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Research Article

Morphological Depiction and Life Table of Newly Recorded *Jatropha* Leaf Miner *Stomphastis* sp. Stages in Egypt

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Abstract

Background and Objective: The larvae of *Stomphastis thraustica*, feed on different *Jatropha* species. The target of the present study was shed light at format of different *jatropha* leaf miner stages and its life table. **Materials and Methods:** For this purpose, development and survival of immature stages, adult longevity, fecundity and oviposition period of *Stomphastis* sp., were studied under $22 \pm 2^\circ\text{C}$, $55 \pm 3\%$ RH and under nearly 16:8 (L:D) by using the computer program TWOSEX and were calculated by using the Jackknife method. **Results:** The results indicated that incubation period of egg stage 4.4 ± 0.09 days, total period of larvae instar 14.41 ± 0.11 days, pupal period 11.12 ± 0.13 days and female fecundity 67.08 ± 0.674 eggs/female. In addition to that Pre-oviposition, oviposition and post-oviposition periods were 1, 5 and 6 days, respectively. The tested parameters intrinsic rate of increase (r_m), finite population increase (λ), net reproductive rate (R_0) and mean generation time (T_0) of *S. thraustica* were 0.0987 day⁻¹, 1.1033 day⁻¹, 29.87 and 34.67 days, respectively. **Conclusion:** Life table gives the most inclusive adjective of the age-specific survival rate and fecundity of insect populations. The information can be used to project the population growth and stage differentiation.

Key words: Morphology, *Jatropha* species, survival, life table, fecundity, *Stomphastis* sp.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Jatropha curcas L., (Family *Euphorbiaceae*) is commonly named by Barbados nut, purging nut, physic nut, or JCL. It is cultivated in tropical and subtropical regions around the world, becoming naturalized in some areas. It is a large drought-resistant multi-purpose shrub. It has been noted for its environmental and economic purposes and has evoked interest all over the tropics as a potential bio-fuel crop¹⁻³. Its seeds contain viscous oil (27-40%), which can be used to manufacture candles, soap and as a diesel/paraffin substitute or extender⁴. It also provides a meal that serves as a highly nutritious and economic protein supplement in animal feed, if the toxins are removed⁵. The plant can be used to prevent soil erosion, to reclaim land, grown as a live fence, especially to exclude farm animals and also planted as a commercial crop⁶. Various parts of the plant are of medicinal value, its bark contains tannin and the flowers are sources of pollen and nectar to honey bees.

Many insect pests attacked target plants which caused significant losses, following damage by fungi or viruses⁷⁻¹¹.

The major insect pest of this plant is *Stomphastis thraustica*, a moth belongs to *Gracillariidae* family, the larvae feed on different *Jatropha* species. They mine the leaves of their host plant. The mine has the form of an irregular blotch mine, often several on one leaf. The objective of this study was to determine the form of leaf miner stages, the biological observations and life table parameters of the *S. thraustica* in the laboratory.

MATERIALS AND METHODS

Insect source: In November, 2016 samples of infested leaves with *Stomphastis* sp. were collected from special farm at Suez city, Egypt. Samples were kept in paper bags and transferred to examine under stereomicroscopy. The overrun leaves were collected and transferred to covered cages (50×25×50 cm) till adult emerged. After emergence, the mature stages were gathered by aspirator and liberate into other cage (100×50×50 cm) which were provided by *Jatropha* pots to act as oviposition site. The culture was established and maintained under 22±2°C, 55±3% RH and nearly 16:8 (L: D). Each stage was followed and notarized by picture.

Statistical analysis: The development times of immature individuals and reproduction were combined to create life tables. The life table *Stomphastis* sp. was analyzed according to the theory of stage, two-sex life table^{12,13} by using the computer program TWOSEX. The age-stage survival rate, the distribution of mortality rate, the age-stage life expectancy

and stable age-stage distribution were calculated. The intrinsic rate of increase (r_m) the net reproductive rate (R_0), the mean generation time (T_0) and the finite of population increase (λ), were calculated by using the Jackknife method¹⁴ Meyer *et al.*¹⁵. All of experiments were conducted in a climate chamber (25±1 °C, 65±5% R: H.; photoperiod: 16L: 8D).

RESULTS AND DISCUSSION

Description of external morphology of *stomphastis* sp.

stages: *Stomphastis* sp. is new recoded pest in Egypt on *Jatropha* plant. There isn't enough information around the description and biology of its life stage. The present study was give notification around the shapes, different leaf miner stages and some biological observations as follows:

The female moths deposited eggs individually and scattered under leaves surface (3-5 eggs/leave). The eggs are circle in shape, faint white colour and strongly adhered under leave surface. Under stereo microscopic examination (10x×10x) can be distinguished deposited eggs which like as little bright bubble at leave surface (Fig. 1a). After egg hatched the neonate larvae penetrated the leave surface directly under egg shell and start its tunnel (Fig. 1b).

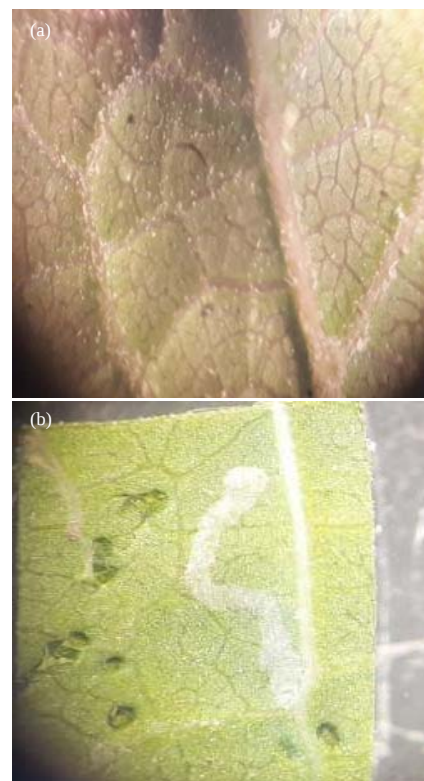


Fig. 1(a-b): (a)Egg stage and (b) Larval tunnel started from egg base of *stomphastis* sp.

Stomphastis sp. had five larval instars (eruciform type) live inside tunnel till 5th instar which exit from tunnel and spent little hours after that it started to spine white silk around its body to start pupation. The larval tunnels appeared as brown blotch shaped patches (Fig. 2).

Adult stage is very small size (less than 1 cm) and silver grayish in colour. There are differential between male and female moths from dorsal and ventral views. At dorsal view, a big dark spot appeared at the upper middle of fore wing of

female while little dark spot noticed in male wing (Fig 3a, b), respectively. At ventral view the last abdominal segments carried insect genitalia and protruded from genital opening as one lobe (called ovipositor) in state of female while looked alike as pair of curved arm (harps or claspers) in state of male (Fig. 4a, b), respectively.

There are few authors who spot on the *Jatropha* leaf miner and agree with the most of present observations. In Sengel Terren *et al.*¹⁶ mentioned that there are three pest insects attack the *Jatropha* at the Bokhol site including the leaf miner *Stomphastis thraustica* (Meyrick, 1908) which caused large brown patches on the leaves.

Age-specific survival life table: Results in Table 1 and Fig. 5 illustrated the development period and survival of *Stomphastis* sp. in days. Duration of eggs stage was recorded 4.4 ± 0.09 days/eggs. On the other side, newly hatched larvae mine directly into the leaf tissue and spent 14.4 ± 0.11 day till reached to 5th larval instars. The first adults appeared on days 28, 29. The life span (from egg hatching until death of the adult) was approximately 36.05 ± 0.7 days.

There are few studies in other countries which interested in record biological observations of *Stomphastis* sp. as Xiao *et al.*¹⁷ from china, who agree with the present observation, except in case of the duration of a whole generation is 18-20 days and that related to variation in longevity of larval stage.

The present observation disagree with Dhileepan *et al.*¹⁸, who recorded duration of generation from adult to adult takes around 22 days under quarantine conditions, but has been completed in as little as 18 days.



Fig. 2: Larval instars of *Stomphastis* sp.

Numbers 1, 2, 3, 4, 5 larval in stars referred to variation between the larval in stars of *Stomphastis* sp. on *Jatropha* plant



Fig. 3(a-b): Dorsal view of (a) Female moth (b) Male moth

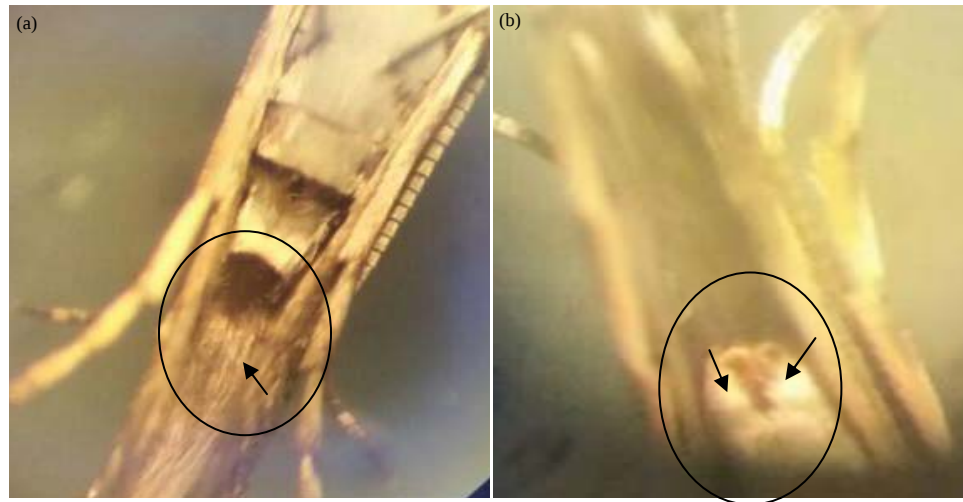


Fig. 4(a-b): Ventral view of (a) Female moth and arrow show ovipositor lobe and (b) Male moth and arrow show male genitalia (harps) of *Stomphastis* sp.

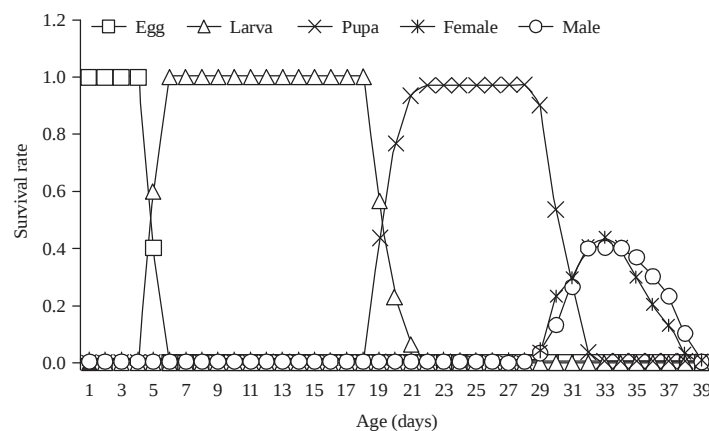


Fig. 5: Age-stage survival rate (s_{ij}) of *Stomphastis* sp. under laboratory conditions

Table 1: Developmental period (days) of *Stomphastis* sp. under laboratory conditions

Stage	Mean $\pm$ SE
Egg	4.4 $\pm$ 0.09
Total larval period	14.41 $\pm$ 0.11
Pupa	11.12 $\pm$ 0.13
Adult longevity	6.12 $\pm$ 0.13
Total life cycle	0.66

Table 2: Life table parameters of *Stomphastis* sp. on of *Jatropha curcas* plants

Population parameters	Mean $\pm$ SE
Mean total fecundity (eggs/female)	67.08 $\pm$ 0.674
The intrinsic rate of increase (r_m , day $^{-1}$)	0.0987 $\pm$ 0.0065
The finite rate of increase (λ , day $^{-1}$)	1.1033 $\pm$ 0.0072
The net reproductive rate (R_0)	29.87 $\pm$ 6.41
The mean generation time (T_0 , days)	34.67 $\pm$ 0.43

Age-specific fertility life table: The survivorship and fecundity of *Jatropha* leaf miner are shown in Fig. 6 based on

the data in Table 2. The first female emerged on day 29 and the first female died on day 37. The pre-oviposition period was on 30th day of pivotal age and female contributed the highest number of progeny ($m_x = 36$ females/female/day) in the life cycle during 36 day of pivotal age.

Population parameters calculated by using the age-stage, two-sex life table are listed in Table 2. The intrinsic rate of increase (r_m), the finite rate of increase (λ), net reproductive rate (R_0) and the mean generation time (T_0) of *S. thraustica* were 0.0987 day $^{-1}$, 1.1033 day $^{-1}$, 29.87 offspring/individual and 34.67 days, respectively. These results suggest that if the population reaches the stable age-stage distribution and if there are no mortality factors other than the physiological ones, *S. thraustica* population can multiply 1.1033 times day $^{-1}$ with an average of 34.67 days with an exponential rate of 0.0987 day $^{-1}$.

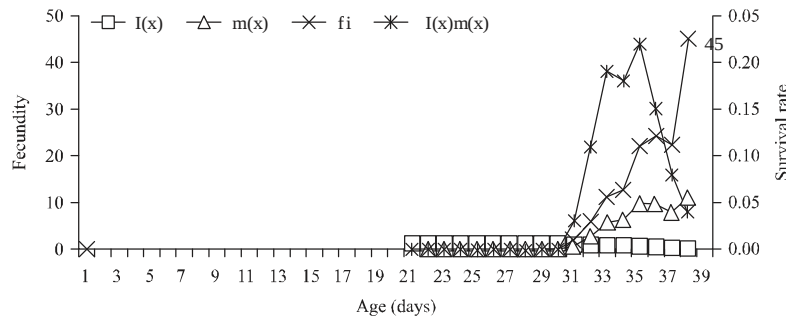


Fig. 6: Age-specific survival rate ($I(x)$), the age-stage fecundity of female (f_i), the age-specific fecundity of the cohort ($m(x)$) and the age-specific maternity ($I(x)m(x)$) of *Stomphastis* sp under laboratory condition

CONCLUSION

Life table gives the most inclusive adjective of the age-specific survival rate and fecundity of insect populations. The information can be used to project the population growth and stage differentiation. The life table is also most important basis for quantitative and qualitative study of population ecology. It can be used to compare different insects under the same conditions.

SIGNIFICANCE STATEMENTS

This study gives valuable information about the life cycle and morphology of different stages of new record insect pest (*Stomphastis* sp.) which attack promising economic plant (called bio-fuel crop) and caused reduction in yield. So the present study provides the researcher the scientific information which helps them in control.

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