



Title	Life Cycle and Survival rate of Three Ariadne Subspecies on Ricinus communis L. Host Plant
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## **Life Cycle and Survival rate of Three *Ariadne* Subspecies on *Ricinus communis* L. Host Plant**

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### **Abstract**

Life cycle and Survival rate of *Ariadne ariadne pallidior*, *Ariadne merione ginosa* and *Ariadne merione tapestrina* of the family Nymphalidae were studied during December 2010 to October 2011. The life cycle of *Ariadne ariadne pallidior*, from egg to pupal stage lasted for 18 days and the imago emerged in 15 days. The life cycle of *Ariadne merione ginosa*, from egg to pupal stage lasted for 18 days but the imago emerged after 14 days. In *Ariadne merione tapestrina*, egg to pupal stage lasted for 20 days but the imago emerged only after 13 days.

**Key words:** Life cycles, family Nymphalidae

### **Introduction**

Larvae of butterflies and moths are usually found feeding on a single species or a few related species of plants. This preference results in the isolation of many species in colonies in particular habitats (Kindersley, 2011).

Butterflies use special nerve cells called chemoreceptors on the pads of their feet to taste food and identify leaves of their caterpillar's host plant before they lay their eggs (Tylka, 2005).

Butterflies and hostplant relationships play an increasingly important role in butterfly biology. (Mani, 1986).

Butterflies have four distinct stages in their life cycle, termed complete metamorphosis: egg (ovum), larva (caterpillar), pupa (a chrysalis in butterflies), and adult (Harris, 2011).

*Ricinus communis* L. belongs to the Euphorbiaceae family, a diverse and economically important family of flowering plants (Weibel, 1948).

In Myanmar, few studies have been undertaken on the life history of butterflies. Therefore, the present work has been undertaken to study the life stages of *Ariadne* sub species and to compare the duration and differences of immature stages among the three subspecies.

## **Materials and Methods**

### **Study Period**

The life cycle of Nymphalid butterflies was studied during December, 2010 to October, 2011 within Kengtung University campus.

### **Identification of Butterfly Species and Host Plant**

The butterflies were pinned and wings spread on spreading board to record the morphological features according to the methods reported by Bingham (1907) and Talbot (1939). The host plant of larvae were identified according to Yin Yin Kyi (2003).

### **Collection of the Butterfly Eggs**

Butterfly eggs were collected from the host plants in the environs of Kengtung. The eggs were searched carefully on the leafy shoots and apices of the prospective shrubs in the study area. The eggs when encountered on a branch, the branch that bear the eggs was cut and one end was inserted into a bottle containing some water to prevent withering of the branch and the leaves.

### **Captive Rearing**

The bottle with the cut branch was then transferred into a basin filled partly with water to prevent the attack by the ants. The mouth of the bottle in which the branch was inserted was plugged with cotton wool, to prevent the hatched larva falling into the water in the bottle. The first larvae hatched from the eggs were transferred into the plastic basket containing adequate tender leaves of the host plant to serve as a source of food for the larvae. Rearing fertilized eggs up to the adult was carried out under laboratory conditions at Zoology Department, Kengtung University.

### **Parameter Record**

The length of the eggs as well as the length of each larval stage and pupal stage were measured and mean taken for further evaluation.

## **Results**

### **Life cycle of *Ariadne ariadne pallidior* on the host plant of *Ricinus communis***

#### **(i) Egg Stage**

At the egg stage, one or several eggs were deposited singly on the underside of tender leaves of the host plant of *Ricinus communis*. The shape of

the eggs were rather like a thumble, green in color, vertically ribbed and bearing numerous white long hairs. Total number of eggs recorded was 21.

**(ii) First Larval Stage**

At the first larval stage, after three days of incubation, the eggs hatched into the first larvae. The characteristic of the larvae were yellowish green in color with brownish black cross bars on it and the head segment was brownish black in color. The length of the larvae ranges from 0.2 cm to 0.3 cm. In this stage only 18 larvae survived (85.71%).

**(iii) Second Larval Stage**

At the second larval stage after living for three days, the first larval stage was moulted and transformed into the second larval stage having a length ranging from 0.5 cm to 0.6 cm. The color of the larvae was greenish with blackish crossing bars and many brownish black spines along the whole length of the body. Longitudinal brownish black line appeared on the body and hairs on the head region became more prominent. 16 larvae survived (76.19%).

**(iv) Third Larval Stage**

At the third larval stage after living for two days of second larval stage, the larval transformed into the third larval stage with a length of 1.7 cm to 2 cm. Segments on the body became more distinct and the brownish black hairs became more longer. The body was bright greenish color with yellowish longitudinal line bordered by black lines on either sides. 15 larvae survived (71.43%).

**(v) Fourth Larval Stage**

At the fourth larval stage after living for three days in third larval stage, the larvae became transformed into fourth larval stage. The length of the larvae ranged from 2.3 cm to 2.4 cm. Body was cylindrical and slender segments armed with two dorsal and two lateral rows of short branched light brownish spines. Head with a pair of long, straight, branched spines which were brownish in color. Body green with cream color dorsal longitudinal line. 14 larvae survived (66.67%).

**(vi) Fifth Larval Stage**

At fifth larval stage after living for three days in the fourth larval stage, the larvae transformed into fifth larval stage. This larva stayed for three days in this stage. The larvae in this stage had a length ranging from 2.6 cm to 2.7 cm.

Body was cylindrical and slender, two dorsal rows of sharp spines greenish in color with three or four fine branched spines springing from a point in the middle of each, two rows of shorter greenish white spines on either side. One pair of long, strong and straight reddish brown spines on the head, set with small spines. Body green with longitudinal reddish white line interrupted with broad dorsal stripe of pinkish red. 14 larvae survived (66.67%).

#### **(vii) Prepupal Stage**

At the pre-pupation activity stage, the movement of the larvae becomes very slow and consumption of food comes to abrupt and stops. This was the final stage of the larval life cycle in this butterfly. In this species, chrysalis was anally attached and suspended downwards by a cremaster.

#### **(viii) Pupal Stage**

At the pupa stage, it became slender, wing cases was somewhat dilated, a dorsal protruberance and two small cephalic points, color variable from greenish to greenish brown, rigidly attached by the tail so that if the surface is horizontal, the pupa stands down vertically. Moulting rate of pupa is 61.90%.

#### **(ix) Adult Stage**

At about two weeks later an imago was emerged from the chrysalis. The imago stage reddish brown in color. The wings were more crenulate. Forewing with a prominent white subapical spot near the apex with fine narrow black crossed lines. Hindwing with transversed sinuate thin dorsal black lines. Pale reddish orange brown in color. Out of 21 eggs, 5 males and 8 females survived (61.90%).

### **Life Cycle of *Ariadne merione tapestrina* on the Host Plant of**

#### ***Ricinus communis***

#### **(i) Egg Stage**

At the egg stage, several eggs were deposited singly on the underside and at the margin of the tender leaves of the host plant of *Ricinus communis*. Egg shape was rather like a thumble and blackish in color with numerous white long hair (Plate 4.2.A). Total number of eggs recorded was 24.

#### **(ii) First Larval Stage**

At the first larval stage, after three days of incubation, the eggs were hatched into the first larvae. The characteristic of the larvae were black in color

with longitudinal light brownish line and the head segment was also black in color. The length of the larvae ranging from 0.3 cm to 0.4 cm. In this stage only 21 larvae survived (87.50%).

### **(iii) Second Larval Stage**

At the second larval stage, after living for three days of the first larval stage which moulted and transformed into the second larval stage having a length ranging from 0.6 cm to 0.7 cm. The color of the larvae was blackish with many brownish black spines along the length of the body. Faint light yellowish spots appeared on the dorsal side of the body and hairs on the head region became more prominent. 20 larvae survived (83.33%).

### **(iv) Third Larval Stage**

At the third larval stage, after living for three days in second larval stage, the larval transformed into the third larval stage ranging a length of 1.2 cm to 1.3 cm. Segments on the body became more distinct and the hair on the scoli became longer. Body black with brownish hairs which sprang from a reddish brown point. Light yellowish spotted line was found at the dorsal side of the body. 19 larvae survived (79.17%).

### **(v) Fourth Larval Stage**

At the fourth larval stage, after living for three days in third larval stage, the larvae transformed into the fourth larval stage. The length of the larvae ranging from 1.7 cm to 1.8 cm. Body cylindrical and slender, segments armed with two dorsal and two lateral rows of short branched brownish black spines, head with a pair of long, straight, branched spines. Color black with yellowish color dorsal longitudinal spotted line. 17 larvae survived (70.83%).

### **(vi) Fifth Larval Stage**

At the fifth larval stage, after living for three days in the fourth larva stage, the larvae transformed into the fifth larval stage. This larvae lived three days in this stage. The larvae at this stage had a length ranging from 2.6 cm to 2.8 cm. Body cylindrical and slender, black in color, two dorsal rows of sharp spines with three branched spine springing from a red point and two rows of similar but shorter spines on either side. One pair of long, strong and straight spines on the head set with small spines at the end. Color black with longitudinal yellowish spot line with an interrupted broad yellow dorsal stripe not extending to either end. 17 larvae survived (70.83%).

**(vii) Pre Pupal Stage**

At the pre pupation activity stage, the movement of the larvae became so slow that consume of food comes to abrupt. This was the final stage of the larval life cycle in the butterflies. In this species, chrysalis was anally attached and suspended downwards by a cremaster.

**(viii) Pupal Stage**

At the pupa stage slender, wing-cases somewhat dilated with dorsal protruberance and two small cephalic points, color variable from brownish to brownish black in color, rigidly attached by the tail. The surface was horizontal, the pupa hanged down vertically (Plate 4.2.A). Moulting rate of pupa was 66.67%.

**(ix) Adult Stage**

Brownish orange red in color at this stage. Forewing with a prominent white costal spot, five narrow black sinuate crossed lines, having a double dark line crossing the forewing just beyond the cell. Hindwing with transverse sinuate thin dark black lines. The wings were barely crenulate. Pale reddish brown in color. Out of 24 eggs, 9 male and 7 female survived (66.67%).

**Life Cycle of *Ariadne merione ginosa* on Host Plant of *Ricinus communis*****(i) Egg Stage**

At the egg stage, the eggs of one to several were deposited singly on the underside of tender leaves of the host plant of *Ricinus communis*. Egg was white in color and thumble in shape and domed with vertical ribs and white fine hairs on it. Total number of eggs recorded was 23.

**(ii) First Larval Stage**

After three days of incubation, the eggs were hatched into the first larvae. The characteristic of the larvae were brownish black in color with light brownish longitudinal dorsal line along the whole length of the body crossing with bars which were cream color and the head segment was black. The length of the larvae ranged from 0.2 cm to 0.3 cm. In this stage 21 larvae survived (91.30%).

**(iii) Second Larval Stage**

After living for two days of first larval stage that was moulted and transformed into the second larval stage having a length ranging from 0.4 cm

to 0.5 cm. The color of the larvae was light brownish black in color with light brownish longitudinal dorsal line along the dorsal side of the body with many light yellowish spines along the whole length of the body. Hairs on the head region became more prominent. 19 larvae survived (82.61%).

#### **(iv) Third Larval Stage**

After living for three days of the second larval stage, the larvae transformed into the third larval stage with a length of 1.3 cm to 1.5 cm. Segments on the body became more distinct and the hair on the scoli became more longer. Body brownish black with dorsal longitudinal faint light cream color spotted line (Plate 4.3.D). 18 larvae survived (78.26%).

#### **(v) Fourth Larval Stage**

After living for two days of the third larval stage, the larvae transformed into the fourth larval stage. The length of the larvae ranging from 1.7 cm to 1.9 cm. Body cylindrical and slender, brownish black segments were armed with two dorsal and two lateral rows of short branched brownish spines. Head with a pair of long, straight, branched blackish spines. Body black with cream color dorsal longitudinal spotted line. 16 larvae survived (69.57%).

#### **(vi) Fifth Larval Stage**

After living for three days in the fourth larval stage, the larvae transformed into the fifth larval stage. This larvae lasted for three days in this stage. The larvae at this stage had a length ranging from 2.6 cm to 3 cm. Body was black, cylindrical and slender with two dorsal rows of sharp spines with three brownish branch fine spines springing from a reddish point and two rows of similar short spines on either side. Head with one pair of long, strong, straight, black spines set with small spines at the end. Body black with longitudinal yellowish spotted line at the dorsal side of the body not extending to either end. 16 larvae survived (69.57%).

#### **(vii) Pre Pupal Stage**

At the pre pupation stage, the movement of the larvae became very slow and consume of food comes to abrupt. This was the final stage of the larval life cycle of the butterflies. In this species, chrysalis was anally attached and suspended downward by a creamaster.

**(viii) Pupal Stage**

At the pupal stage, slender wing-cases was dilated with dorsal protruberance with pointed triangular cephalic points, color green brownish black and attached by the tail so that if the surface was horizontal, the pupa hanged down vertically. Moulting rate of pupa is 65.22%.

**(ix) Adult Stage**

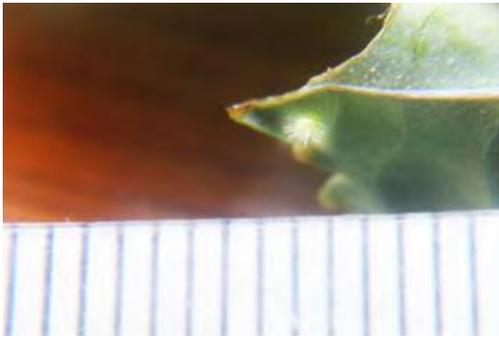
At the imago stage which was brownish orange red in color at this stage. The wings were barely crenulate. Forewing with obscure white costal spot near the forewing apex with narrow black sinuate crossed lines, by having a double dark line crossing the forewing just beyond the cell. Hindwing with transverse sinuate thin black lines. Pale brownish orange red in color. Out of 23 eggs, 7 male and 8 female survived (65.22%).

Table 1. Chronological presentation of developmental stages of *A. a. pallidior*, *A. m. tapestrina* and *A. m. ginosa*

Species	Total egg number	No: of first larva	Moulting rate of second larva	Moulting rate of third larva	Moulting rate of fourth larva	Moulting rate of fifth larva	Moulting rate of pupa	Duration of days	Survival rate
<i>Ariadne ariadne pallidior</i>	21	18	16	15	14	14	13	31.5	13
		85.71%	76.19%	71.43%	66.67%	66.67%	61.90%	days	61.90%
<i>Ariadne merione tapestrina</i>	24	21	20	19	17	17	16	31	16
		87.50%	83.33%	79.17%	70.83%	70.83%	66.67%	days	66.67 %
<i>Ariadne merione ginosa</i>	23	21	19	18	16	16	15	30.5	15
		91.30%	82.61%	78.26%	69.57%	69.57%	65.22%	days	65.22%

Table 2. Parametric data recorded on the stages of the life cycle (n=10)

Stages	Length					
	<i>Ariadne ariadne pallidior</i>		<i>Ariadne merione tapestrina</i>		<i>Ariadne merione gionsa</i>	
	Range	Mean	Range	Mean	Range	Mean
Egg size (mm)	2.0-2.1	2.05 ± 0.053	2.1-2.2	2.15 ± 0.053	1.9-2.0	1.95 ± 0.053
1 <sup>st</sup> larva (cm)	0.2-0.3	0.25 ± 0.053	0.3-0.4	0.35 ± 0.053	0.2-0.3	0.25 ± 0.053
2 <sup>nd</sup> larva (cm)	0.5-0.6	0.55 ± 0.053	0.6-0.7	0.65 ± 0.053	0.4-0.5	0.45 ± 0.053
3 <sup>rd</sup> larva (cm)	1.7-2.0	1.85 ± 0.16	1.2-1.3	1.25 ± 0.053	1.3-1.5	1.4 ± 0.11
4 <sup>th</sup> larva (cm)	2.3-2.4	2.35 ± 0.053	1.7-1.8	1.75 ± 0.053	1.7-1.9	1.8 ± 0.11
5 <sup>th</sup> larva (cm)	2.6-2.7	2.65 ± 0.053	2.6-2.8	2.7 ± 0.11	2.6-3	2.8 ± 0.21
Pupa (cm)	1.6-1.9	1.75 ± 0.16	1.7-2.0	1.85 ± 0.16	1.8-1.9	1.85 ± 0.053
Adult (cm)	51-56	53.5 ± 2.64	49-54	51.5 ± 2.64	50-53	51.5 ± 1.58



A. Egg stage



B. First larval stage (Dorsal view)



C. Second larval stage (Dorsal view)



D. Third larval stage (Dorsal view)



E. Fourth larval stage (Dorsal view)



F. Fifth larval stage (Dorsal view)



G. Pupa stage



H. Eclosion

I. Male *Ariadne ariadne pallidior*J. Female *Ariadne ariadne pallidior*Plate 1. Stages in the life cycle of *Ariadne ariadne pallidior*

A. Egg stage



B. First larval stage (Dorsal view)



C. Second larval stage (Dorsal view)



D. Third larval stage (Dorsal view)



E. Fourth larval stage (Dorsal view)



F. Fifth larval stage (Dorsal view)



G. Pupa stage



H. Eclosion



I. Male *Ariadne merione tapestrina*

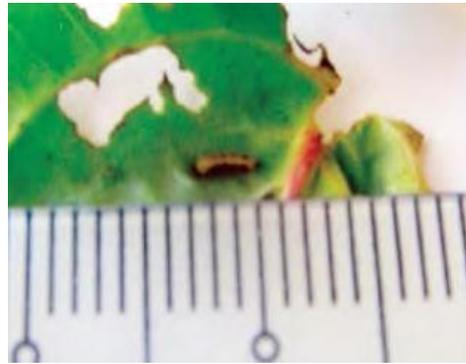


J. Female *Ariadne merione tapestrina*

Plate 2. Stages in the life cycle of *Ariadne merione tapestrina*



A. Egg stage



B. First larval stage (Dorsal view)



C. Second larval stage (Dorsal view)



D. Third larval stage (Dorsal view)



E. Fourth larval stage (Dorsal view)



F. Fifth larval stage (Dorsal view)



G. Pupa stage



H. Eclosion



I. Male *Ariadne merione ginosa*  
(Upperside)



J. Female *Ariadne merione ginosa*

Plate 3. Stages in the life cycle of *Ariadne merione ginosa*

### Discussion

In Kengtung environments the host plants and nectar plants of butterflies are abundant seasonally.

The butterfly egg is hard to find. A butterfly starts its life cycle as a small egg deposited underside of a leaf of a host plant. The tiny larva will eat as it grows into a fat caterpillar. The female butterfly finds a suitable host plant by sight and by smell. She uses chemical receptors on her feet to scratch the leaf surface to “taste” plant to see her abdomen downwards and lays an egg. Butterfly eggs are tiny. Usually one to two millimeters. Butterfly eggs vary in shape, size, color and texture. The shapes vary with species. Some are round but most are oval. Some eggs are ribbed (Cassie, 2004).

Some eggs are usually laid singly. It depends on the species of butterfly. Eggs are attached to the plant by a sticky fluid that the female butterfly secretes. The egg is glued to the plant. In family Nymphalidae, the eggs are most often melon shape as reported by Corbet and Pendlebury (1992). In three species of present study, the study butterflies laid singly, the shape and size of the egg varied greatly. The eggs of *A. a. pallidior* is thumble and green in color and covered with white hairs, that of *A. m. tapestrina* is thumble and blackish in color with numerous white long hair and that of *A. m. ginosa* is white, thumble and domed with vertical ribs with white fine hairs on it.

As a butterfly caterpillars grow, they shed their skin (moult) from time to time because the skin cannot stretch indefinitely and so must be shed. The caterpillars that hatch from the egg are called first instar (or first stage) larvae;

they usually pass through five instars, each one larger, with the last instar larvae moulting to reveal the pupa case. Butterfly caterpillars are best recognized by the family or subfamily characteristics.

Consumption of empty egg shell by the young larva as its first meal, could be related to the fact that an empty pellucid, white speck makes a rather conspicuous object which might attract the attention of enemies, but most probably because the ingredients of the shell are necessary for growth as reported by Corbet and Pendlebury (1992). This kind of consumption of egg shell by the first larva stage was also observed in the present study.

Owen (1971) stated that the larva is the main feeding stage in the development of a butterfly. The larvae of the family Nymphalidae are usually spiny and are often black or brown, marked with paler-colored yellowish band. These larvae are conspicuous on the food plant. Each larva stops feeding at the time of moulting and remain motionless on the food plant until the new skin is formed. The larvae feed back on the shed skin before resuming normal feeding on the leaves of the host plant. This kind of behaviour was also observed in the present study.

The development of the first larva in the egg takes an average of three days in the studied nymphalid species of *Ariadne ariadne pallidior*, *A. merione tapestrina* and *A. merione ginosa* within the temperature of 20.3° C to 29.2°C.

A Nymphalid spins a silken pad and hangs head down using its anal claspers to grip on. A short while after the larva has attached itself that change to a pupa begins. It is thought a hormone is introduced into the system to begin this process. After all the transformations have been taken place, imago emerges by breaking the pupal casing. In the family Nymphalidae, the pupae of all the three species were anally attached and suspended downwards. Anal attachment is by mean of tail hooks or creamaster (Ghosh, 1940). In the present study, the pupae of all the three species were anally attached and suspended downwards by a creamaster which is the characteristic of Nymphalid species.

Feeding time for the larvae of the Nymphalid species on the leaves of the host plants took place during the day time.

The larvae of *A. ariadne pallidior*, *A. merione tapestrina* and *A. merione ginosa* of this study live solitarily on the leaf gradually consume the leaf blade

by perforating small holes on the leaves. The holes are widened as the consumption progress.

Brightly colored Nymphalid larvae consisting of an armour of sharp spines could be one of the protective devices. Green larva on a green leaf is common feature among Nymphalid species. The larvae of *Ariadne ariadne pallidior* exhibit green color whereas *A. merione tapestrina* was blackish and brownish black in *A. merione ginosa*.

Many caterpillars, especially among the Nymphalidae, combine a formidable armour of spines with presumed distasteful properties advertising aposematic colors (Preton-Mafhan, 1988). This kind of spined armoured was also found in the three subspecies of *Ariadne* of the present study.

In most families the pupae are hard, usually smooth and rounded, and with appendages, and the shape and mode of pupation varies considerably in different families. In the family Nymphalidae the pupa is anally attached and suspended head downwards. Anal attachment is by mean of tail hooks or cremaster. This kind of pupating method in Nymphalidae is known as suspension.

The pupa of *Ariadne ariadne pallidior*, became slender, wing cases was somewhat dilated, a dorsal protruberance and two small cephalic points, color variable from greenish to greenish brown, rigidly attached by the tail, the pupa stands down vertically. The pupa of *Ariadne merione tapestrina* is slender, wing cases somewhat dilated with dorsal protruberance and two small cephalic points, color variable from brownish to brownish green in color, rigidly attached by the tail, the pupa hanged down vertically. The pupa of *Ariadne merione ginosa*, slender wing-cases was dilated with dorsal protruberance with pointed triangular cephalic points, color green brownish black and attached by the tail, the pupa hanged down vertically.

The wings of three subspecies of *Ariadne* under study were different. In *A. ariadne pallidior*, the wings are more crenulate. Forewing with a prominent white subapical spot near the apex with fine narrow black crossed lines. Hindwing with transversed sinuate thin dorsal black lines. Pale reddish orange brown in color. In *A. merione tapestrina*, the wings are barely crenulate. Forewing with a more prominent white costal spot having a double dark line crossing the forewing just beyond the cell. Hindwing with transverse sinuate thin dark black lines. Pale reddish brown in color while in *A. merione ginosa*, display the wings as barely crenulate. Forewing with obscure white costal spot near the forewing apex with narrow black sinuate crossed lines; by having a

double dark line crossing the forewing just beyond the cell. Hindwing with transverse sinuate thin black lines. Pale brownish orange red in color.

Butterflies vary considerably in the details of their life cycles and in most species, the study on the life cycles of butterflies should be attempted in order to accomplish conservation measures to safeguard their sustainability.

Since host plant of butterfly species is mostly con-specific there is also a need to maintain these plants, not only for the butterflies but also for successful accomplishment of rearing of butterflies in captivity, which is so vital for conservation of the species, especially those that are rare in nature.

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