

Development and Leaf Area Consumption Rate of Two-Colour Coconut Leaf Beetle *Plesispa reichei* on Selected Coconut Leaf Stages

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Introduction

Plesispa beetle (*Plesispa reichei* Chapuis) (Coleoptera: Chrysomelidae) is an important pest of coconut in Sri Lanka. This pest was first reported in 1997 from Gampaha district and is believed to have been accidentally introduced to Sri Lanka (Anon, 1999). *Plesispa reichei* mainly infests coconut seedlings. Seldom infestations on mature coconut palms could occur. Little information is available on the biology and feeding habit of this insect species. The objectives of this study were to determine the egg production, incubation period, egg hatchability and developmental times of larval instars of *P. reichei* on selected leaf stages under room temperature, and to determine the most suitable coconut leaf stage for the mass rearing of larvae and adults of *Plesispa reichei* under laboratory conditions.

Methodology

Plastic boxes were used to maintain eggs (18 cm × 6 cm × 18 cm) and rear larvae (14 cm × 4 cm × 9.5 cm). Adult beetles were reared in plastic bottles (250 mL). To maintain mother cultures, coconut leaf pieces were collected from the most immature fronds of the palm (spear leaf), second frond from the spear leaf, first open frond and the second open frond. Ten female beetles and five male beetles were introduced into adult rearing bottles. Adult beetles were fed separately on coconut leaf pieces (12 cm long) of different stages. Ten rearing bottles were maintained in the laboratory to rear beetles on leaves of each stage. Old leaf pieces were replaced with new leaf pieces at every two day intervals. A small piece of cotton wool soaked in water was kept in the bottles to provide moisture.

In experiment 1, egg production, incubation period, egg hatchability, number of larval instars and developmental times of *P. reichei* on different leaf stages were determined. Eggs laid on different leaf stages were counted daily to determine the egg production. Small pieces of coconut leaves of different stages with the eggs of *P. reichei* were cut ('egg patches') and maintained on moistened filter papers in boxes to determine the egg hatchability. Filter papers were moistened at two-day intervals. Ten boxes were maintained for one month for each leaf stage. These 'egg patches' were kept at 28-30°C and checked daily for their hatching. The incubation period of eggs was determined by counting the number of days until L-1 larval instar emerged. To determine the developmental time of different instars, thirty one-day-old larvae were reared separately in larval rearing boxes with fresh coconut leaf pieces of different stages. Body length and head capsule width of individual larva were measured at two-day intervals using a graticule in a binocular microscope to determine the larval instars (Mohammadi *et al.*, 2010; Ramsden and Elek, 1998). Developmental times were determined by counting the days for respective life cycle stage.

In experiment 2, leaf area consumption of field-collected and laboratory-reared adults was determined. They were allowed to feed on selected leaf stages (6 cm long). After two days, feeding marks on the leaf pieces were traced on transparent papers and leaf area was measured using the leaf area meter.

The experimental design of all experiments was Completely Randomized Design (CRD). All the data were analyzed by ANOVA using SAS package (SAS Institute, 2002- 2008). Mean separation was done by LSD.

Results and Discussion

Mean egg production and percentage hatchability of the adult females reared on coconut leaf pieces of different leaf stages differed significantly. But incubation period of eggs was not affected by the leaf stage. Compared to the adult females reared on spear leaves, higher numbers of eggs were produced by the adult females that fed on first open leaf and the second open leaf. Conversely, higher egg hatchability was observed when the adult females were reared on spear leaves than the other two leaf stages (Table 1).

Table 1. Mean egg production, percentage hatchability and mean incubation period when adult female of *Plesispa reichei* was reared on coconut leaves of different stages.

Leaf stage	Egg production (mean±SD)	Hatchability (%)	Incubation period (mean±SD)
Spear leaf	13.04±3.75 ^b	41 ^a	7.44±23.42 ^a
First open leaf	34.12±7.87 ^a	19 ^b	7.08±15.15 ^a
Second open leaf	35.60±8.29 ^a	21 ^b	7.44±13.28 ^a
F value	82.52	12.99	0.69
P value	0.0001	0.0001	0.5048

Means followed by same letter in each column are not significantly different at P=0.05.

The mean fecundity of a *Plesispa* is 112 eggs with a range of 13-178 (Sivapragasam and Hong, 2005), and agrees with our finding. With aging, the chlorophyll (Jayasekara *et al.*, 1996), Nitrogen and Calcium content is increased and Phosphorus content decreased (Amer, 1997). Therefore, the nutritional differences in leaves would have increased the mean egg production on first open leaf and second open leaf, compared to spear leaf. Kumari *et al.* (2009) reported that the incubation period of *Plesispa* eggs in the field is 7-14 days with a hatchability of 80%. Incubation periods reported in our study agrees with that previous finding. Humidity and temperature affect the incubation and hatchability of eggs. High humidity in tightly compressed spear leaf would have increased egg hatchability.

Table 2. Effect of different leaf stages on the larval developmental times.

Larval instar	Mean duration(days)±SD			P value
	Spear leaf	First open leaf	Second open leaf	
1st	3.26±2.18 ^a	2.43±1.61 ^b	2.2±1.62 ^b	<0.0072
2nd	7.95±4.27 ^a	3.92±1.79 ^b	4.92±1.74 ^b	<0.0001
3rd	15.07±6.24 ^a	8.54±1.71 ^b	9.45±1.93 ^b	<0.0001
4th	23.9±8.03 ^a	13.36±2.87 ^b	13.97±2.16 ^b	<0.0001
5th	29.6±9.16 ^a	20.6±5.86 ^b	20.2±4.20 ^b	<0.0001

Means followed by each letter in each column are not statistically significant at P=0.05.

Table 3. Leaf area consumption by adult beetles of *Plesispa reichei*

Leaf stage	Mean leaf area consumed \pm SD (cm ²)	
	Field-collected adults	Laboratory-reared adults
Spear leaf	2.81 \pm 2.28 ^{ab}	3.27 \pm 2.95 ^a
First open leaf	1.83 \pm 1.2 ^a	0.83 \pm 1.29 ^b
Second open leaf	3.15 \pm 2.3 ^b	0.23 \pm 0.4 ^{ab}
P value	<0.0024	<0.0001

Means followed by the same letter in each row are not statistically significant at P=0.05.

According to Dyar's law, five different groups of larvae were identified irrespective of the leaf stage on which they fed. Larval development was significantly affected by the leaf stage. Time taken to complete each instar was significantly higher when they were reared on spear leaf. But, there were no significant differences between the durations taken to complete larval development when they were reared on first open leaf or second open leaf (Table 2). The reduced time spent on first open leaf and second open leaf for the completion of larval instars may be attributed to the high carbohydrates and minerals in these leaves compared with the spear leaf (Jayasekara *et al.*, 1996).

Field-collected beetles consumed more leaf area of second open leaf than first open leaf and spear leaf. Laboratory-reared beetles consumed higher leaf area of spear leaf than first or second open leaf (Table 3).

Conclusions

This study shows that the egg production, egg hatchability, developmental time and leaf area consumption by *P. reichei* are significantly affected by the leaf stage they feed. The first or second open leaves are better than spear leaf for oviposition and the development of larvae, although the hatchability is higher in the spear leaf. Therefore first open leaf and second open leaf are more suitable than the spear leaf for the development of larval instars in mass rearing of *Plesispa* beetle.

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