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Life-Cycle Development and Morphology of Three Butterfly Species: *Danaus chrysippus*, *Papilio demoleus* and *Papilio polytes* (Lepidoptera)

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A B S T R A C T

The relationship between butterflies and plants is an essential one since adults rely on nectar while larvae depend on the proper host plants. This paper examines the development of *Danaus chrysippus*, *Papilio demoleus*, and *Papilio polytes* from eggs to adulthood in a controlled lab environment. Freshly collected eggs were kept in a ventilated jar with sufficient moisture and regularly fed with fresh leaves. *D. chrysippus* was raised using milkweed while *P. demoleus* used citruses. *P. polytes* was raised with Aegle marmelos-associated tissues. Data from observations made at different stages during the development cycle from the egg stage to reach adulthood with the measurements of body sizes included. *D. chrysippus* reached 30.2 mm during the fifth larval stage and had an average of 7–8 days in pupal stage, while *P. demoleus* reached 41.2 mm in the fifth larval stage and had an average of 8 days in the pupal stage. Statistics from observations recorded also tells that *P. polytes* reached 39 m min the fifth larval stage with the pupa taking about 10 days. Notable defensive and morphological characteristics were recorded indicating bird-droppings-like early instars and osmeterial defense in Papilio species, as well as color change and particular host plants used by *D. chrysippus*. The results represent a good database that will aid in understanding the developmental biology and importance of these butterflies.

Introduction

Butterflies play a crucial ecological role with plants and rely on plants from the larval and the adult stage. The larval food plants for butterflies and the adult nectar sources should be included in the definition of butterfly habitat. Larvae do feeding primarily on leaves, and adults use flowers as their resources. Thus observations of development are important in studying butterfly ecology.

Danaus chrysippus (Plain Tiger or *African Monarch*) has a distribution in the Indian subcontinent and also Africa, southern Europe, Saudi Arabia, tropical Asia, Australia, and New Zealand. Its larvae are associated with the milkweed in genera Asclepias and Calotropis. The source material refers to the milkweed-feeding found to allow toxin sequestration in the plant for defence from predators as well. The species is characterized by tawny to brownish-orange wings with black borders with white markings and also the presence of the male scent pouch.

Papilio demoleus (the Lime or Citrus Butterfly) is a common member of the family Papilionidae in Asia-Pacific, though it has no hind wing tails, which is characteristic for many species of this family. The species has black wings with irregular pale-yellow or white markings and a distinct tornal marking. The larvae feed on Rutaceae and can defoliate the young citrus plants. The developmental stages of *P. demoleus* are very different, from the early larvae resembling bird dropping to the green final stage, well-defended (Riaz *et al*., 2020; Islam *et al*., 2019).

Papilio polytes (Common Mormon Butterfly) is another economically important member of the family associated with citrus and other Rutaceae plants. This species exhibits sexual polymorphism, with males having conserved pigmentation and females showing diversity. The larvae of the species feed on plants of *Murraya koenigii* and can also consume a lot of foliage. Studies conducted in laboratories have proven the importance of developmental and morphological aspects of the species (Islam *et al*., 2017; Nagalakshmi *et al*., 2017). The study aims at documenting and comparing development of *D. chrysippus*, *P. demoleus* and *P. polytes* from the egg to adult stage under laboratory conditions with special focus on stage-wise morphology, body measurements, and time frame for each phase of development, as well as host plants.

Materials and Methods

2.1 Study design and collection- In the study, the collection of fresh eggs in the field was combined with laboratory rearing. Observations in the field and collection of eggs were done during the flowering time of the host plants. The date and time of collecting the eggs were recorded, and after that, the eggs were taken to the laboratory for observation through subsequent stages of development.

2.2 Laboratory rearing- It is claimed that eggs were kept in plastic container described as being about 14 × 2.5 × 25.1 cm in size. In the technique it is claimed that wick made wet cotton plugs allowed to produce moisture, and the lids of jars had perforations for ventilation. For feeding purposes the larvae were provided with fresh leaves of their host plants at regular intervals after hatching. *D. chrysippus* was fed with milkweed/Asclepias leaves, but *P. demoleus* with either *Aegle marmelos* or any other Rutaceae plants (all belong to the family of Citrus plants) while *P. polytes* was given *Murraya koenigii* leaves.

2.3 Developmental observations-The species was studied across different stages of development including egg, from the first to fifth instar larval stages, pre-pupal, pupal and adult stages of development. The studies included observations made on body shape and colour pattern at each developmental stage and behaviour of larvae including defensive features and body dimensions. Some of the measurements

made on this organism are reported together with the values for standard deviations of those measurements made on separate instances of *D. chrysippus*.

Results

3.1 Danaus chrysippus- The eggs of *D. chrysippus* were dome-like and exhibited longitudinal stripes. They were white initially but got creamy white after a day. Their dimensions showed 0.9 to 1.5 mm in length and 0.8 to 1.2 mm in width, the mean values being 1.2 ± 0.22 mm and 0.9 ± 0.17 mm, respectively. The incubation period lasted about 3 to 4 days. The larvae were four time molting and they grew through five larval instars during a period of 12 to 13 days. There was an increase in size throughout larval stages. The first instar was about 4.4 to 4.8 mm long, while the fifth instar was about 29.8 to 30.2 mm long. During its growth the larva's coloration and markings developed further. At its pre-pupal stage the larva prepared a silk attachment and took typical head-down J-like furl.

Its size in pupal stage was about 17.3 to 17.6 mm in length and 7.5 to 7.9 mm in width, lasting throughout the pupal stage, for about 7 to 8 days. The adult's wingspan was reported to be around 75.4 to 80 mm in width with its typical wing pattern of orange, black and white in colour.

Table 1 Stage-wise measurements and duration recorded for *Danaus chrysippus*

Stage	Length (mm)	Width (mm)	Duration (days)
Egg	1.2	1.0	3
Instar I	4.8	1.0	1
Instar II	8.7	1.6	2
Instar III	14.1	2.8	2
Instar IV	21.2	3.5	1
Instar V	30.2	5.5	3
Pre-pupa	19.8	6.8	2
Pupa	17.5	7.6	7
Adult	23.3	80	11

The data in Table 1 illustrate a gradual increase in body length of *D. chrysippus* throughout its larval stages. The total body length went up from 4.8 mm in the first larval stage (instar) to 30.2 mm in the fifth larval stage, which indicates rapid body growth during different larval instars. The fifth instar represents the maximum growth record during the life cycle, followed by reduction in length during pre-pupal and pupal stages due to metamorphosis. Of all the stages shown in the table, the pupal stage had the longest duration of 7 days. Thus, it can be concluded that larval occurrences reflect specific changes during the time of transition from egg to adult.

3.2 *Papilio demoleus*- The eggs of *P. demoleus* are creamy yellow and smooth with a mean diameter of approximately 0.99 mm. The first instars of *P. demoleus* are brown to brown-black colour with patchy white marks that resemble bird droppings. The second instar is becoming darker and more active and the third may grow up to 13.1–13.4 mm long. The osmeterium is strongly developed in the fourth stage. The fifth instar is greenish-yellow with markings similar to eyes, and it is approximately 41.2 mm long and 6.8 mm wide. The duration of the prepupal stage is one day, and it is then followed by a pupa that undergoes colour changes from green to straw or brown colour before the formation of the adult. The adult butterflies have black wings with uneven and incomplete yellow markings. The dimensions of the adult butterfly are mentioned in the reference as well with a wingspan ranging from 80 to 90 mm. The data regarding different developmental stages was included in the table.

Table 2 Stage-wise measurements and duration recorded for *Papilio demoleus*.

Stage	Length (mm)	Width (mm)	Duration (days)
Egg	1.2	0.1	3
Instar I	2.3	0.4	3
Instar II	9.1	0.85	3
Instar III	13.1	3.7	4
Instar IV	25.0	5.6	3.3
Instar V	41.2	6.8	4
Pre-pupa	26.7	7.7	1
Pupa	28	9	8
Adult	80	2.5	5

Table 2 indicates there has been considerable increase in P.demoleus in various larval instars. Larval length records show that growth was observed from 2.3 mm in the first instar to 41.2 mm, which makes the fifth instar the biggest in terms of size. In comparison, the length of the pre-pupae phase was very small (1 day) while the pupal stage lasted for a much longer period (8 days). Most of the growth of the body occurred at the larval stage followed by a relatively long row of pupae in which it becomes an adult.

3.3 Papilio polytes- *Papilio polytes* egg characteristics included colors of cream-yellow and smooth with a near-spherical shape; eggs appeared to be smooth and spherical but also somewhat slightly compressed at the base. The larvae that succeeded in hatching appeared colored in brown to brownish-black tones and had the appearance of having blotches of white color. In the second and third instar stages of their life cycle, they underwent subsequent growth, whereas the fourth instar larvae had greenish-black appearance with lateral white stripes and developed the osmeterium. In their fifth instar, their color changed to yellowish-green and green, hence they were estimated to have been about 39 mm in length. The process of development of larvae into pupae took about a day. The pupae were different from each other according to the data. Therefore, the pupal duration separated the pupal life into approximately 10 days. The recently formed butterflies revealed weakness in their wings, hence it could manage to fly during their first 45-60 minutes of life. The adults had club-shaped antennae and a sucking mouthpart.

Table 3. Stage-wise measurements and duration recorded for *Papilio polytes*.

Stage	Length (mm)	Width (mm)	Duration (days)
Egg	0.9	1.8	3
Instar I	2	0.4	2
Instar II	8	1.5	2
Instar III	13.0	2.5	2
Instar IV	24.0	5	3
Instar V	39	7.0	4
Pre-pupa	39	7.0	1
Pupa	29.0	8.0	10
Adult	25	90	4

Like data available for *P. polytes*, the same trend was observed in this species. The size of *P. polytes* changed from 2.0 mm during Instar I to 39.0 mm during Instar V. The later instars such as IV and V had significant results compared to former stages. The duration in pre-pupal kept around 1 day, whereas the length of the pupal duration was noted as 10 days. Therefore, it can be claimed that the larval period is followed by a lengthy pupal period.

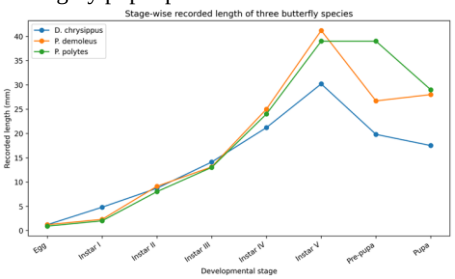

Figure 1 Stage-wise recorded length of *Danaus chrysippus*, *Papilio demoleus* and *Papilio polytes*.

The variations in developmental growth pattern across the three butterfly species can clearly be seen in the graph shown in figure 1. All three species show an increased length when compared during the early and late larval instars. For instance, *D. chrysippus* reached a length of 30.2 mm during the fifth instar while the two species *P. demoleus* and *P. polytes* attained the lengths of 41.2 and 39.0 mm respectively. Hence, based on the measured lengths, *P. demoleus* was seen to record the largest fifth instar length followed by *P. polytes* then *D. chrysippus*. The decrease or change in length recorded later during the pre-pupal and pupal stage is evidence of structural changes occurring due to metamorphosis and not just regular linear growth seen during larval stage.

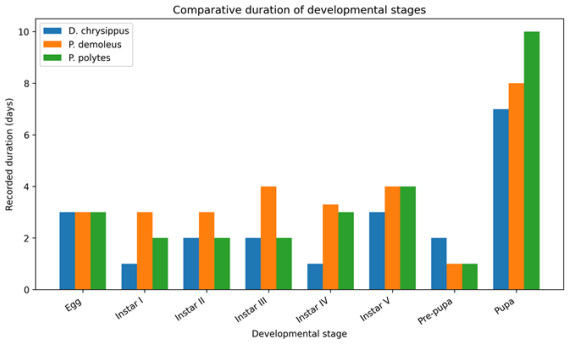

Figure 2. Comparative duration of developmental stages of *D. chrysippus*, *P. demoleus* and *P. polytes*.

As seen in Figure 2, there is variation in duration across species. Early larval periods were quite short across the species but later larval stages as well as especially pupal stages required a logner time period for completion. In fact, the pupal stage took a duration of about seven days in *D. chrysippus*; eight days in *P. demoleus* and ten days in *P. polytes*. As a result, the pupal duration in *P. polytes* was the highest out of all the three species while that of the *D. chrysippus* was the lowest. This indicates the species-specfic pattern in the duration of periods of development under the present rearing conditions.

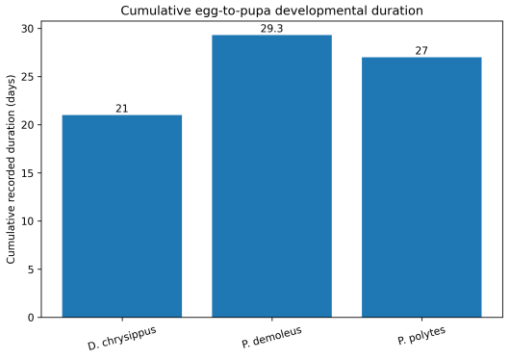

Figure 3. Cumulative egg-to-pupa developmental duration of the three butterfly species.

The cumulative period from the egg to pupal stage was estimated in the case of the three butterflies as shown in Fig. 3 and according to the stage-wise durations as detailed in the manuscript. The cumulative period was found to be approximately 21 days in the case of *D. chrysippus*, 29.3 days in the case of *P. demoleus* and 27 days in the case of *P. polytes*. Thus, *P. demoleus* had the maximum cumulative period for the egg to pupa stage, followed by *P. polytes* while *D. chrysippus* had the least cumulative time. The findings demonstrate significant interspecific differences in the period of development of the three butterfly species. Looking at Tables 1-3 along with Figures 1-3, we can see that all three species of butterflies follow a common pattern of development, which is similar in nature although there are some differences in growth patterns. The butterflies belonging to the genus Papilio reach a larger length in the fifth-instar stage than *D. chrysippus*, whereas *P. polytes* is slower in its pupal stage. However, *D. chrysippus* is the fastest species when it comes to the time taken from egg to pupa.

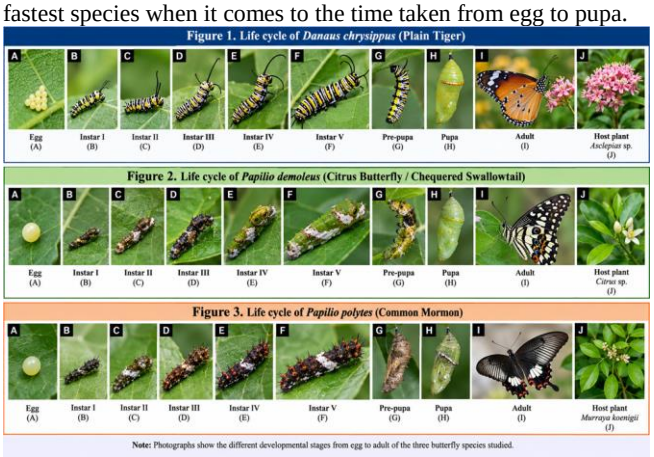

Figure 1. *Danaus chrysippus*:

Figure 1. Life-cycle and developmental stages of *Danaus chrysippus* (Plain Tiger): (A) egg, (B) first larval instar, (C) second larval instar, (D) third larval instar, (E) fourth larval instar, (F) fifth larval instar, (G) pre-pupal stage, (H) pupa, (I) adult, and (J) associated host plant.

The developmental stages of the butterfly species *D. chrysippus* from eggs to adulthood are shown in Figure 1. The changes in body size, coloration and external morphology of the organism can be seen in all five larval instars. The later instars weigh more and have less overlap in their patterns of markings. After the completion of larval stages, the insect proceeds to an abbreviated pre-pupal stage and then to pupa, during which time metamorphosis is completed. The emergence of adults marks the end of the life cycle. The figure also depicts the close association and dependence of the immature stages on the host plant from which larvae develop.

Figure 2. *Papilio demoleus*:

Figure 2. Life-cycle and developmental stages of *Papilio demoleus* (Lime/Citrus Butterfly): (A) egg, (B) first larval instar, (C) second larval instar, (D) third larval instar, (E) fourth larval instar, (F) fifth larval instar, (G) pre-pupal stage, (H) pupa, (I) adult, and (J) associated host plant.:

Figure 2 illustrates clear morphologic changes during *P. demoleus* development. Early instars have a darker and spotted body but the adult pests show at least double growth and more distinctly visible colors and patterns. The transformation of the larva at successive instars has to do with rapid growth and stage differentiation. After the fifth instar, the larva enters the pre-pupa stage followed by the pupa stage and emergence of the adult. The sequence of changes indicated in the figure confirms the process of complete metamorphosis and the larva's dependence on suitable host plants.

Figure 3. *Papilio polytes*

Figure 3. Life-cycle and developmental stages of *Papilio polytes* (Common Mormon): (A) egg, (B) first larval instar, (C) second larval instar, (D) third larval instar, (E) fourth larval instar, (F) fifth larval instar, (G) pre-pupal stage, (H) pupa, (I) adult, and (J) associated host plant.

Figure 3 shows the developmental stages of *P. polytes* and illustrates significant morphological changes that take place during the transition from the early larval instars to the adult stage. The early larval instars are relatively small and dark while the later instars take on a bigger body size and better color patterns. The fifth instar is the last active feeding period before entering the pre-pupal and pupal stages. The adult stage shows complete metamorphosis. By showing the host plant, the ecological relationship between larval development and host plant availability is also shown.

Figures 1 to 3 show a comparative series of images of the entire life cycle of *D. chrysippus*, *P. demoleus* and *P. polytes*. All three species display the same holometabolous pattern of egg, five larval instars, pre-pupa, pupa and adult stages. Although they follow this common developmental stage, there are distinct species-specific characteristics in larval form and coloration, and pupal morphology. The two Papilio species display particularly notable morphological differences between the early and later stages of development, whereas *D. chrysippus* develops the characteristic form of its larval color continuously.

Discussion

The three species were similar regarding their development in that all progressed through the same phases—egg, five larvae forms, prepupal phase, pupal phase and finally through to adulthood—but differed in terms of morphology, host association, and the measurements recorded for the various stages of development. *D. chrysippus* was associated with milkweed while the two species belonging to the genus Papilio associated with Rutaceae, and this is an important biological aspect of these associations because the choice of food plants by larvae influences their development, survival, and the ecological niche in which the adults mature and reproduce. The association of *D. chrysippus* with the milkweed is especially striking in this regard. All the reference sources indicate feeding on Calotropis and Asclepias, as well as the ability to sequester cardenolides, rendering them less palatable to the predators. The reference sources also provide information on the role of plant-derived pyrrolizidine alkaloids in the pheromone biology of males. The growth pattern observed—i.e. gradually progressive growth in size of larvae in addition to the specific pre-pupal and pupal changes—corresponds to the life cycle pattern of this butterfly reported in previous studies. *Papilio demoleus* showed a spectacular

change in its appearance during its development. The early larval forms appeared similar to the bird droppings, while the last instar transformed into the greener-looking form with an eye-like pattern. Besides, the osmeterium served as an additional protective mechanism. The larvae of this species are responsible for feeding on citrus plants and other Rutaceae plants and thus are significant for agriculture since they can defoliate young plants. Therefore, the reference sources focus on the insect's biology in the context of pest management, taking into account the information on the application of parasites and neem products in dealing with pests. The larval stages of *Papilio polytes* displayed similar changes and osmeterial response; however, its ecology stands out because the species exhibits female polymorphism as well as mimicry. The reference sources provide the following types of females based on their coloration: cyrus, polytes, and romulus female types and discuss the similarities with the protected swallowtail species. Overall, it can be concluded that the host-plant specialization, larval defenses, and mimicry strategies of *Papilio polytes* make this species quite popular for the studies in both developmental biology and ecology.

The conclusion can be that the observations presented demonstrate that laboratory rearing can be an effective way of studying the morphology of the insects. However, it should be noted that the dataset includes some measurements that differ from one stage to another: for instance, in the case with the adults, the measurements include both body size as well as wingspan size.

Conclusion

The developmental research on *Danaus chrysippus*, *Papilio demoleus*, and *Papilio polytes* presents a comparative description of the processes of butterfly breeding from egg to adult. All three species underwent five larval instars, before going through the pre-pupal and pupal stages, but each one has its own peculiarities as far as morphology, defense mechanisms, and relationships with host plants are concerned. *D. chrysippus* was connected to milkweed plants and showed characteristic coloration and changes in pupation; *P. demoleus* showed pronounced changes in camouflage because of its type of environment; and *P. polytes* combines the breeding patterns typical of the families Rutaceae and Polytes, with a noticeable polymorphism in adult females and mimicry. These findings confirm that the availability of host plants and the conservation of habitats are essential for butterfly diversity to exist, and may serve as supplementary data for future studies connected with entomology and conservationism.

Declarations

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Data availability: The observations and compiled measurements reported in this paper are presented in the manuscript.

References

Islam, M. S., Islam, A. T. M. F., Rahman, M. M., & Yamanaka, A. (2017). Biology and morphometrics of the common mormon butterfly, *Papilio polytes* Linnaeus (Lepidoptera: Papilionidae) rearing in laboratory condition. Rajshahi Univ J Zool, 36, 49–56.

Nagalakshmi, P., Suryanarayana, K., & Ramana, S. V. (2017). Life history of common mormon *Papilio polytes* (Lepidoptera: Rhopalocera: Papilionidae) from Sri Lankamalleswara Reserve Forest–Eastern Ghats–Andhra Pradesh.

Riaz, S., Johnson, J. B., Rasheed, T., & Wiemers, M. (2020). Morphology, life cycle and management of two invasive subspecies of *Papilio demoleus* (Lepidoptera: Papilionidae): A review. Journal of Applied Entomology, 144(10), 845–856.

Islam, M. S., Yasmin, M., & Islam, A. T. M. F. (2019). Studies on the biology and population abundance of lemon butterfly, *Papilio demoleus* L. (Papilionidae: Lepidoptera). Bangladesh Journal of Entomology, 29(1), 77–90.

Devkar, S. S., & Chati, R. S. (2025). Life cycle of citrus butterfly (*Papilio demoleus* Linnaeus) and importance of butterflies' conservation in around Barshi from Solapur district (MS) India.

Rao, K. E., Chandar, G. S., & Atluri, J. B. (2016). Life cycle and biology of *Danaus chrysippus* (L.) (Plain Tiger) on Asclepias curassavica (L.) at Andhra University Campus, Visakhapatnam. J Pharm Biol, 11(3), 91–98.

Kininge, S. A., Pachunde, N. A., & Patil, P. S. (2018). Effect of different season on the life cycle of *Danaus chrysippus* (L.) (Plain Tiger). International Journal of Innovative Science and Research Technology, 3(4), 1–3.

Deshmukh, S. M., & Telkhade, M. (2025). Biodiversity of butterfly species of order (Lepidoptera) and impact of climate change across different rural region of Ghot, near Chamorshi, Dist. Gadchiroli (MS), India. Indian J. Applied & Pure Bio., 40(2), 1128–1134.

Kumar, A. (2013). Butterfly (Lepidoptera: Insecta) diversity from different sites of Jhagadia, Ankleshwar, district-Bharuch, Gujarat. Octa Journal of Environmental Research, 1(1).

Modak, A. Life cycle of citrus butterfly *Papilio polytes* Linnaeus (Lepidoptera: Papilionidae) on sweet lemon.

Chaudhry, S., Chettri, N., & Uddin, K. (2022). Implementation of the Convention on Biological Diversity in the Hindu Kush Himalayan countries: A retrospective analysis of Aichi Targets.