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**Preliminary study on a predacious natural enemy,  
Broad vein-longitudinal striped ladybug *Brumoides lineatus* (Weise)**

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Broad vein-longitudinal striped ladybug *Brumoides lineatus* (Weise) is a newly-recorded natural enemy species in our province. It can prey on soybean aphids *Aphis glycines* Matsumura, mealy scale *Planococcus citri* (Risso) and other pests. In order to protect and utilize this kind of natural enemy, we have done investigations in fields and laboratory rearing from 1980 to 1983. Now the data are presented as follows:

1. Morphological characteristics

**Adult:** The modality of adult can be seen in figure I:1.

**Egg:** Long shaped egg. Front part of the egg is blunt, not sharp. Rear part of the egg is round. The diameters of the egg are 1.0-1.1 mm in length and 0.3-0.4mm in width. The egg just laid by the female is a light yellow color, and then changes gradually to orange-yellow. It is silvery gray before hatching (figure I:2).

**Larvae:** The head of the larvae is cream-colored when just hatched from the egg and later the color changes to brown. Compound eyes are black colored. Body of the abdomen is light grass green. Body length of just hatched larva is 1.0-1.3mm and of last instar larva is 4.6-5.0mm. The last instar larva is in a spindle shape and of light pink color. The head of last instar larva is a black brown color. There are a pair of half-round black specks on prothorax tergum. Some branched seta on the specks. A pair of warts in the middle between mesothorax and metathorax link with the warts surrounding the thoraxes, which resembles the shape of a paramecium. Twenty eight branch seta stand on the warts. There are 8 segments in the abdomen. Each segment has 6 warts set in a circle. Each wart has several branched seta. There are 8 pairs of white yellow spiracles on the abdomen. Thoracic legs are cone-shaped and black colored. At the end of the thorax legs are many tiny hairs (figure I:3).

**Pupae:** Exarate pupa. The color changes from cream-yellow into orange-yellow.

Prothorax tergum is of a dark orange color. Mesothorax, metathorax and dorsal abdomen near the edge of body are dark brown colored. From a view above, the first 1-5 segments of the abdomen look like an upside-down conch in longitudinal section. Strip off larva exuviae, three segments in the rear abdomen (the 6-8<sup>th</sup> segments) appear in a cream-white color. At the end of the 8<sup>th</sup> segment there is a pair of tail pods. The end of the segment is a round shape. The length of pupae is 3.0-3.2 mm and the width is 2.0mm (figure I:4).

## 2. Biological characteristics

### 1. Life cycle (life history)

In a Fuzhou suburb, broad vein-longitudinal striped ladybug *Brumordes lineatus* (Weise) occurs 1~4 generations a year. It has an obvious generational overlap. Adults hibernate in weed hassocks beside pools, ditches and ridges of fields in late November. In mid to late March of the following year, the hibernated adults begin to move about and get food. The period of adult oviposition is from mid-April to mid- August. Even in the first part of September the adult of the first generation can emerge. The adults of each generation start to hibernate when the temperature is declining to 14~12 C<sup>o</sup> (Chart II).

Chart II Life cycle of *Brumordes lineatus* (Weise)

	(month) 3			4			5			6			7			first
	first	mid	last	first	mid	last	first	mid	last	first	mid	last	first	mid	last	
Hibernated generation	(+)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
First							-	-	-	-	-	-	-	-	-	-
Second																
Third																
Forth																

Rearing the ladybug indoors, the period for developing one generation is different

according to different temperatures. Egg stage is 7.48d on average under daily average temperatures of 26.6 C° and 84.7% RH. Larvae stage is 12.93d (1st instar 4d, 2nd instar 2.94d, 3<sup>rd</sup> instar 2.25d and 4<sup>th</sup> instar 3.74d) and pupae stage is 3.45d on average. The development period of each generation is presented in Table 1.

Table 1 Development period of each generation

Generation	Number of ladybug	Egg stage	Larvae stage					Pupae stage	Development period	Daily a
			1st instar	2nd instar	3rd instaar	4th instar	total			temper
First										Temperatur
Second										
Third										
Forth										

Note: the development period of 4th instar include prepupae stage.

From first to third generations the greatest longevity of females is 159d and that of males is 146d. In hibernating generations, that of females and males is 297d and 257d, respectively. The average longevity of female and male is 243.4d and 222d respectively (Table 2).

Table 2 Adult longevity in every generation

Generation	Observing date (y.m.d)	Number of adults	Longevity (number of days)						Daily average of Temperature and humidity	
			longest		shortest		average		Temperature	Relat
Hibernated generation			female	male	female	male	female	male		humid
First										
Second										
Third										

## 2. Life habit

Most adults emerge between 22:00 pm and 7:00 am, from one night to the next morning. Only a few adults emerge between 14pm and 16pm. It seems that the adult has no phototaxis because it could not be lured by a moth-killing lamp. The adult is not good at volitation, but is good at crawling. It can “play dead”. After 3~8d emergence, adults begin to mate. Females and males can mate several times within their entire life. By maintaining observation of 5 generations from 1981-1982 on 48

couples of the ladybug it was found that the longest pre-oviposition period is 23d and the shortest is only 7d; the longest and shortest oviposition period is 72d and 2d, respectively. In the generation of hibernation the longest pre-oviposition period is 204d and the shortest of that is 192d. The oviposition period is 38.6d on average. The longest oviposition period is 95d. Each female in its entire life can oviposit 509 eggs at most and 5 eggs at least. A maximum 46 eggs can be produced each day. In 1982 the average oviposition quantity from 1st~3rd generations is 48.6, 180.5 and 43.9 eggs, respectively. The sex ratio of 1<sup>st</sup> ~3rd generations is 0.82:1, 1:1 and 1.5:1, respectively. The ratio in a hibernated generation is 1.17:1.

Daily preying capacity was determined in the laboratory by feeding sorghum aphids. The maximum preying quantity a day for one female is 28 aphids and the minimum is 10. The average quantity is 17. For one male a day, the most, the least and the average preying quantity are 29, 7 and 24 aphids, respectively. The capacity of hunger tolerance of females is 14d at most and 8d at least. The average is 11.4d. Hunger tolerance of males is 13, 6 and 8d of the most, least and average, respectively. During June to July, adults can live 10 days at 8 C° and the survival rate is 70% at this temperature.

The pattern of laying eggs was observed during feeding the ladybug in laboratory. The eggs were laid singly or massively. In general, 2-3 eggs are linked together. Sometimes 5-6 eggs are put in one site. They are arranged irregularly. According to observations on 781 eggs of 8 generations, the egg hatching rate is 44.4~85.2% under average temperatures of 23.1~29.6 C°. Under the optimum conditions with 23~24C° temperature and more than 85% RH the hatching rate is 80~85.2%. The 2~3.5 day-old eggs can hatch normally after storage at 10 C° for 6 days.

The first hatched larva may eat eggs if they cannot find predators. Larva can kill each other due to lack of food. The appetite of larvae is quite varied with different temperatures and aphid species. The larvae of first generations fed on soybean aphids can prey on 174.9 aphids in average. However the larvae of third generations fed on sorghum aphids can consume only 74.6 aphids. The hunger tolerance capacity of 1<sup>st</sup> - 4<sup>th</sup> instar larvae in third generations is 2.3d, 5.3d, 6.1d and 8.2d, respectively.

The last instar larvae stop eating and moving for 1-2 days and then pupate by fixing one site with pedal tubercles at the end of the abdomen. Pupation happens mostly from 20:00 pm to 7:00 am. Seldom do larva pupate during the daytime, morning or afternoon. The exuviae does not fall down to the end of pupae, but only dehisce in the middle of pupae back and surround most parts of pupae. Gradually the exuviae becomes harder for pupae protection. The fresh pupa can still have 100% emergence rate even though they are stored at 10 C° for 10 days.

### 3. Indoor ladybug reproducing and rearing

The rearing container is a 250ml jar. Soybean aphid is the food of adults and larvae.

One individual is raised in one jar. Stems and leaves of soybeans with aphids were changed once a day. The observations were made every morning and afternoon. The adults were encouraged to mate after emergence. The rearing results are presented in Table 3.

Table 3 Rates of pupation and emergence of every generation (Fuzhou suburb)

Year	Generation	Number of pupae	Pupation rate	Emergence rate	Average temperature and humidity	
					Temperature (C <sup>o</sup> )	Relative humidity (%)
1981	First					
	Second					
	Third					
	Forth					
1982	First					
	Second					
	Third					
	Forth					