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Immature Stages of *Spodoptera eridania* (Lepidoptera: Noctuidae): Developmental Parameters and Host Plants

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ABSTRACT. This study aimed to detail the temporal and morphological parameters of the immature stages of southern armyworm *Spodoptera eridania* (Stoll, 1782) with larvae feed on artificial diet, under controlled conditions (25 ± 1°C, 70 ± 10% relative humidity and 14-h photophase) and gather information about their larval host plants. The viability of the egg, larval, pupal, and prepupal stages was 97.82, 93.62, 96.42, and 97.03%, respectively. The average duration of the egg, larval, pupal, and pre–pupal stages was 4.00, 16.18, 1.58, and 9.17 d, respectively. During the larval stage, 43.44% of females passed through seven instars, observing that the female's development was significant slower than males. The female larvae that developed through six and seven instars exhibited a mean growth rate of 1.52 and 1.44, respectively. Female pupae were significantly larger, exhibiting faster development than males. The rearing method proved to be adequate, providing more detailed observations of the biological cycle, especially at the larval stage, and resulting in an overall survival of almost 85%. Two hundred two plant species belonging to 58 families are listed as natural hosts for *S. eridania*, mainly including Asteraceae, Fabaceae, Solanaceae, Poaceae, Amaranthaceae, and Malvaceae.

Key Words: caterpillar, developmental parameter, egg, pupae, southern armyworm

The genus *Spodoptera* Guenée, 1852 (Lepidoptera: Noctuidae: Noctuinae) (Lafontaine and Schmidth 2010) is cosmopolitan and includes many of the most important agricultural caterpillars (Pogue 2002). *Spodoptera eridania* (Stoll 1782) occurs from South America through North America (e.g., Pogue 2002, Pastrana 2004, Bentancourt and Scatoni 2006, Angulo et al. 2008).

Since the beginning of the last century, *S. eridania* has a high reported degree of polyphagy (e.g., Chittenden and Russel 1909, Crumb 1956, Silva et al. 1968, Pastrana 2004, Angulo et al. 2008). The polyphagy of this species led to important studies on the selection and use of various host plants by polyphagous insects (e.g., Soo Hoo and Fraenkel 1966a,b; Scriber 1979, 1981; Manuwoto and Scriber 1982, 1985).

In the "World *Spodoptera* Database (Lepidoptera: Noctuidae)" (Pogue 2012), the largest *Spodoptera* database, 106 host plants are presently indicated for *S. eridania*, mostly with records from North and Central America. A large number of records are from crop pest survey studies (e.g., Crumb 1929) together with 56 host plants of 31 families from a population outbreak after Hurricane Hugo in 1989 (Torres 1992), mostly native to Puerto Rico. Furthermore, studies by Soo Hoo and Fraenkel (1966a,b) reveal that this species tolerates, and grows well on, several species on which their larvae were not collected in nature.

The large number of references of this species indicates the importance of this insect to different crops such as alfalfa, bean, beet, cabbage, cassava, collard, cotton, onion, peanuts, quinoa, soybean, tobacco, tomato, sweet potato, sunflower, and truck crops, in various locations throughout American continent (e.g., Silva et al. 1968, Pastrana 2004, Angulo et al. 2008, Pogue 2012). Additionally, this species has been reported from outbreaks under different conditions, such as after the passage of a hurricane (Torres 1992), in reforestation projects of native species (Mattana and Foerster 1988), in truck crops (Michereff-Filho et al. 2008), reaching economic injury levels in commercial crops, especially alfalfa (Hichings and Rabinovich 1974) cotton and soybeans (Parra et al. 1977; Santos et al. 2005, 2010; Sujii et al. 2006; Quintela et al. 2007; Valverde 2007).

Beyond its great voracity and reproductive capacity (e.g., Valverde and Sarmiento 1987 [1986], Mattana and Foerster 1988, Santos et al. 2005), *S. eridania* develops on weeds, which generally constitute a primary source of cultivated plant infestations (Tingle et al. 1978, Savoie 1988, Sánchez and Vergara 1996 [1995], Santos et al. 2005), and presents different degrees of tolerance to several chemical insecticides (e.g., González 1966; Campos 1972, 1982; Aziz 1973; Aguilera and Vasquez 1974), botanical insecticides, and soap (Valler and Capinera 1993, Rosseti et al. 2008), and to the *Bacillus thuringiensis Cry1Ac* gene (Zenner-de-Polanía et al. 2008, Amaya et al. 2009).

Considering the importance of *S. eridania* for several crops of economic interest and a possibility of outbreaks, this study is part of a project that aims to compare the biology of the main representatives of *Spodoptera* occurring in the Americas, particularly in South America, under same conditions. In these studies, we compare in sequence the biological aspects of *Spodoptera albula* (Montezano et al. 2013), *S. eridania*, *Spodoptera dolichos*, *Spodoptera cosmioides,* and *Spodoptera frugiperda*. We employ and validate a methodology that incorporated detail setting not made by others studies, e.g., a larger number of neonates evaluated individually to adult emergence, including a more complete detailing of biological parameters, with minimal interference in its development. Additionally, this study aimed to gather and organize information relating to host plants, emphasizing South American records.

Materials and Methods

Insects and Rearing. These experiments only used first generation specimens whose ancestor moths were reared from 32 larvae collected

on soybean, within the Jataizinho and Ibiporã municipalities, Paraná State, Brazil (23° 11'11.9" S, 51° 01'58.3" W, Datum WGS84, 424 m.a.s.l.). Identification was accomplished by comparing larvae and adults with descriptions in Pogue (2002). All the experiments were performed, with one daily observation indicated at 2:00 p.m., in a climate-controlled room (25 ± 1°C, 70 ± 10% relative humidity [RH], and a 14-h photophase).

Egg Stage. The egg masses were individually placed into a Petri dish (Pyrex® St. Louis, MO) lined with filter paper moistened with distilled water, where it remained until the eclosion of the larvae. We evaluated the feasibility (fertility) and the embryonic period, in days, of 28 egg masses (2,383 eggs) taken randomly from five couples, including the first and last ovipositions. The egg masses used were from females that presented one ($n = 2$) and two ($n = 3$) spermatophores in the bursa copulatrix, indicating that they had been fertilized during the experiment. For this purpose, adults were kept in pairs ($n = 15$) within cylindrical plastic containers, 10 cm in diameter and 15 cm in height, with tops closed using plastic film, to which container with long filter paper strips were attached, to stimulate oviposition. The bottom part of the container was closed with a Petri dish (10.5 cm in diameter) lined with filter paper.

Larval Stage. Soon after hatching, 298 larvae from the second-laid egg mass of a single female were individually placed in properly identified 150-ml plastic cups, covered with a transparent plastic cap. A small wad of cotton wool (~1 cm in diameter), moistened with distilled water to maintain humidity, along with a small piece of ~1 cm^3 of artificial diet were deposited with a sterilized tweezer each cup, as described below. Daily observations were made to verify the survival and development of the larva (with the removal of the head capsule). During these observations, the diet and the cotton were replaced, to maintain humidity, always being careful to not interfere and to touch the larva as little as possible. The head capsules were individually stored, by larvae, in microcentrifuge tubes, for posterior measurement. In some cases, the change of instar was noticed through the development of the larva, but the capsule was not found, most likely because it had been eaten by the larva, which is relatively common among insects. In these cases, the date of ecdysis was recorded, and the size was then compared with the other larvae to confirm ecdysis, and the corresponding duration of each stage.

When the larvae reached the prepupal period, characterized by a decrease in size and the interruption of feeding, the diet and the cotton swab were removed. Thereafter, expanded vermiculite, moistened with distilled water, was added to each cup to a height of 0.5 cm to encourage the development of the pupal chamber and to allow the observation of metamorphosis, recording the prepupal period.

We maintained the identification number from the larval to the pupal stage to record the number of instars, the survival, and the individual duration of each stadia and prepupal period, taking into account the sex of each larva. It also allowed us to evaluate growth as a function of the number of larval instars.

To record the average size of each larval instar of *S. eridania*, the width of the cephalic capsules was measured, with a micrometer under a microscope. Most of the larvae developed through six instars, of which randomly selected 15 specimens that originate females and males to measure the head capsules. Only nine females went through seven instars, which were all measured. The mean growth rate was calculated by taking the average of the subsequent instar subtracted by the previous.

Composition and Preparation of Larval Diet. The artificial diet (adapted from Greene et al. 1976) composed of 2,150 ml of distilled water; 35 g of agar; 125 g of type 1 carioca bean; 100 g of wheat germ; 25 g of powdered whole milk; 62.5 g of yeast extract; 6 g of ascorbic acid; 10 ml of Vanderzant vitamin mixture; 250 mg of tetracycline; 6 ml of 40% formaldehyde; 5 g of methyl parahydroxybenzoate (Nipagin); 3 g of sorbic acid; and 50 g of soy protein, modified according to Montezano et al. (2013).

Initially, the beans, placed in an Erlenmeyer flask (500 ml) with distilled water (150 ml) and capped with a wad of hydrophobic cotton wrapped in gauze, were cooked in an autoclave, at one atmosphere, for 40 min. After which the flask with the baked beans was removed from the autoclave, capped with aluminum foil, and kept on the laboratory table until the temperature reached 25°C.

The prebaked beans were then ground together with the remaining ingredients (wheat germ, powdered milk, yeast extract, soy protein, and agar), which were added slowly along with the distilled water (1,500 ml) into a domestic blender at full power for at least 10 min, forming a homogeneous mass. This homogenized mass was transferred to a stainless steel pot and cooked for 5 min, after the boiling point. After cooking, the mass was removed from the heat and was cooled to 40°C, by mixing it manually.

At the same time, the ascorbic acid, sorbic acid, Nipagin, tetracycline chlorhydrate, vitamin mixture, and formaldehyde solution were manually mixed in a 1-liter beaker containing distilled water (500 ml), until the complete homogenization of the ingredients. This solution was added to the cooked mass, and both were manually mixed together until completely homogenized.

The finished diet was placed in polyethylene boxes (11 by 11 by 3.5 cm) to the maximum height of 2.5 cm of diet. The boxes were immediately transferred to a laminar flow chamber with ultraviolet light, until the temperature of 25°C was reached. After that, the polyethylene boxes were closed and kept under refrigeration (5°C) until the diet was used.

The diet was cut with a stainless steel spatula, previously cleaned with 70% alcohol, and individually offered to each caterpillar, in cubes of ~1 cm^3, during the daily maintenance activities.

Considering the polyphagous habit and lack of organization of information relating to larval host plants, a survey of the plants cited in literature and in the internet sites hosted by educational or research institutions was performed, gathering information on the botanical family, specific and common names, and bibliographic references. The nomenclature of the plants has been updated mainly using Backes and Nardino (2001). Furthermore, this work gathered additional information including records from Rio Grande do Sul State, Brazil, especially in the mountainous region during two population outbreaks occurring in the spring of 1997 and 2004.

Pupal Stage. The pupae were kept without food, under the same conditions, and in the same containers of the prepupa. On the second day after pupation, when the cuticle was further hardened, the sex was determined according to the drawings in Angulo and Jana (1982). In addition to duration, the mass was measured using a semi-analytical balance, accurate to 100th of a gram. As the sex can only be precisely identified during the pupal stage, the identification number of each larva was maintained until pupation to know whether it was male or female, allowing comparisons between genders, even during the larval stage. The daily maintenance activities consisted of maintaining the moisture, with a few drops of distilled water, and detecting the emergence of the adult.

The biological parameters such as duration, size, and weight were analyzed using descriptive statistics with the calculation of means and standard deviations. When necessary, means were compared using a *t*-test assuming unequal variances, at a significance level of 5%.

Results

The eggs from females, which had copulated once or twice, have viability of 97.82%, and the embryonic period has no variation (Table 1).

In the larval stage, including the prepupal period (Table 1), we observed the lowest survival (90.27%), driven especially by the larvae that died between the first and second instars. Most larvae (96.56%) developed through six instars, and only a few females (3.44%) went through seven instars (Table 2).

The duration of the female larvae, which developed six instars, was significantly higher than that of the male larvae. However, it was

significantly lower than those of larvae female, which developed through seven instars. The differences in the duration of the six and seven instar female larvae were detected during the fifth instar, when it was observed that both in the fifth and sixth instars, the larvae with an additional instar experienced a significantly faster larval development (Table 2).

The length of the prepupal period was quite variable and did not differ between gender and among females who developed for six and seven instars.

With respect to the size of the head capsule of individuals who passed through six instars, the females were significantly larger than males from the fifth instar on. Similarly, six instar females were significantly larger than those of seven instars, from fourth instar on. However, the additional instar resulted in a significantly larger final size ($P = 0.038$) of the female larvae that developed through seven instars (Table 3).

The literature search and author's field observations records of the plants consumed by *S. eridania* provided a list of 202 taxa belonging to 58 plant families. In Rio Grande do Sul, 69 host plants were recorded, of which 38 had not been previously reported (Table 4).

The botanical families with the greatest number of species consumed include Asteraceae (20); Fabaceae (19); Solanaceae (14); Poaceae (10); Amaranthaceae (9); Malvaceae (8); Brassicaceae; Cucurbitaceae; Polygoniaceae; Rubiaceae (7); Lamiaceae, Phytolaccaceae, and Rosaceae (6); and both Convolvulaceae and Euphorbiaceae (5) (Table 4). Besides the large number of cultivated species, the large number of weeds and native plants stand out.

The sex ratio obtained from 135 female and 134 male pupae was 0.502, which does not differ significantly from a 1:1 ratio ($\chi^2 = 0.951$; $P < 0.05$). Female pupae were significantly heavier than male, among individuals who had six larval instars. Furthermore, the females that experienced an additional instar were significantly heavier that those who went through six instars (Table 5).

Discussion

Egg Stage. Our results (Table 1) indicate that the duration of the incubation period of *S. eridania* is invariable, similar to that observed by under the same temperatures using different host plants (Chittenden and Russel 1909, Valverde and Sarmiento 1987 [1986], Mattana and Foerster 1988).

The egg viability (Table 1) obtained from fertilized females corresponds to those described by Valverde and Sarmiento 1987 [1986], for the first generation of the same species on four host plants. The differences with respect to other publications that are reported smaller percentages of viability (e.g., Parra et al. 1977, Mattana and Foerster 1988, Bortoli et al. 2012) may be due to eggs from couples that did not copulate. In these cases, high fecundity values are always attributed to representatives of *Spodoptera* in studies where multiple mating is known to enhance the reproductive capacity, including fertility (Kehat and Gordon 1975, Sadek 2001, Sadek and Anderson 2007, Busato et al. 2008, Milano et al. 2008, Montezano et al. 2013).

Larval Stage. The larval survival (Table 1) indicates that the diet and the rearing conditions were satisfactory for the development of *S. eridania* in the laboratory.

The fact that most of the larvae (96.56%) developed through six instars indicates that diet met the specific needs similarly to that observed with host plants considered as adequate. In this direction, under the same conditions of this study, Mattana and Foerster (1988) found that *S. eridania* presented six instars when created in sweet potatoes (a suitable plant) and seven instars in bracatinga an unsuitable plant. It should be emphasized that the same species had only five instars when reared on slim amaranth [*Amaranthus hybridus* (L.)] considered as the most appropriate, among the four tested (Valverde and Sarmiento 1987 [1986]). The observation that only a few *S. eridania* females developed through seven instars (Table 2) is consistent with observations that in *S. albula* many more females than males develop through an additional instar, probably due to their larger size (see Pupal Stage) (Montezano et al. 2013). In previous studies of *S. eridania*, all subjects which fed on bracatinga passed through an additional instar (Mattana and Foerster 1988). Though in Parra et al. (1977) and Santos et al. (2005), ~20% of the individuals had additional instars on less adequate diets, although their rearing methods did not allow us to infer the gender of the individuals who developed through seven instars.

Duration of the larval stage, including the prepupal period (Tables 1 and 2) is similar to descriptions for the same species reared under similar temperatures, on more adequate food plants (Parra et al. 1977, Valverde and Sarmiento 1987 [1986], Mattana and Foerster 1988). The several temporal differences detected between the number of larval instars, including the longer duration of the first instar, than the subsequent three (Table 2), is also described for the same species (Parra et al. 1977, Valverde and Sarmiento 1987 [1986], Mattana and Foerster 1988, Santos et al. 2005) and for several *Spodoptera* representatives (e.g., Santos et al. 2003, Azidah and Sofian-Azirum 2006, Montezano et al. 2013). The temporal differences between sexes are also described for *S. albula* and probably are related to the sex dimorphism (Montezano et al. 2013).

The longer duration of *S. eridania* female larvae, which developed through seven instars (Table 2), is similar to that observed for *S. albula* (Montezano et al. 2013) and is consistent with experiments with other *Spodoptera* species in which the authors associated a longer larval period with an increased number of instars (e.g., Santos et al. 2005, Azidah and Sofian-Azirum 2006).

The significant difference in the overall developmental time of female and male *S. eridania* larvae that underwent six instars (Table 2) and the corresponding differences between the duration of the stages, which are more pronounced (significant) from the fifth instar on, agree with the observations reported for *S. albula* under the same conditions (Montezano et al. 2013).

The mean width of the head capsule (Table 3) is very similar to that described by Parra et al. (1977) and Mattana and Foerster (1988) and is slightly larger than that described by Mayer and Babers (1944), and Valverde and Sarmiento 1987 [1986] for the first instar, but not for the last instar.

Both the larvae that had six instars and those which went through seven instars (Table 3) showed higher growth rates during the first instars, decreasing progressively until the last, especially noticeable in larvae that underwent seven instars. Similar behavior was also observed for the same species (Mayer and Babers 1944, Parra et al. 1977, Valverde and Sarmiento 1987 [1986], Mattana and Foerster 1988) and for *S. albula* (Montezano et al. 2013). However, the largest mean growth rate recorded for larvae that develop through a fewer number of instars (Table 3) is consistent with that described for the same species feeding on slim amaranth [*Amaranthus hibridus* (L.)], considered the best food plant under which the larvae completed their development for only five instars. In the fifth instar, the larvae fed on slim amaranth reached the size resembling sixth instar larvae fed on tomato, sweet potato, and purslane (Valverde and Sarmiento 1987 [1986]).

The measurement of the largest width of the head capsule of the last instar of *S. eridania* (Table 3) is very similar to the values described in several studies of the same species (Mayer and Babers 1944, Parra et al. 1977, Valverde and Sarmiento 1987 [1986], Mattana and Foerster 1988).

Table 1. Survival and duration of the *S. eridania* life cycle during different developmental stages, on artificial diet under controlled conditions (25 ± 1°C, 70 ± 10% RH, and 14-h photophase)

Stage	*N* initial–final	Survival (%)	Duration (d)	Range (d)
Egg	2,383–2,331	97.818	4.00 ± 0.000	4
Larval	298–279	93.624	16.183 ± 1.591	14–21
Prepupal	279–269	96.416	1.575 ± 0.588	1–3
Pupal	269–261	97.026	9.169 ± 1.328	7–14
Total	—	85.673	30.927	—

Table 2. Mean larval and pupal duration (d) of *S. eridania*, during each instar, including the larvae of each sex which developed for six and seven instars, fed with an artificial diet, under controlled conditions (25 ± 1°C, 70 ± 10% RH, and 14-h photophase)

Developmental period	Six instars (mean ± SD)				Seven instars (mean ± SD)
	Females (120)	Significance	Males (132)	Significance	Females (9)
I	3.008 ± 0.330	NS	3.023 ± 0.380	NS	3.222 ± 0.441
II	2.408 ± 0.587	NS	2.318 ± 0.529	NS	2.222 ± 0.441
III	2.333 ± 0.599	NS	2.242 ± 0.526	NS	2.444 ± 0.726
IV	2.500 ± 0.710	NS	2.402 ± 0.652	NS	2.444 ± 0.726
V	2.867 ± 0.733	NS	2.674 ± 0.682	*	2.444 ± 0.527
VI	4.875 ± 1.142	NS	4.606 ± 0.979	**	3.111 ± 0.928
VII	—	NS	—	NS[a]	5.222 ± 0.667
Prepupal	1.525 ± 0.549	NS	1.629 ± 0.623	NS	1.444 ± 0.527
Total[b]	17.992 ± 1.452	**	17.265 ± 1.353	**	21.111 ± 1.167
Pupal	8. 933 ± 1.352	**	9.500 ± 1.485	NS	8.444 ± 1.333
Larval + pupal	26.925 ± 2.087	NS	26.765 ± 1.773	**	29.556 ± 2.007

Comparisons of means using a Student's *t*-test, considering different variances, at a significance level of 95% (NS, $P > 0.05$; *$P < 0.05$; **$P < 0.01$).
[a]Nine females.
[b]Larval including prepupal period.

Table 3. Width (mm) of head capsules of *S. eridania* larvae reared on artificial diet, at each instar and respective growth rates, including larvae which developed for six (15 females and 15 males) and seven instars (9 females), under controlled conditions (25 ± 1°C, 70 ± 10% RH, and 14-h photophase)

Instar	Six instars						Seven instars	
	Females (15)			Males (15)			Females (9)	
	Mean ± SD	Growth rate	Significance	Mean ± SD	Growth rate	Significance[a]	Mean ± SD	Growth rate
I	0.323 ± 0.021	—	NS	0.318 ± 0.030	—	NS	0.313 ± 0.026	
II	0.485 ± 0.026	1.501	NS	0.483 ± 0.046	1.520	NS	0.484 ± 0.041	1.546
III	0.783 ± 0.038	1.614	NS	0.785 ± 0.047	1.625	NS	0.747 ± 0.046	1.541
IV	1.183 ± 0.060	1.510	NS	1.189 ± 0.035	1.514	*	1.114 ± 0.066	1.493
V	1.773 ± 0.104	1.499	*	1.664 ± 0.087	1.400	**	1.540 ± 0.101	1.382
VI	2.636 ± 0.105	1.486	*	2.505 ± 0.117	1.505	**	2.096 ± 0.119	1.361
VII	—	—		—	—	—	2.720 ± 0.077	1.298
Mean	—	1.522		—	1.513	—	—	1.437

Comparison of means using a Student's *t*-test, considering different variances, at a significance level of 95% (NS, $P > 0.05$; *$P < 0.05$; **$P < 0.01$).

This is certainly related to the theory that the absolute size of caterpillars at the end of development triggers the process of metamorphosis (Nijhout 1975). This also explains the low growth rate between the penultimate and last larval instar of specimens that have undergone additional instars (Table 3), also described by Parra et al. (1977) and Mattana and Foerster (1988).

During the prepupal period (Tables 1 and 2), which corresponds to the time when the larvae do not feed and prepare for the pupal stage, a relatively high survival was observed, along with a relatively short duration, without any significant differences between sexes and individuals which underwent six or seven larval instars. The only data in the literature referring to prepupal survival for this species (Santos et al. 2005) indicates 100.0, 90.0, and 37.5% survival during this period, with larvae feeding on cotton, morning glory, and soybean leaves, respectively. In any case, *S. eridania* was very well adapted to its rearing conditions, even during this period, usually considered critical for holometabolous insects due to metamorphosis (Parra 1991).

The records of at least 202 natural host plants of *S. eridania* (Table 4) is certainly related to the high degree of polyphagy described by several authors in North America (e.g., Chittenden and Russel 1909, Crumb 1929, Soo Hoo and Fraenkel 1966a,b), Central America (e.g., Maes and Tellez 1988, Torres 1992, Coto et al. 1995), and South America (e.g., Silva et al. 1968, Biezanko et al. 1974, Pastrana 2004).

The large number of natural host plants of *S. eridania* (Table 4) is only comparable to *S. frugiperda* (Smith 1797) for which there are 186 host plants (Casmuz et al. 2010). However, for *S. frugiperda,* there is a clear preference for Poaceae (66 species), which is not observed in *S. eridania*, with only 10 Poaceae; the number of Fabaceae (21) recorded for *S. frugiperda* is almost equal to that obtained for *S. eridania* (20); yet the numbers of Asteraceae and Solanaceae (8) reported for *S. frugiperda* are much lower than those recorded for *S. eridania* (20 and 19, respectively). Beside these differences, it should be noted that *S. eridania* seems to have a preference for certain groups of plants not commonly used by other species such as *S. albula* (Montezano et al. 2013) and *S. frugiperda* (Casmuz et al. 2010), with few or no records of Amaranthaceae and Phytolaccaceae (Table 4). The fact that this species was initially recorded very early in North (Smith 1797), Central (Puerto Rico) (Chittenden and Russel 1909) and South America (e.g., Lima 1928 [1927], Marques 1932) as feeding on Phytolaccaceae (Table 4) in all these localities supports the hypothesis presented by Scriber (1986) that pokeweeds are their natural hosts.

We highlight the occurrence of this species in crops of regional importance or which have been explored with greater intensity at different locations during the same periods or at different times (Table 4). This data relate to the versatility and ability of this species to rapidly adapt in various regions of the continent feeding on cultivated plants such as alfalfa, bean, beet, cabbage, cassava, corn, cotton, potato, sweet potato, and tomato (e.g., Chittenden and Russel 1909; Lima 1928 [1927]; Crumb 1929; Marques 1932; Wolcott 1936, 1948 [1951]; Hambleton 1939; Tucker 1939; Waterston 1939, 1947; Corseuil 1955; Olalquiaga 1955; Costa 1958; Nickel 1958; Harris 1959; Kimbal 1965; González 1966; McGuire and Crandal 1967; Silva et al. 1968; Cantu and Wolfenbarger 1970; Creighton et al. 1971; Tietz 1972; Valencia and Valdivia 1973; Biezanko et al. 1974; Hichings and Rabinovich 1974;

Table 4. Natural host plants of *S. eridania* larvae recorded in several bibliographic sources and new records from Rio Grande do Sul State, Brazil, especially within the mountainous region from two population outbreaks, during the spring of 1997 and 2004

Botanic family	Scientific name	Common name	References
1. Acanthaceae	*Odontonema strictum* (Nees) Kuntze		55, 71
2.	*Sanchezia speciosa* Leonard		55, 71
3.	*Teliostachya alopecuroidea* (Vahl) Ness		55, 71
4. Amaranthaceae	*Achyranthes aspera* L.	Devil's horsewhip	67
5.	*Amaranthus deflexus* L.	Red-root amaranth	31, 63, [a]
6.	*Amaranthus hibridus* L.	Slim amaranth	37, 54, 31, 71
7.	*Amaranthus quitensis* Kunth	Ataco	63
8.	*Amaranthus retroflexus.* L.	Rough pigweed	54
9.	*Amaranthus spinosus* L.	Spiny amaranth	1, 2, 6, 29, 51, 67, 71, [a]
10.	*Amaranthus viridis* L.	Callalco	59
11.	*Celosia cristata* L.	Cockscomb	[a]
12.	*Spinacia oleracea* L.	Spinach	54
13. Anacardiaceae	*Schinus terebentifolium* Raddi	Brazilian peppertree	[a]
14. Apiaceae	*Apium graveolens* L.	Celery	3, 22, 29, 54, 56, [a]
15.	*Daucus carota* L.	Carrot	2, 29, 71
16.	*Hydrocotyle ranunculoides* L.	Water pennywort	70
17. Apocynaceae	*Nerium oleander* L.	Oleander	2, 29, 71
18. Araceae	*Xanthosoma* sp.		55, 71
19. Araliaceae	*Didymopanax morototoni* (Aubl.) Decne & Pl.		55, 71
20. Asteraceae	*Artemisia absinthium* L.	Absinthium	[a]
21.	*Baccharis trimera* (Lessing) de Candolle	Carqueja	[a]
22.	*Bidens pilosa* L.	Hairy beggarticks	[a]
23.	*Chrysanthemum morifolium* Ramat	Chrysanthemum	38, 39, 71
24.	*Clibadium erosum* (Swartz) de Candolle		55, 71
25.	*Conyza bonariensis* (L.) Cron.	Weed	55, 71
26.	*Conyza canadensis* (L.) Cron.	Hogweed	55, 71
27.	*Eclipta prostrata* (L.) L.	Eclipta	55, 71
28.	*Erechtites valerianaefolia* (Wolf) DC.	Brazilian fireweed	55, 71
29.	*Gerbera jamesonii* Bolus	Gerbera daisy	[a]
30.	*Helianthus* sp.		29
31.	*Helianthus annuus* L.	Sunflower	2, 43, 71
32.	*Lactuca sativa* L.	Lettuce	23, 48, 56, 71, [a]
33.	*Mikania cordifolia* (L.) Willdenow	Guaco	55, 71
34.	*Neurolaena lobata* (L.) Cassini		55, 71
35.	*Pseudoelephantopus spicatus* (Jussieu ex Aublet) C.F. Baker	Weed	55, 71
36.	*Sonchus* sp.	Sonchus	2, 71
37.	*Sonchus oleraceus* L.	Common sowthistle	29, [a]
38.	*Taraxacum officinale* Webber	Blowball	[a]
39.	*Vernonia tweedieana* Baker	Ironweed	[a]
40. Balsaminaceae	*Impatiens sultani* HooK	Balsamine	[a]
41.	*Impatiens wallerana* Hook.		55, 71
42. Begoniaceae	*Begonia rex* Putz	Begonia	[a]
43. Brassicaceae	*Coronopus didymus* (L.) Smith	Lesser swinecress	[a]
44.	*Brassica napus* L. var. *oleifera* (de Candolle) Metzger	Colza	62
45.	*Brassica nigra* (L.) W.D.J. Koch	Black mustard	42, 71
46.	*Brassica oleracea* var. *capitata* L.	Cabbage	2, 29, 34, 48, 56, 71, [a]
47.	*Brassica oleracea* L. var. *viridis* L.	Collard	1, 2, 29, 71, [a]
48.	*Eruca sativa* Gars.	Garden rocket	[a]
49.	*Nasturium officinale* R. Brown	Watercress	[a]
50. Campanulaceae	*Lobelia portoricensis* (Vatke) Urban		55, 71
51. Caprifoliaceae	*Lonicera japonica* Thumberg	Japanese honeysuckle	[a]
52. Caricaceae	*Carica papaya* L.	Papaya	68
53. Caryophyllaceae	*Dianthus caryophillus* L.	Carnation	4, 10, 17, 19, 24
54. Cecropiaceae	*Cecropia peltata* L.	Trumpet tree	55, 71
55. Chenopodiaceae	*Beta vulgaris* L.	Beet	2, 24, 29, 48, 54, 56, 62, 63, 65, 71, [a]
56.	*Beta vulgaris vulgaris* L.	Sugar beet	31.
57.	*Beta vulgaris* L. var. *cicla* L.	Swiss chard	16, 62, 65, 71, [a]
58.	*Chenopodium quinoa* Willdenow	Quinoa	12, 60, 71
59. Commelinaceae	*Commelina diffusa* Burman		55, 71
60.	*Tripogandra serrula* (Wahl) Handles		55, 71
61. Convolvulaceae	*Calonyctium speciosum* Choisy	Good night	[a]
62.	*Ipomoea batatas* (L.) Lamarck	Sweet potato	1, 2, 4, 5, 13, 15, 17, 19, 20, 22, 24, 29, 31, 33, 48, 56, 62, 63, 71, [a]
63.	*Ipomoea grandiflora* L.	Moonflower	64
64.	Ipomea purpurea Roth	Handbell	[a]
65.	*Ipomea tiliacea* (Willdenow) Choisy		55, 71
66. Cucurbitaceae	*Cayaponia americana* Lamarck		55, 71
67.	*Cayaponia racemosa* Miller		55, 71
68.	*Cucumis melo* L.	Melon	48, [a]
69.	*Cucumis sativus* L.	Cucumber	24, 48, 56, [a]
70.	*Cucurbita maxima* Duch	Squash	29
71.	*Citrullus lanatus* var. *lanatus* (Thumberg) Matsumura & Naka	Watermelon	2, 29, 48, 56, 71

(*continued*)

Table 4. Continued

Botanic family	Scientific name	Common name	References
72.	*Sechium edule* (Jacquin.) Swartz	Chayote	[a]
73. Dioscoreaceae	*Dioscorea polygonoides* Humboldt Bonpland ex. Willdenow	Dioscorea	55, 71
74.	*Rajania cordata* L.		55, 71
75. Ericaceae	*Vaccinium macrocarpum* Aiton	Cranberry	29
76. Escrofulariaceae	*Antirrhinum majus* L.	Snapdragons	[a]
77. Euphorbiaceae	*Aleurites fordii* Hemsley	Tung tree	5, 17, 19, 24, 62.
78.	*Manihot esculenta* Crantz	Cassava	17, 19, 24, 36, 41, 47, 48, 56, 71
79.	*Phyllanthusurinaria* L.		55, 71
80.	*Ricinus communis* L.	Castor bean	2, 17, 19, 22, 24, 29, 54, 71, 72
81.	*Sapium jamaicense* Swartz		55, 71
82. Fabaceae	*Arachis hypogaea* L.	Peanuts	2, 20, 26, 29, 56, 71, [a]
83.	*Centrosema pubescens* Benth	Spurred butterfly pea	55, 71
84.	*Cicer arietinum* L.	Chick pea	44, 71
85.	*Crotalaria breviflora* de Candolle	Shortflower rattlebox	66
86.	*Crotalaria spectabilis* Roth.	Showy rattlebox	66
87.	*Desmodium adscendens* (Swartz) de Candolle	Tick clover	55, 71
88.	*Glycine max* (L.) Merril.	Soybean	29, 56, 62, 65, 71, [a]
89.	*Leucaena leucocephala* Lamarck		55, 71
90.	*Medicago sativa* L.	Alfalfa	24, 28, 30, 31, 62, 63, 65, 71
91.	*Mimosa pudica* L.	Sensitive plant	55, 71
92.	*Mimosa scabrella* Benthan	Bracatinga	49, 52, 71
93.	*Mucuna pruriens* var. Utillis (Wallich ex. Wight) Backer ex. Burk	Velvet bean	2, 29, 71
94.	*Phaseolus lunatus* L.	Lima bean	44, 71
95.	*Phaseolus polystachios* (L.) Britton, Sterns & Poggenburg	Thicket bean	29
96.	*Phaseolus vulgaris* L.	Bean	13, 24, 29, 31, 48, 54, 56, 62, 63, 65, 71, [a]
97.	*Pisum sativum* L.	Pea	54, [a]
98.	*Trifolium* sp.	Clovers	2, 29, 71
99.	*Vicia faba* L.	Faba bean	61
100.	*Vignum unguiculata* (L.) Walpers	Cowpea	1, 2, 29, 40, 56, 71
101. Geraniaceae	*Geranium* sp.	Geranium	54
102.	*Pelargonium hortorum* L.H. Bailey	Geranium	[a]
103. Lamiaceae	*Lavandula angustifolia* Miller	True lavender	[a]
104.	*Melissa officinalis* L.	Common balm	[a]
105.	*Mentha arvensis* L. var. *piperacens* Malinvaud.	Peppermint	69
106.	*Mentha piperita* L.		55, 71, [a]
107.	*Mentha spicata* L.	Garden mint	[a]
108.	*Mentha* sp.	Peppermint	24, 62
109. Lauraceae	*Ocotea* sp.		55, 71
110.	*Persea americana* Miller	Avocado	2, 29, 71
111. Liliaceae	*Allium cepa* L.	Onion	23, 24, 31, 48, 56, 71, [a]
112.	*Allium fistulosum* L.	Green Onion	[a]
113.	*Allium sativum* L.	Garlic	48,
114.	*Asparagus officinalis* L.	Asparagus	57
115. Linaceae	*Linum usitatissimum* L.	Flax	11, 31, 63, 71
116. Litraceae	*Lagerstroemia indica* Linn	Crape myrtle	[a]
117. Lomariopsidaceae	*Elaphoglossum* sp.	—	67
118. Malvaceae	*Abelmoschus esculentus* (L.) Moench	Okra	1, 2, 29, 31, 63, 71
119.	*Althaea rosea* (L.) Cavanilles	Hollyhock	29
120.	*Gossypium herbacium* L.	Cotton	2, 7, 8, 17, 20, 24, 25, 29, 48, 56, 62, 71
121.	*Hibiscus cannabinus* L.	Brown Indianhemp	56
122.	*Hibiscus rosa–sinensis* L.		55, 71
123.	*Malva parviflora* L.	Mallow	24, 31, 63,
124.	*Pavonia fruticosa* (Mill.) Fawcett & Rendle		55, 71
125.	*Sida rhombifolia* L.	Arrow–leaf sida	55, 71, [a]
126. Melastomataceae	*Heterotrichum cymosum* (Wendland) Urban		55, 71
127. Moraceae	*Morus alba* L.	Mulberry	16
128. Myrtaceae	*Eucalyptus* sp.	Eucalyptus	24, 65
129.	*Psidium guajava* L.	Apple guava	[a]
130. Ochnaceae	*Sauvagesia erecta* Linn		55, 71
131. Onagraceae	*Ludwigia* sp.		55, 71
132. Papaveraceae	*Sanguinaria canadensis* L.	Bloodroot	2, 29, 71
133. Passifloraceae	*Passiflora edulis* Sims.	Passion–flower	55, 71
134.	*Passiflora sexflora* Juss.		55, 71
135. Phytolaccaceae	*Phytolacca americana* (L.)	Pokeweed	1, 2, 29, 45, 71
136.	*Phytolacca decandra* L.	Pokeweed	16, [a]
137.	*Phytolacca dioica* L.		[a]
138.	*Phytolacca rigida* (Small)	Pokeweed	2, 45, 71
139.	*Phytolacca rivinoides* Kunth & Bouché		55, 71
140.	*Phytolacca thyrsiflora* Fenz ex Schmidt	Pokeweed	[a]
141. Piperaceae	*Lepianthes umbellatum* (L.) Rafinesque		55, 71
142. Plantaginaceae	*Plantago major* L.	Common plantain	55, 71
143. Poaceae	*Cynodon nlemfuensis* Vanderyst	African Bermudagrass	67

(*continued*)

Table 4. Continued

Botanic family	Scientific name	Common name	References
144.	*Digitaria ischaemum* (Schreb.) Schreber ex Muhlenberg	Small crabgrass	29
145.	*Digitaria sanguinalis* (L.) Scopoli	Large crabgrass	2, 22, 29, 71
146.	*Ichnanthus pallens* (Sw.) Munroe		55, 71
147.	*Lolium perene* L.	Ryegrass	46, 71
148.	*Melinis minutiflora* Beauverie	Molassesgrass	24
149.	*Oryza sativa* L.	Rice	31, 63,
150.	*Pennisetum purpureum* (Persoon)	Elephant grass	[a]
151.	*Stenopaphrum secundatum* (Walter) Kunze	Buffalo grass	6, 55, 71
152.	*Zea mays* L.	Corn	2, 17, 18, 21, 22, 23, 29, 31, 48, 56, 63, 65, 71, [a]
153. Polygonaceae	*Persicaria hydropiperoides* (Michaux) Small	False water–pepper	[a]
154.	*Polygonium* sp.	Polygonium	65
155.	*Polygonium segetum* Kunth	Field Smartweed	67
156.	*Rheum rhabarbarum* L.	Rhubarb	29
157.	*Rumex* sp.	Rumex	2, 29, 71
158.	*Rumex crispus* L.	Curly dock	[a]
159.	*Rumex obtusifolius* L.	Broad Leaved Dock	[a]
160. Portulacaceae	*Portulaca oleracea* L.	Purslane	32, 31, 51, 54, 63, 71, [a]
161.	*Portulaca grandiflora* Hook	Portulaca	[a]
162. Rosaceae	*Fragaria vesca* L.	Strawberry	9, 71, [a]
163.	*Malus domestica* Borkhausen	Apple	50, 53, 71, [a]
164.	*Pyrus communis* L.	Common Pear	[a]
165.	*Rosa* spp.	Rose	58, [a]
166.	*Rubus idaeus* L.	Rasberry	[a]
167.	*Rubus rosifolius* Smith	Mauritius rasberry	55, 71
168. Rubiaceae	*Coffea arabica* L.	Coffe	56
169.	*Diodia ocimifolia* (Willdenow ex. Roemer & Schultes) Bremekamp	Weed	55, 71
170.	*Gonzalagunia spictata* (Lam.) Maza		55, 71
171.	*Hamelia ptlens* Jacquin		55, 71
172.	*Pentas* sp.	Pentas	54
173.	*Psycotria berteriana* de Candolle		55, 71
174.	*Spermacoce ocymifolia* Willdenow ex Roemer & Schultes	Slender Buttonweed	67
175. Rutaceae	*Citrus* sp.	Citrus trees	2, 14, 71
176.	*Citrus limon* (L.) Burman	Lemon tree	29
177.	*Citrus grandis* (L.) Osbeck	Grapefruit	29
178.	*Citrus sinensis* (L.) Osbeck	Orange	29
179. Salicaceae	*Salix* sp.	Willow	2, 29, 71
180. Scrophulariaceae	*Bacopa stricta* (Schrad.) Robins		55, 71
181. Solanaceae	*Capsicum annuum* L.	Pepper	1, 2, 6, 16, 29, 31, 63, 71, [a]
182.	*Cestrum macrophyllum* Ventenat	Galán del monte	55, 71
183.	*Lycopersicum esculentum* Mill.	Tomato	1, 2, 6, 15, 16, 17, 19, 22, 23, 24, 27, 29, 30, 31, 35, 48, 54, 56, 62, 63, 65, 67, 71, [a]
184.	*Nicotiana alata* Link & Otto	Jasmine tobacco	31, 63,
185.	*Nicotiana tabacum* L.	Tobacco	2, 6, 16, 24, 29, 31, 48, 63, 71
186.	*Solanum acerosum* Sendtner	Arrebenta–cavalo	[a]
187.	*Solanum americanum* Schultz	American nightshade	55, 71
188.	*Solanum andigenum* Juz & Bukasov	Andigena	30
189.	*Solanum jamaicense* Miller	Jamaica nightshade	67
190.	*Solanum melongena* L.	Eggplant	1, 2, 29, 56, 63, 71, [a]
191.	*Solanum peruvianum* L.	Peruvian nightshade	30
192.	*Solanum rugosum* Dunal	Tabacon aspero	55, 71
193.	*Solanum torvum* Swartz	Turkey Berry	6, 16, 55, 71
194.	*Solanum tuberosum* L.	Potato	1, 2, 6, 9, 13, 16, 19, 22, 24, 29, 30, 31, 48, 54, 56, 62, 63, 71, [a]
195. Teaceae	*Camelia japonica* L.	Camellia	24
196. Urticaceae	*Laportea aestuans* (L.) Chew	West Indian woodnettle	67
197.	*Urera bacifera* (L.) Gaudichaud-Beaupré ex Weddell	Scratchbush	[a]
198. Verbenaceae	*Citharexylum fruticosum* L.	Fiddlewood	55, 71
199. Violaceae	*Viola tricolor* L.	Pansy	[a]
200. Vitaceae	*Vitis labrusca* L.	Fox grape	[a]
201.	*Vitis vinifera* L.	Wine grape	72, [a]
202. Zingiberaceae	*Alpinia purpurata* Vieillard ex K. Schumann	Red ginger	55, 71

1, Chittenden and Russel (1909); 2, Crumb (1929); 3, Stoner and Wisecup (1930); 4, Marques (1932); 5, Monte (1934); 6, Wolcott (1936); 7, Hambleton (1939); 8, Tucker (1939); 9, Waterston (1939); 10, Brandão Filho (1942); 11, Wille and Garcia (1942); 12, Alberts (1947); 13, Waterston (1947); 14, Bedford (1949); 15, Biezanko and Bertholdi (1951); 16, Wolcott 1948 (1951); 17, Corseuil (1955); 18, Olalquiaga (1955); 19, Costa (1958); 20, Nickel (1958); 21, Harris (1959); 22, Kimbal (1965); 23, McGuire and Crandal (1967); 24, Silva et al. (1968); 25, Cantu and Wolfenbarger (1970); 26, Briceno (1971); 27, Creighton et al. (1971); 28, Cortés and Campos (1972); 29, Tietz (1972); 30, Valencia and Valdivia. (1973); 31, Biezanko et al. (1974); 32, Figueroa (1976); 33, Habeck (1976); 34, Link (1977); 35, Price and Poe (1977); 36, Bellotti and Schoonhoven (1978); 37, Tingle et al. (1978); 38, Schuster and Engelhard (1979); 39, Price et al. (1980); 40, Silva and Magalhães (1980); 41, Pena and Wadill (1981); 42, Wolfson (1982); 43, Mitchell (1984); 44, Anderson et al. (1986); 45, Scriber (1986); 46, Ahmad et al. (1987); 47, Jones (1987); 48, Maes and Tellez (1988); 49, Mattana and Foerster (1988); 50, Nora and Reis (1988); 51, Savoie (1988); 52 -Foerster and Dionisio (1989); 53, Nora et al. (1989); 54, Ferguson et al. (1991); 55, Torres (1992); 56, Coto et al. (1995); 57, Sanchéz and Vergara 1996 (1995); 58, Sánchez-Aguirre, R (1996); 59, Clarke-Harris et al. (1998); 60, Rasmussen et al. (2003); 61, Nuessly et al. (2004); 62, Pastrana (2004); 63, Specht et al. (2004); 64, Santos et al. (2005); 65, Angulo et al. (2008); 66, Dias et al. (2009); 67, Janzen and Hallwachs (2009); 68, Semillas del Caribe (2010); 69, Mendoza et al. (2011); 70, Walsh and Maestro (2011); 71, Pogue (2012; 72, Bortoli et al. (2012).

[a]New record—author's field observations.

Table 5. Pupal weight (mg) of *S. eridania* reared on artificial diet, including pupae whose larvae developed for six and seven instars (only females), under controlled conditions (25 ± 1°C, 70 ± 10% RH, and 14-h photophase)

Larval instars	Gender	*N*	Mean ± SD	Range
Six	Female	120	377.533 ± 51.654	253–538
	Male	132	329.447 ± 41.427	205–399
	Significance[a]		**	—
Seven	Female	9	435.111 ± 41.619	389–528
	Significance[b]		*	—

Comparison of means using a Student's *t*-test, considering different variances, at a significance level of 95% (*$P < 0.01$; **$P < 0.001$).

[a]Comparisons between females and males—six larval instars.

[b]Comparisons between females and females—six and seven larval instars.

Price and Poe 1977; Pena and Wadill 1981; Maes and Tellez 1988; Ferguson et al. 1991; Coto et al. 1995; Pastrana 2004; Specht et al. 2004; Bentancourt and Scatoni 2006; Angulo et al. 2008). Exemplifying its appearance in more recently explored annual crops of great importance, we can cite the occurrence of *S. eridania* in soybeans since the 1970s after the expansion of the crop, in the United States (e.g., Tietz 1972), Brazil (e.g., Parra et al. 1977), and Argentina (Pastrana 2004), with a growing importance in other American countries (e.g., Coto et al. 1995, Santos et al. 2005, Valverde 2007, Angulo et al. 2008).

Similarly, this species has been associated to various weeds of different families (see Table 4). Surely, this wide range of weeds, as alternative hosts, is related to their importance as plants used by females for oviposition and to the ability of their larger larvae to migrate to cultivated plants (e.g., Chittenden and Russel 1909, Savoie 1988, Huiza and Loayza 1993 [1992], Sánchez-Aguirre 1996 [1995], Sánchez and Vergara 1996 [1995], Rodríguez et al. 2002, Castillo Valiente and Castillio Oliva 2004, Santos et al. 2005). According to some authors, these alternative host plants are so important to populations of this and other *Spodoptera* species that in some studies they were treated as sources of parasitoids of other species such as *S. frugiperda* (Tingle et al. 1978). Another important aspect of weeds on the development of *S. eridania* is the fact that in the slim amaranth its larval development was completed with only five instars and its shortest life cycle. In this host plant, the pupal weight of *S. eridania* whose larvae throughout five instars was similar or higher until the larvae that passed through six instars when fed on tomato, sweet potato, and purslane (Valverde and Sarmiento 1987 [1986]).

As demonstrated (Brattsten and Wilkinson 1973; Brattsten et al. 1977, 1980; Blau et al. 1978; Scriber 1978, 1979, 1981; Manuwoto and Scriber 1982), *S. eridania* has the great ability to use various host plants as a function of its detoxification mechanisms. However, except for the work of Torres (1992), the majority of records, including the new records in this study (Table 4), for the most part were obtained from ornamentals, truck, or extensive annual crops.

Pupal Stage. In this study, the pupal survival of *S. eridania* (Table 1), despite being relatively high, was lower than obtained by Mattana and Foerster (1988) on sweet potato, was similar to the obtained on cotton and soybean (Parra et al. 1977) and higher than on bracatinga (Mattana and Foerster 1988), cotton, morning glory, soybean (Santos et al. 2005) strawberry, and on grape (Bortoli et al. 2012). The survival of female pupae (95.56%; 129/135) was lower than that of males (98.51%; 132/134). These results are similar to those obtained by Santos et al. (2005) for larvae feeding on cotton, morning glory, and soybean. These results, together with the observations on *S. albula* (Montezano et al. 2013), may indicate that, in general, the female pupae have a greater difficulty in transforming into adults.

Similar to that observed for several *Spodoptera* representatives (e.g., Santos et al. 1980, Bavaresco et al. 2004, Farahni et al. 2011, Nagoshi 2011, Montezano et al. 2013), female *S. eridania* pupae from larvae that underwent six instars developed significantly faster than their male counterparts (Table 5). However, our results suggest that faster development of females pupae in *S. eridania* and, as documented in *S. albula* (Montezano et al. 2013), may emerge as a compensation for larval growth, where the duration of female larvae was significantly longer than male larvae (Table 2). Thus, when the data on the duration of the larval and pupal stages are brought together, there are no significant differences for the duration of the entire immature period between females and males which had six instars. The duration of larval + pupal development was markedly higher in females which had an additional instar (Table 2).

The sexual dimorphism, represented by the weight during the pupal phase, is relatively well documented among representatives of *Spodoptera* (e.g., Habib et al. 1983, Mattana and Foerster 1988, Bavaresco et al. 2004, Santos et al. 2005, Xue et al. 2010, Montezano et al. 2013) and other Lepidoptera. The larger size of the females which went through seven instars (Table 5) should be attributed to the additional instar (e.g., Esperk et al. 2007, Nagoshi 2011, Montezano et al. 2013).

Although there are previously described natural and artificial diets (Peterson 1953, Soo Hoo and Fraenkel 1964, Redfern 1967, Smilowitz and Dewey 1969, Redfern and Raulston 1970) for the mass production of *S. eridania*, we used the artificial diet and the proposed rearing method, which was previously described for *S. albula* (Montezano et al. 2013). This methodology resulted in an overall survival of almost 85% (Table 1), above the 75% recommended by Singh (1983) and permitted a more complete detailing of several biological parameters of *S. eridania,* with minimal interference in its development. Moreover, the artificial diet allows the introduction of different substances and concentrations such as toxins for experiments, which evaluate toxicity, in a more standardized manner.

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