

Leaf consumption and duration of instars of the cassava defoliator *Erinnyis ello* (L., 1758) (Lepidoptera, Sphingidae)

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ABSTRACT. The objectives of this research were to evaluate leaf consumption and the developmental time of the larvae of *Erinnyis ello* (L., 1758) (Lepidoptera, Sphingidae) reared on cassava, in order to obtain information for the integrated management of this pest. The larvae were reared on excised cassava leaves in Petri dishes and later in gerbox, and kept in chambers at 24 ± 2 °C and $75 \pm 10\%$ RH. The total leaf area consumed by the larva to complete its development was 589.67 cm²; each of the five instars consumed, respectively: 1.89 cm²; 5.74 cm²; 17.48 cm²; 76.66 cm²; and 487.90 cm². The consumption by the first three instars was insignificant, and did not reach 5% altogether; the 4th represented 13%; the 5th presented a consumption significantly higher, about 82.7%. The total time for the larval development was 22.61 days, and the duration for each of the five larval instar was, respectively: 4.35; 3.19; 3.32; 4.52; and 4.94 days. The pre-pupal period lasted 2.29 days. Since the highest consumption is by the 5th instar larva, the control should be applied before this age to avoid heavier damages to the cassava crop.

KEYWORDS. Cassava; larval development; leaf consumption; pest damage.

INTRODUCTION

The cassava plant had been cultivated by American natives long before the New World was discovered. Those people spread this crop to the whole American Continent. The Portuguese and the Spaniards later started the cultivation of cassava in other continents, especially in Asia and Africa (LORENZI *et al.* 1996; BEZERRA 2000). The cassava crop can be linked to the historical, social and economical development of the Brazilian people as a subsistence and typical culture due to its easy cultivation, adaptation to poor soils and good resistance to diseases. The cassava has been produced almost exclusively in small properties (DUARTE 1997; BEZERRA 2000).

World production of cassava is estimated in about 120 million tons a year. Larger areas are cultivated with this culture in the tropics where it is considered the third most important agricultural product (LORENZI *et al.* 1996). Nigeria and Thailand are the world largest producers of cassava, ranking as the sixth food product in volume, after wheat, rice, corn, potato and barley. Brazil is the third largest world producer of cassava with about 20 million tons of roots per year. From the volume

produced about 60% is used for human and animal consumption, 30% as flour and starch, and 10% for pharmaceutical, textile and chemical industries (TERNES *et al.* 1984; BEZERRA 2000).

The main pest problem on cassava crops is the defoliator *Erinnyis ello* (L. 1758) (Lepidoptera: Sphingidae) which is known as the “mandarová-da-mandioca” in Brazil. This pest can cause 100% defoliation of cassava plants; it also feeds on tender parts of the plants (TERNES *et al.* 1984; GALLO *et al.* 1988). Such defoliation can have a high impact on cassava production when it reaches 100% in six month old plants of “Mantiqueira” and “Santa Catarina” cultivars. Defoliation reduces significantly the total weight production of roots and branches (CARVALHO 1980).

This species is also a pest of rubber trees and its damage in nurseries of this plant is significantly important. An infestation of 16 caterpillars per 10 plants of rubber trees affects the normal growth of 52.2% of the plants in the nursery (CELESTINO FILHO *et al.* 1982).

Erinnyis ello generally presents five instars, this number is not constant. The number of instars can vary due to the impact

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of biotic and abiotic factors such as hereditary, rearing techniques, temperature, nutrition, sex, and intrinsic characters of each species (SILVEIRA NETO *et al.* 1976; PARRA & HADDAD 1989; PIZZAMIGLIO 1991; PARRA 2000).

The objective of this research was to evaluate leaf consumption and duration of the instars and of the larval and pre-pupal periods of *E. ello* fed with cassava leaves in laboratory conditions.

MATERIAL AND METHODS

This research was developed at the Laboratory of Entomology of the Centro de Ciências Agrárias da Universidade Federal do Espírito Santo (CCAUFES) of the Universidade Federal do Espírito Santo (UFES) in the County of Alegre, State of Espírito Santo, Brazil, at a temperature of 24 ± 2 °C, relative humidity of $75 \pm 10\%$ and photophase without control.

Eggs of *E. ello* were collected from cassava plants in the Escola Agrotécnica Federal de Alegre, in Alegre. After removed from the plants, these eggs were taken to the laboratory and maintained in gerbox plastic boxes until the emergence of caterpillars. Newly emerged caterpillars were transferred daily to individual Petri dishes of 20 x 5 cm, until they reached third instar when they were placed in gerbox boxes due to their bigger size.

The larvae of *E. ello* were maintained in six groups with ten caterpillars of similar age to obtain a uniform development, and the dead larvae were discarded. Only thirty one caterpillars that reached pupal stage were considered in the analysis.

Consumption of cassava leaves per caterpillar was evaluated using fresh leaves of the cultivars "Mantiqueira". Each caterpillar received one cassava leaf daily with its stalk inserted in moistened cotton to keep it fresh. To determine the leaf consumption per caterpillar, the leaf area was previously measured, and again at the moment of replacement by fresh ones. Leaf consumption during each instar and of complete larval stage was evaluated.

Duration of each instar and of the total larval period and pre-pupal stage were also evaluated.

RESULTS

The larvae of *E. ello* passed through five instars. The largest leaf consumption occurred during the fifth instar, and the larvae stop feeding when reach the pre-pupal stage.

Leaf consumption during the first instar was 1.89 cm² (variation from 1.2 to 3.0 cm²) what corresponded to 0.32% of the total leaf area consumed during the larval stage. During the second instar the leaf consumption was 5.74 cm² (3.4 to 8.0), what was almost three times higher than that of the first instar and it corresponded to 0.97% of the total leaf consumption of the larval stage. The third instar consumed 17.48 cm² (11.7 to 30.2) what corresponded to 2.96% of the total leaf consumption and about three times more than the previous instar. The fourth instar consumed 76.66 cm² (45.8 to 111.3), which representing

13% of the total leaf area consumed, this value was 4.4 times higher than that of the previous instar. Leaf consumption during the last instar was 487.90 cm² (324.0 to 620.0) representing 82.75% of the total leaf consumption during the larval stage, it was 6.4 times higher than that of the fourth instar (Table 1 and Fig. 1). The total leaf consumed per caterpillar during the larval stage was 589.67 cm² (variation from 389.7 to 756.6 cm²) (Table 1).

Caterpillars of *E. ello* completed the first instar in an average of 4.35 days (variation from 3.0 to 8.0 days); the second instar lasted 3.19 days (2.0 to 4.0); the third instar lasted 3.32 days (2.0 to 4.0); the fourth instar lasted 4.52 days (2.0 to 6.0) and the fifth was completed in 4.94 days (4.0 to 7.0).

The total duration of the larval stage was 20.32 days and the pre-pupal phase 2.29 days. This shows that the pre-pupal period of this insect was relatively short and it varied from one to three days.

DISCUSSION

BELLOTTI & SCHOONHOVEV (1978) reported a total leaf consumption of 1,107 cm² per caterpillar of *E. ello* which was much higher than that found in this research. However, those authors obtained 75.0% of the total leaf consumption during the fifth instar what was similar to the value registered in the present research, and also to that found by CARVALHO (1980), which was 82.34%. The highest leaf consumption during the last instars is related to a more rapid growth of the caterpillars and to the storage of nutrient reserves for posterior transformation processes during the pupal phase, as well as for the adult since this does not feed on protein but only on energetic material (PANIZZI & PARRA 1991; PARRA 2000). This fact was also reported by BOLDT *et al.* (1975) who found a soybean leaf consumption of 119, 114, 155 and 336 cm² during the last instars of the noctuid caterpillars *Trichoplusia ni* (Huebner, 1802), *Pseudoplusia includens* (Walker), *Heliothis virescens* (Fabricius, 1781) and *Heliothis zea* (Boddie, 1850).

Fig. 1. Leaf area (%) of cassava leaves consumed during each instar by the defoliator *Erinnyis ello* in laboratory at 24 ± 2 °C and $75 \pm 10\%$ relative humidity.

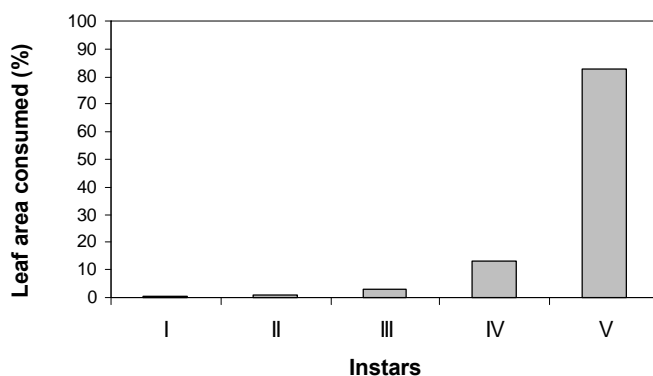


Table 1. Area of cassava leaves (cm²) consumed per caterpillar (C) and mean duration, in days (D), of the instars of the cassava defoliator *Erinnyis ello*, in laboratory at 24 ± 2 °C and 75 ± 10% relative humidity .

Caterpillar	Instar I		Instar II		Instar III		Instar IV		Instar V		Total		Pre-pupa
	C	D	C	D	C	D	C	D	C	D	C	D	
01	1.7	5	7.2	4	12.7	3	50.0	5	504.0	6	575.6	23	2
02	1.8	5	7.0	4	12.4	3	49.0	5	503.0	6	573.2	23	2
03	2.2	5	8.0	4	13.0	3	49.7	5	502.6	6	575.4	23	2
04	1.5	4	4.0	3	13.8	4	46.4	4	324.0	6	389.7	21	3
05	2.1	5	4.0	3	13.8	4	46.0	4	504.0	7	569.5	23	3
06	1.6	7	4.0	3	12.5	3	49.8	5	504.0	7	572.0	22	3
07	1.6	4	4.0	3	24.4	4	59.6	5	492.0	6	581.6	22	3
08	1.0	5	8.2	4	11.9	3	77.2	5	468.0	5	566.3	22	3
09	1.4	4	3.4	4	10.2	3	98.2	6	468.0	5	581.2	22	2
10	1.2	4	5.8	4	12.4	3	45.8	5	502.5	6	567.7	22	2
11	2.1	8	8.6	3	30.2	3	67.0	3	420.0	4	527.9	21	2
12	1.9	5	6.4	3	21.8	4	110.5	5	420.0	4	560.6	21	2
13	1.8	4	4.6	4	15.8	3	110.5	6	620.0	5	752.7	22	1
14	1.5	4	7.4	4	15.5	3	91.5	5	457.0	5	573.3	21	2
15	2.4	6	5.4	3	21.9	4	111.0	4	420.0	4	560.7	21	2
16	2.7	4	6.8	4	15.8	4	111.3	5	620.0	5	756.6	22	3
17	3.0	4	7.0	4	14.8	3	110.9	6	620.0	5	755.7	22	3
18	1.6	8	7.0	3	21.6	3	110.3	4	560.0	4	700.5	22	2
19	2.6	4	4.4	3	21.7	4	70.8	4	420.0	4	519.5	19	2
20	2.5	3	7.4	4	23.2	4	89.0	4	420.0	4	542.1	19	2
21	2.0	4	6.8	3	20.5	4	71.5	4	420.0	4	520.8	19	2
22	1.9	3	4.8	3	12.1	3	69.0	5	466.5	5	554.3	19	2
23	1.9	4	5.7	3	11.7	2	61.3	5	463.5	5	544.1	19	2
24	2.7	4	6.7	2	20.3	3	79.5	4	620.0	5	729.2	18	2
25	2.1	4	6.2	3	20.0	4	61.5	2	580.0	5	669.8	18	3
26	1.7	4	5.1	2	20.2	3	73.0	4	420.0	4	520.0	17	2
27	1.6	4	4.2	2	20.3	3	71.5	4	420.0	4	517.6	17	2
28	1.2	3	4.4	3	20.0	3	81.5	4	418.0	4	525.1	17	2
29	1.3	3	3.4	2	21.9	4	72.0	4	420.0	4	518.6	17	2
30	1.7	3	6.2	3	21.0	3	81.0	4	578.5	5	688.4	18	3
31	1.7	4	4.0	2	15.0	3	100.2	5	569.5	4	690.4	18	3
Total	58.50	135	178.1	99	542.0	102	2376.5	140	15125.0	153	18280.1	630	71
Mean	1.89	4.35	5.74	3.19	17.48	3.32	76.66	4.52	487.90	4.94	589.67	20.32	2.29
Range	1.0-3.0	3-8	3.4-8.6	2-4	10.2-30.2	2-4	46.0-111.3	2-6	324.0-620.0	4-7	389.7-756.6	17-23	1-3

Those numbers represent about 90.0% of the total leaf consumed by these insects during their last instar.

Studies about damage by insect pests are important because they allow to predict its impact on the crop production. BELLOTTI & SCHOONHOVEV (1978) showed that the defoliation of cassava plants has a high impact on cassava production when the damage occurs when the plants are six to 10 months old. They obtained 1.107 cm² of consumed area of cassava leaves per caterpillar, and observed that a relatively high population of *E. ello* can be tolerated by these plants. This can be explained by the fact that cassava plants do not present significant losses of root production even with defoliation up to about 80%.

CONCLUSION

Caterpillars of *E. ello* present the higher leaf consumption during the fifth instar. For this reason, the pest control can be directed to the last instars, and only when the population reaches high number of individuals. The biological dates can be useful to predict the insect infestation period and to establish the most adequate integrated pest management strategies.

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