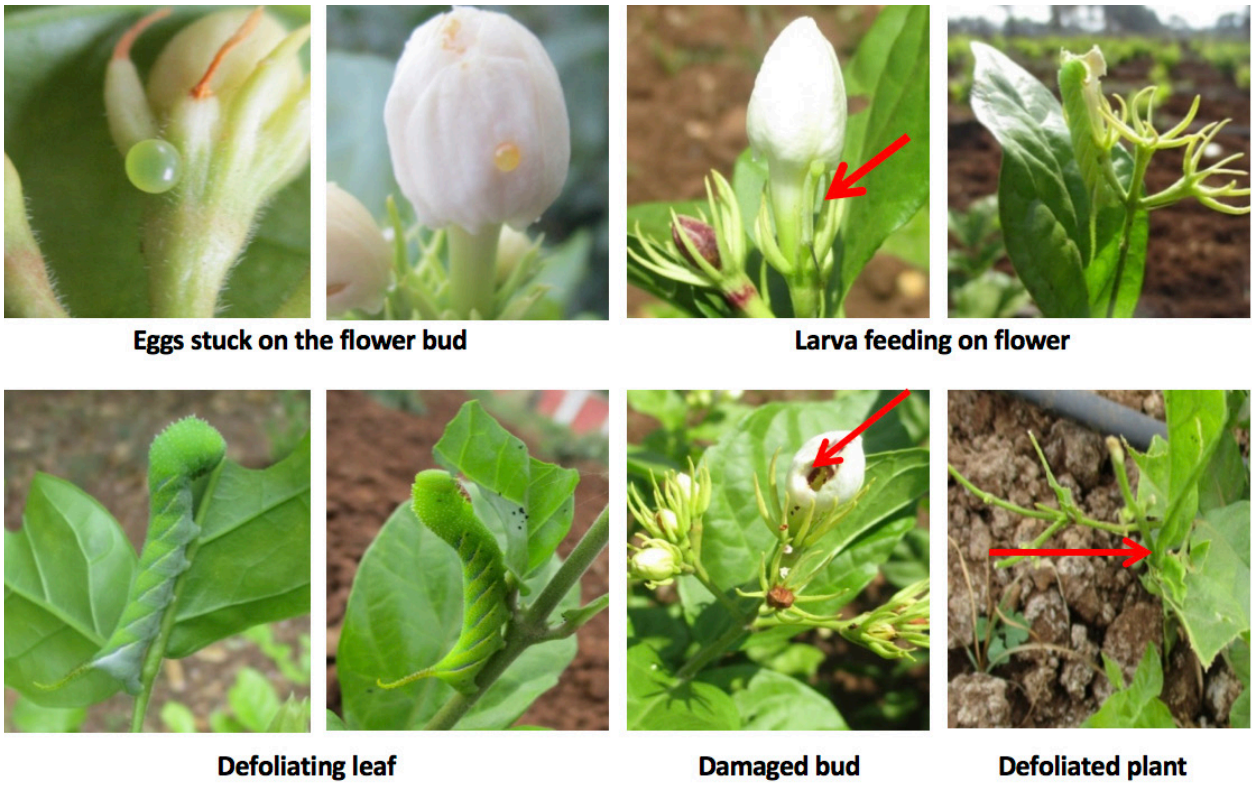

Image 1. Symptoms of predation by the hawk moth *Acherontia styx* on Jasmine. © I. Merlin K. Davidson.

in February, 26.4% in October and 21.3% in November. The least percentage of the leaves was observed in the month of August, which clearly depicted that during summer months the incidence was less. Maximum percent damage to flowers/ buds was in September with 46.8% damage followed by February 38.9%, October 37.8%, and November 30.7% (Figure 1).

Seasonal Incidence: The multiple linear regression analysis of *A. styx* was correlated in Table 2. A positive correlation was observed with maximum temperature (r = +0.530), but had a negative correlation with relative humidity (-0.677), rainfall (r = -0.553), and wind velocity (r = -0.251) with the incidence of *A. Styx* (Figure 2). The maximum (T_{max}) and minimum (T_{min}) temperature had significant contribution towards their abundance with the R^2 value 0.523 and a 1 °C increase in maximum temperature (T_{max}), 0.144% increase and with 1 °C decrease in minimum temperature (T_{min}) 0.259% decrease in *A. styx* incidence could be predicted.

Natural Parasitization: The eggs of *A. styx*, with slightly changed ash colour present in leaves and bud stalk, monitored in the laboratory, changed dark black color in two days confirming the parasitization (Image 2). After two days tiny parasitoids were found flying in the containers where parasitized eggs were

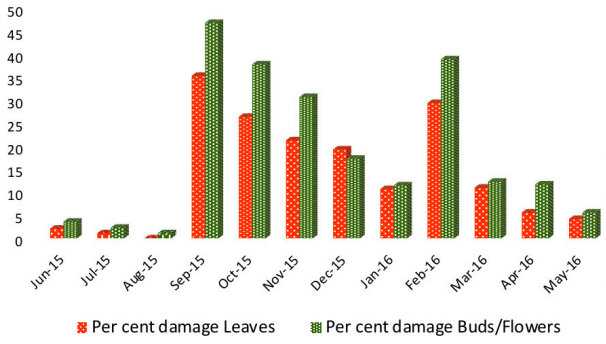

Figure 1. Extent of predation of Jasmine by the hawk moth, A. styx

placed. The emerged wasps were submitted to the division of germplasm collection and characterization, ICAR-National Bureau of Agricultural Insect Resources (NBAIR), Bengaluru, India for identification. The wasps were identified as *Trichogramma achaeae* (syn. *Trichogramma achaea*) Nagaraja & Nagarkatti (Image 3).

Bioecology: The biology of *A. styx* was studied extensively by rearing on *J. sambac* leaves as host under invitro conditions. The lifecycle consisted of egg, five larval instars, pupal, and adult stages (Image 4). The biological parameters are enumerated in Tables 3 & 4

and detailed below.

Egg: The shiny white pearl like eggs were laid singly on the upper surface of leaves. An adult female lived 3–6 days and laid only 3–10 eggs at different intervals. Freshly laid eggs were white in colour and measured 0.70–0.80 mm, slowly changed to greenish color but they turned yellow during the incubation period when they grow from 0.90–0.97 mm. The eggs turned greenish in two days and turned bright yellow as the development progressed. The incubation period varied from 2–4 days with subsequent hatching of eggs. The egg period lasted for 5–6 days, in an average of 5.4 days with 94.7% hatchability.

Larval stages

Neonate larva: There were five larval instars in the larval stage of *A. styx*, apart from the neonate larva, which was the newly hatched larvae from the egg after completion of incubation. The neonate larva was tiny, white, cylindrical white colored instar with a conspicuous projection, anal horn, at the hind end of the abdomen. This stage fed on its own egg case immediately after hatching and after 10–15 minutes on the leaves. The nascent larva measured 3.3–4.0 mm x 0.4–0.5 mm whereas fully fed larva before moulting to the 1st instar grew to 4.5-5.5 mm x 0.6–0.7 mm. The neonate larva was tiny, whitish with long black anal horn.

First instar larva: The first instar larvae were yellowish green in colour with anal horn and measured 6.0–11.0 x 0.5–1.3 mm. The fully grown larvae measured 11.0–20.0 x 0.7–2.0 mm with yellow green head and thorax; and dark green abdomen. The anal horn was dark black. Three pairs of thoracic legs on 1st and 3rd thoracic segment and four pairs of prolegs on 6th–9th abdominal segments were observed. A fifth pair of prolegs was seen on the 13th abdominal segment. The larva fed on leaves but remained inactive prior to moulting. The first instar lasted for 3–4 days in an average of 3.50±0.5 days.

Second instar larva: The second instar larva was greenish with lateral yellow oblique lines in the sides of the abdomen and started eating voraciously. The anal horn turned greenish. The larva measured 20.0–35.0 x 2.0–4.0 mm. The fully fed larva measured 35.0–40.0 x 4.0–6.0 mm prior to moulting. The anal horn was dark reddish-black and measured 3.5–5.5 mm long and has a width of 0.3–0.4 mm. The legs displayed minute black spots. The second instar larva lasted for 3–4 days in an average of 3.6±0.7 days.

Third instar larva: The third instar larva was more plumpy and caused extensive defoliation. The larva had yellowish oblique bands lined with a bluish-green outer layer with prominent black spiracles. The larva was quite big in size, 40.0–50.0 mm x 6.0–6.5 mm when newly moulted and 50.0–60.0 mm x 6.5–7.0 mm when fully fed. The anal horn was greenish and the tip was yellowish and measured 5.0–6.5 mm x 0.4–0.5 mm. The body colour was green with light yellow oblique lines on the abdomen. Tiny tubercles were present laterally on the terga. It voraciously fed on the leaves and branches and almost entire plant was denuded within 24 hours. The third instar lasted for 4–5 days in an average of 4.5±0.52 days.

Fourth instar larva: The fourth instar larva was greenish yellow and stout with lateral yellow marking and prominent black spiracles in each abdominal segment measuring 60.0–65.0 mm x 7.0–7.5 mm having

Table 1. Extent of damage of hawk moth, *Acherontia styx* in jasmine.

	Months	Percent predated	
		Leaves (%)	Buds/flowers (%)
1	June 2015	2.10	3.60
2	July 2015	1.10	2.30
3	August 2015	-	1.10
4	September 2015	35.30	46.80
5	October 2015	26.40	37.80
6	November 2015	21.30	30.70
7	December 2015	19.30	17.30
8	January 2016	10.70	11.50
9	February 2016	29.40	38.90
10	March 2016	11.0	12.30
11	April 2016	5.60	11.70
12	May 2016	4.20	5.60

*Mean of three observations

Table 2. Multiple linear regression analysis for the prediction of hawk moth, *Acherontia styx* in jasmine.

Weather parameter	Correlation coefficient
Intercept (a)	28.83*
Maximum temperature (T_{max})(°C)	0.144
Minimum temperature (T_{min}) (°C)	-0.259
Relative humidity (%)	-0.718*
Rainfall (mm)	-0.032
Sunshine (hrs)	2.034*
Wind Velocity(Km/hr)	0.343
R^2	0.523

Regression equation:
Y2 = 28.83*+ 0.144X1 – 0.259X2-0.718*X3-0.032*X4+2.034* X5+0.343X6

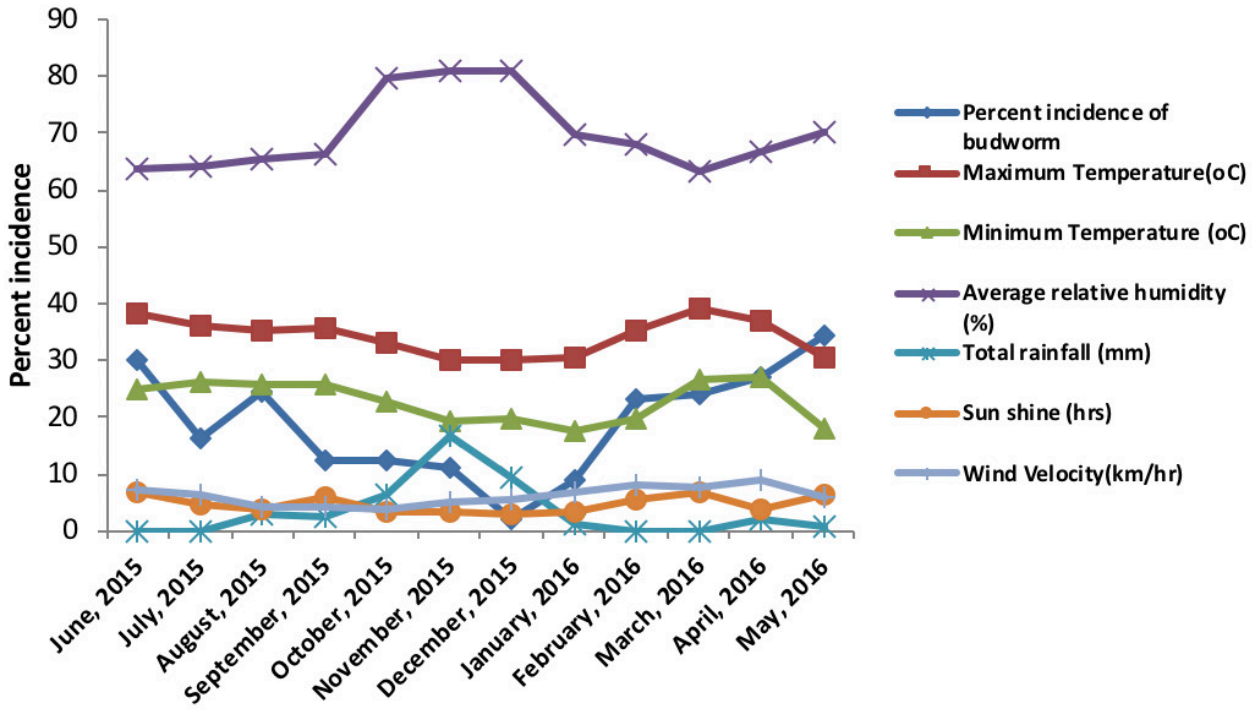

Figure 2. Influence of weather parameters on seasonal incidence of the hawk moth, *Acherontia* styx.

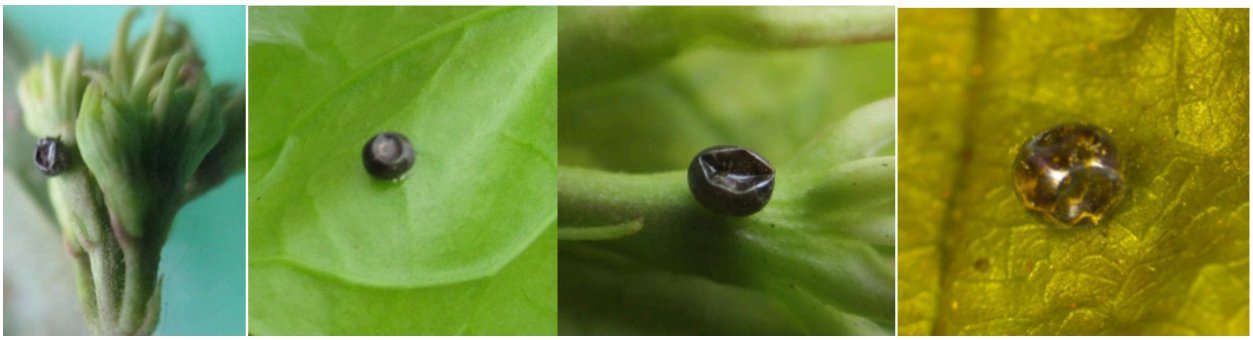

Image 2. Parasitized eggs of the hawk moth *Acherontia styx* in bud stalk and leaves. © I. Merlin K. Davidson.

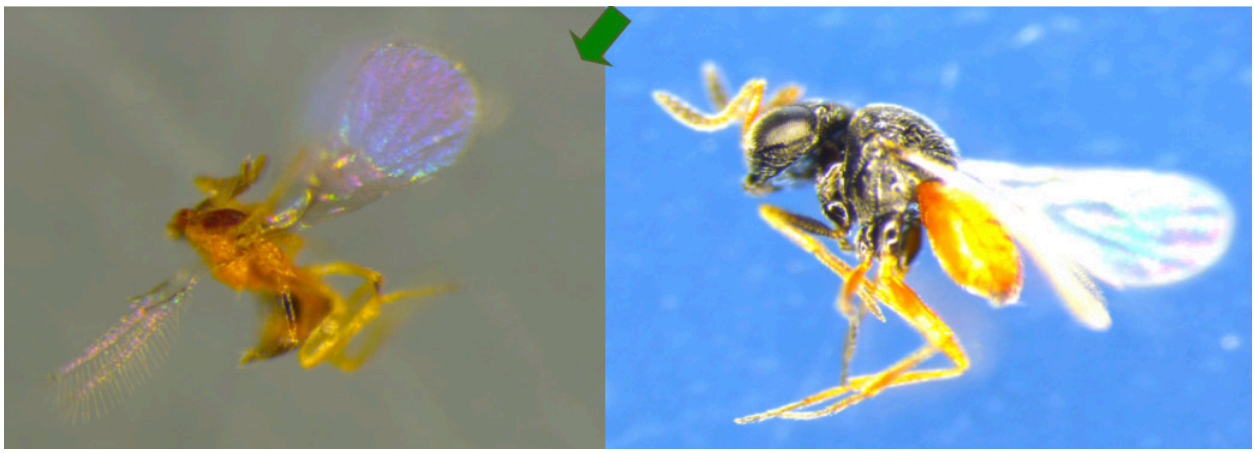

Image 3. *Trichogramma achaeae* emerged from parasitized *Acherontia styx* eggs. © I. Merlin K. Davidson.

Table 3. Mean sizes of different life stages of hawkmoth, *Acherontia styx*.

Stage		Length (mm)		Width (mm)	
		Range	Mean ±SD	Range (mm)	Mean ±SD
Egg	Freshly laid			0.70–0.80	0.75±0.03
	Full grown			0.90–0.97	0.94±0.02
Neonate larve	Young larva	3.3–4.0	3.64±0.30	0.40–0.50	0.45±0.04
	Full grown	4.5–5.5	5.04 ±0.04	0.60–0.70	0.68±0.07
	Anal horn	2.3–3.0	2.68±0.31	0.2–0.25	0.33±0.01
First instar larva	Young larva	6.0–11.0	8.26±1.95	0.5–1.3	0.9 ± 0.31
	Full grown	11.0–20.0	15.2±3.83	0.7–2.0	1.32±0.53
	Anal horn	2.8–3.2	2.18±0.18	0.2–0.3	0.24±0.04
Second instar larva	Young larva	20.0–35.0	26.4±6.02	2.0–4.0	2.9±0.87
	Full grown	35.0–40.0	37.4±2.07	4.0–6.0	4.74±0.78
	Anal horn	3.5–5.0	4.18±0.55	0.3–0.4	0.34±0.04
Third instar larva	Young larva	40.0–50.0	45.4±4.33	6.0–6.5	6.3±0.16
	Full grown	50.0–60.0	54.8±4.15	6.5–7.0	6.72±0.19
	Anal horn	5.0–6.5	5.76±0.614	0.4–0.5	0.43±0.015
Fourth instar larva	Young larva	60.0–65.0	63.2±1.5	7.0–7.5	7.5±0.34
	Full grown	65.0–75.0	68.3±1.9	7.6–8.0	7.82±0.15
	Anal horn	6.5–7.5	6.96±0.34	0.5–0.6	0.72±0.19
Fifth instar larva	Young larva	65.0–75.0	69.4±3.85	7.5–8.5	7.88±0.311
	Full grown	75.0–85.0	79.6±3.71	8.5–10.0	9.22±0.53
	Anal horn	7.5–8.5	7.96±0.39	0.6–0.75	0.68±0.05
Pre-pupa		50.0–62.0	57.8±3.19	5.0–5.30	5.21±0.07
Pupa		40.0–42.0	41.1±0.53	4.5–5.0	4.68±0.16
Adult male		30.0–32.0	31.6±0.22	35.0–36.0	35.28±0.19
Adult female		37.0–38.0	37.46±0.29	39.0–40.0	39.48±0.25

a cylindrical shape. The anal horn changed its colour to yellow and measured 6.5–7.5 mm x 0.5–0.6 mm in size. One pair of spiracles is situated laterally on the thorax and seven pairs on abdomen (4th–10th segments). The last pair of spiracles was seen on the 11th segment. The yellow oblique lateral stripes on segments 5–11 were sharply defined, edged above with dark purple region. The anal horn was yellowish in color, true legs black, prolegs, and claspers green shaded. Spiracles were oval, yellowish with a central black slit, bordered greenish. The fully fed larva before moulting was of 65.0–73.0 mm x 7.6–8.0 mm size. The last instar larvae voraciously fed on the leaves which lasted for 4–5 days in an average of 4.8 days.

Fifth instar larva: The fifth instar larva was a colourful plump cylindrical creature, appeared yellowish-green and turned reddish-yellow as the stage progressed. The newly moulted larva measured 65.0–75.0 x 7.5–8.5 mm. The full fed caterpillar measured 75.0–85.0 x 8.5–10.0

Table 4. Biological parameters of the hawk moth, *Acherontia styx* of jasmine.

	Particulars	Period (days)
1	Egg period	5.40±0.527
2	Hatching per centage	94.70±1.11
3	Larval period First instar Second instar Third instar Fourth instar Fifth instar	 3.50±0.52 3.60±0.70 4.50±0.52 4.80±0.44 4.70±0.44
4	Pre-pupal period	4.50±0.52
5	Pupal period	19.7±2.23
7	Female Adult longevity Male Adult longevity	18.9±32.95 12.8±1.32
8	Total life cycle -Females Total life cycle -Males	58.6±4.97 55.8±2.10
9	Pre-oviposition period	1.30±0.50
10	Ovi-position period	2.10±0.33
12	Sex ratio	1:0.96
13	Fecundity	6.10±1.20

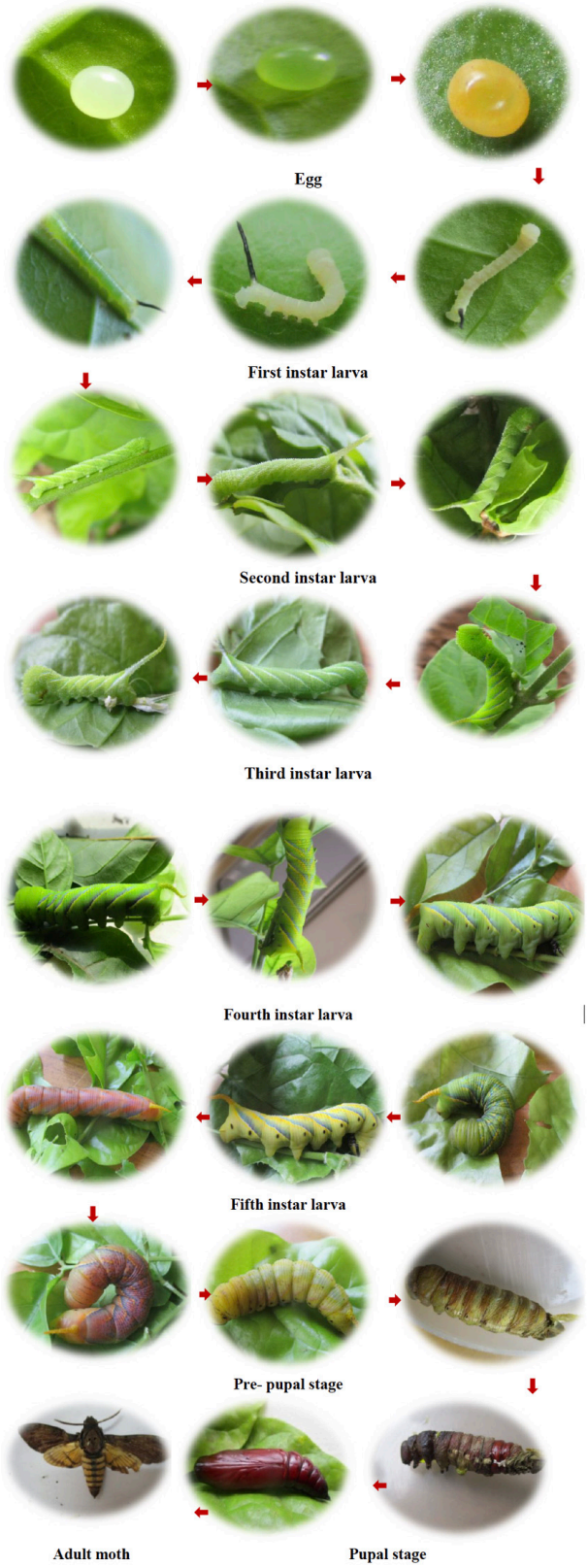

Image 4. Biology of Hawk Moth *Acherontia atyx*. © I. Merlin K. Davidson.

mm with dark yellow anal horn of 7.5–8.5 x 0.6–0.75 mm. The larva completely turned reddish, sluggish, and stopped feeding into its process of pupation. The mean larval period varied from 19.75–20.00 days in field conditions.

Cannibalism: Cannibalism was observed in older larvae, frequently in 4th and 5th instar larvae. When different larval instars were present in the tray, the older larvae attacked the younger instar larvae and sucked the fluid oozing out from the injured terga of the thoracic region. Thereafter, the injured larvae were totally consumed leaving the head capsule along with the prothorax. Moreover, during moulting process, the exuviae were completely consumed by the molted caterpillars.

Pre-Pupa: The larvae were pupated in soil. The full-grown last/5th instar larva stopped feeding and burrowed deep in soil with head forwards. It formed a cell like structure for pupation, shrunk in size, and curved to a semilunar shape. Then abdominal and thoracic legs were deformed and finally the head capsule was casted out and a pre pupa was formed. It is conical, dark yellowish-green coloured measuring 50.0–62.0 x 5.0–05.3 mm. The prepupal stage lasted for 4–5 days in an average of 4.5±0.52 days.

Pupa: The pre-pupa turned to a conical, soft, shining blood red coloured pupa with two black eyes on the anterior end, which was the head region measuring 40.0–42.0 x 4.5–5.3 mm. Distinct marks were present in the abdominal segments and the terminal segment ending into a spine like structure. The presence of genital and anal pores in the 8th and 9th abdominal segments respectively in male and on 7th and 9th abdominal segments in the female represented the sexual dimorphism. The pupa was obtect, stout, and dark reddish-brown. The pupal period varied between 17 and 23 days, in an average of 19.7 ±2.23days.

Adult: The Adult moths were large, robust, heavily built with a wing span of 35.0–40.0 mm. They were commonly called as a hawk moth, sphinx moth or death's head moth in the basis of their structural and behavioral characters. The moths were swift fliers resembling hawk. The forewing of moth was ornamented with a mixture of dark blotchy brown and grey patterns with black wavy markings and a protruding yellow spot on each wing. The abdomen was yellow in colour, the hind wings were yellowish-grey with black marks and large vertical line. A pair of large, black, and transparent eyes and a pair of thin feathery antennae were present on the lateral sides of head of both sexes. Adult males measured 30.00–32.00 mm in length and 35.00–36.00 mm in width

with an expanded wing (both wing span about 7 cm). Females were longer, being 37.00–38.00 mm in length and 39.00–40.00 mm (mean 39.90±0.21 mm) in width with an expanded wing (both wing span about 8 cm) (Table 3). Males were smaller in size than the females. A shiny greyish tuft on thorax with one pair of black dots in males distinguished them from the females. Females were larger in size and had shiny reddish grey tuft like a human skull on the thorax. The adult moth had dark brownish fore wings and yellow hind wings with black markings, with a characteristic, skull-like marking on the thorax. The adult female lived for 18.9 days and males for 12.8 days. The ratio of male to female was 1:0.96.

Total lifecycle: The total life cycle from egg to adult was 55.8 ± 2.10 days for males and 58.6 ± 4.97 days for females.

DISCUSSION

Jasmine is a traditional flower crop belonging to the olive family (Oleaceae), cultivated throughout the tropical and subtropical parts of the world for its sweet-scented fragrant flowers (Ranadas et al. 1985; Bose & Yadav 1989; Kanniamal & Divya 2016). The commercial production of jasmine is affected by various pests. The hawk moth, *A. styx* Westwood was a sporadic pest, but voracious feeder of jasmine crop at larval stage, observed for the first time.

The incidence of hawkmoth was noticed in jasmine plant for the first time. The larvae were voracious feeders of leaves and caused severe defoliation perpetrating substantial damage at times. The adult moth laid eggs singly on both the side of leaves as well as flower buds. The emerged larva fed on the leaves as well as on the flowers. The matured larvae severely defoliated the plant leaving the vein alone. A single larva was capable of skeletonizing the whole plant. The present work was a novel approach in Tamil Nadu Agricultural University, Coimbatore, which has not been studied before or explored elaborately. However, some works on the bioecology of hawk moth, *A. styx* was reported by Mehta & Verma (1968), Lefroy (1990), Rai et al. (2001) Biswas et al., (2001), Sharma & Choudhary (2005), Atwal & Dhaliwal (2005) in *Sesamum indicum*, and Kumar et al. (2012) in an alternate host, *Clerodendrum phlomidis*.

The hawkmoth, *A. styx*, is newly recorded as a voracious predator of Jasmine in the present study during the year 2016. *J. sambac* as a larval host plant of *A. styx* was reported by Bangpai et al. (2017) in Thailand. The adult moth laid eggs in the adaxial and abaxial side as well as on the bud surface. The emerged larvae severely defoliated the leaves and fed on the flowers with the plants left with the stem and veins alone. This nature of the feeding of *A.styx* was reported previously by several workers (Ahirwar & Gupta 2010; Kumar et al. 2012; Devi & Ramaraju 2016).

The incidence of A. *styx* was found to be maximum in the month of September followed by February, October, and November. This finding is in line with Premdas (2017) who stated that the peak infestation of *A. styx* in terms of symptoms of infestation was observed in the 2nd week of February at 40 DAS in 1st sowing and the 3rd week of February at 33 DAS in the 2nd sowing with regard to sesame crop. The results also coincided with Bondre et al. (2016) in sesame crop who stated that the peak activity of the hawk moth were recorded during the 2nd week of October and reached its ultimate in a week (0.14 larvae/ plant) and declined progressively until the crop matures. Virani (2010) also stated that the incidence of this sphinx moth (*A. styx*) appeared after the 6th week of sowing, i.e., the 3rd week of March with a minimal infestation of 0.24 larvae per plant.

The multiple linear regression analysis of hawk moth, *A. styx* showed a positive correlation with maximum temperature (r = +0.530), but had a negative correlation with relative humidity (-0.677), rainfall (r = -0.553) and wind velocity (r = -0.251), which is in agreement with Ahirwar et al. (2009), who stated that maximum had a positive correlation but minimum temperature and rainfall had a negative correlation with the incidence of *A. Styx.*

A new record of natural parasitization was recorded in the eggs of hawkmoth, *A. styx* in jasmine. The ash coloured parsitized eggs slowly changed to black (Hoffman et al. 2002) from which a tiny parasitic wasp emerged which was identified as *Trichogramma achaea*. *T. achaeae* is a very tiny parasitic wasp in managing tiny lepidopteran larva, *Tuta absoluta*. *T. achaeae* laid its eggs in the eggs of a butterfly or moth. After an egg has been parasitized, it turns black. An adult *T. achaeae* is about 0.3 mm in size. The egg parasitoid *T. achaeae* has been recognized as a potential candidate parasitoid for the managing tomato pinworm, *T. absoluta* (Cabello et al. 2009; Oliveria et al. 2017; Zouba et al. 2013). Parasitism of *H. zea* eggs by *T. achaeae* in corn fields up to 60% and eggs of lepidopteran species belonging to family Lycaenidae was reported by Wright & Richard (2011). Eggs of *Achaea janata* (Noctuidae) being parasitized by *T. achaeae*, was also reported (Wright & Richard 2011; Krishnamoorthy 2012).

The binomics of *A. styx* was studied in detail. Eggs

are oval, translucent and yellowish-green color usually singly on a host plant leaf, which was previously reported by Bangpai et al. (2017). The newly hatched larvae fed their egg shell as their first meal which was in line with the findings of Bangpai et al. (2017). The neonate larva emerged in 2–3 days as reported by Rai et al. (2001); Sharma & Chowdary (2005); Atwal & Dhaliwal (2005). The larval period was usually longer and lasted for around two months or more, which coincided with the findings of Mehta & Verma (1968); Lefroy (1990); Rai et al. (2001); Atwal & Dhaliwal (2005) and Sharma & Choudhary (2005). The full-grown 5th instar larvae burrow about deep in the soil and form an oval cell for pupation, which is in agreement with the previous findings (Lefroy 1990; Rai et al. 2001; Atwal & Dhaliwal 2005). The pupal period existed for 15–21 days which was witnessed in previous studies too (Sharma & Choudary 2005). The full-grown caterpillar was bright green in colour with light oblique yellow strips on each side and an anal horn, which was also reported by Mehta & Verma (1968); Lefroy (1990); Rai et al. (2001). A generation of hawk moth, *A. styx* lasted for 58.6 days, which is in conformity with Kumar et al. (2012), who found that the total life of hawk moth is 52.6 days in its new alternate host *C. phlomidis* Linneaus. Analogous results were corroborated by Mehta & Cerma (1968), Atwal & Dhaliwal (2005) and Sharma & Chowdary (2005).

CONCLUSION

The hawk moth, *A. styx* as a predator of Jasmine is reported for the first time. All the stages of larva defoliated the leaves and fed on flowers too. The incidence was severe in February and October. The pearly eggs lasted between 5–6 days and the total larval period was between 22–23 days. It took 4–5 days to get prepared for pupation in soil for around 20 days. The adult female lived for around 18–19 days and male for around 12–13 days with a total life cycle of 58–59 days for female and 55–56 days for males. A new record of natural egg parasitizion by the parasitic wasp, *T. achaea* was noticed, which could aid in the natural parasitization of the pest.

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