

NATALITY AND NATURAL MORTALITY OF *Spartocera lativentris*  
STAL, 1870 (HETEROPTERA: COREIDAE) IN THE EGG STAGE

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RESUMO

Natalidade em *Spartocera lativentris* Stal, 1870  
(Heteroptera: Coreidae) e mortalidade natural no  
estágio de ovo

A natalidade na segunda geração de *Spartocera lativentris* Stal, 1870 e a mortalidade natural dos ovos foram estudadas em condições de campo em 1979. A natalidade foi estimada através da contagem semanal de ovos em 400 plantas de *Solanum sisymbriifolium* L. amostradas ao acaso. A densidade das posturas foi baixa no decorrer de todo o período e a distribuição espacial das posturas foi ao acaso. A mortalidade foi estimada através da observação sucessiva das posturas. A mais importante causa de mortalidade dos ovos foi a predação por remoção, seguida pelo parasitismo por *Gryon gallardoï* (Brethes, 1913) (Scelionidae) e *Neorileya ashmeadi* Crawford, 1913 (Eurytomidae). Os órgãos internos de reprodução da fêmea de *S. lativentris* são descritos e ilustrados.

INTRODUCTION

In Brazil, as is the general practice elsewhere, field studies on insects have been concentrated on pest species. On the other hand, literature concerning the ecology of either pest or innocuous species in natural habitats is particularly scanty in this country.

It is the aim of this work to study some of the processes taking place in a natural population in the absence of major man-made disturbances. So far, no economic importance has been attached to *Spartocera lativentris* Stal, 1870. However, other species of the

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Recebido em 19/07/82

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same genus at least morphologically closed allied to *S. lativentris*, viz. *S. brevicornis* Stal, 1870, *S. dentiventris* (Berg, 1844), *S. fusca* (Thunberg, 1783) and *S. granulata* Stal, 1870 have been registered in Brazil as pests of cultivated solanaceae such as tobacco, tomato and potatoes. Records on cultivated plants, and occasionally on wild solanaceae as well, have been made mainly for the Southern states of Brazil (SILVA *et alii*, 1968). For Rio Grande do Sul, of the above species, only *S. granulata* has not been registered so far (BERTELS & BAUCKE, 1966). Despite of its economic importance, no studies had been carried out so far in this country on any aspect of the population ecology of *Spartocera* species.

#### Life history of the insect

*S. lativentris* was found to have only two generations per season (October-May). The adults of the Summer generation abandon the breeding area soon after being recruited to the stage to overwinter in nearby clumps of grasses and in mats of *Eryngium* sp. *S. lativentris* has limited dispersal powers. Invasion of the breeding site is gradual and not a result of a mass migratory flight. In the study grounds the first generation (October-December) occurred in too low a density to be properly followed. The second generation extends from January to May. There are five nymphal instars. A total overlap of nymphal stages occurs within three to four weeks after the appearance of the first instar. Both nymphs and adults feed on *Solanum sisymbriifolium* L. leaves and stems. They were never seen feeding on the fruits. First instar nymphs do not feed; they remain aggregated for some time after hatching. Second to fifth instar nymphs as well as the adults move down the host plant at high temperatures, where their dirty gray colour renders them inconspicuous to the general background.

Several attempts were made to breed *S. lativentris* under laboratory conditions with no success. A high mortality was obtained specially in the second nymphal instar. Adults failed to mate and the few laboratory bred females did not oviposit. Successful results were obtained for egg incubation. Under constant conditions (25°C, 78% RH, 14 light hours/day) the incubation period lasted for 18-20 days.

#### The study area

Field work was carried out in the grounds of the Federal University of Rio Grande do Sul, in the outskirts of Porto Alegre, 30° 01' S and 51° 13' W, 15 km from the city center. This area, known as "Morro Santana" (Santana Hill) was chosen for field work for being a relatively undisturbed, preserved area for the last three decades.

The Santana area is about 604 hectares. The vegetation at

the higher grounds is an open field consisting of Gramineae, Compositae and numerous rosettes of *Eryngium* spp. At some places this open field is invaded by a low woodland rich in Myrtaceae species which covers the hill from mid-heights upwards.

The study site was located at the top of the hill, at an altitude of 310 meters, where a moderately dense population of *S. lativentris* was found in the Summer of 1977. *S. lativentris* was found restricted to a single host plant, *S. sisymbriifolium*, a rather common, widespread weed of disturbed areas in Rio Grande do Sul. In the Santana Hill this plant occurred in dense patches only at that site as a consequence of ploughing on a restricted area adjacent to the warden's quarters. In the hill *S. sisymbriifolium* behaves as an annual plant in the sense that it does not survive for two consecutive summer seasons.

#### MATERIALS AND METHODS

In late Winter 1978 a 20 x 25 meters area was ploughed with a tractor with views to obtaining higher densities of the host plant by favouring competition with grasses and compositae. In early Summer a nearly pure stand of *S. sisymbriifolium* was obtained, with an average of 3.95 plants per square meter. The area was divided up into 20 equal sized subdivisions which in turn were further subdivided into five smaller units resulting into 100 sub-areas of 5 square meters. Sectioned pipes were hammered into the soil at the corners of each 1 x 5 meters rectangle. At sampling, the area to be sampled was thus delimited by the aid of a rope of the same sides fastened at each angle to a 70cm high pole that was inserted into each of the four pipes.

##### Estimation of natality

Samples were taken at regular weekly intervals. The sampling unit was the plant itself. At each occasion 400 plants were sampled. The absolute density of plants per sub-area was known by careful and repeated counting of the plants. This permitted to estimate in advance the number of 1 x 5 sub-areas to be sampled to attain 400 plants. In general, 20 would suffice. For each occasion the sub-area to be sampled in each of the 20 areas was selected by random numbers.

Every part of the plant was inspected and eggs found were recorded for each plant. Records were also taken of the number of eggs per egg-group, its position in the plant and the aspect of each egg. The sampling programme for natality extended from 1st. January to 10 April.

##### Estimation of mortality

Each egg-group found was identified by a small label attached

to the plant in a convenient position. Egg-groups were examined at one weeks interval until the fate of its last egg was determined. Field checks were carried out throughout the season in parallel to the estimation of natality and extended up to 9 May. At each occasion records were taken of the number of eggs per egg-group, eggs hatched, color and aspect of each egg and special care was taken to detect any evidence of natural enemies attack. Shed leaves containing egg-groups were taken to the laboratory for the breeding of parasites, if any. Exclusion techniques were adopted to assess the role of predators: egg-groups were either caged in small framed muslin sleeves or surrounded by a ring of a sticky substance used for the trapping of small birds.

## RESULTS

### Natality

Eggs are broadly oval in shape, the operculum clearly visible at one end. The flat lower side is firmly glued to the host plant. Though rather resistant the chorion shows the coloration of its content. Thus, development of the embryo can be assessed by the egg color: light amber (newly laid), dark amber (intermediate phase) and reddish brown (fully grown embryo) prior to the eclosion of the bright red first instar nymph. Eggs are laid in clusters in a generally irregular double row. Data on oviposition sites in *S. sisymbriifolium* based on 152 egg-groups is summarized in table 1. The leaf petiole accounts for nearly 3/4 of the total preference. Figure 1 illustrates the frequency of the different sizes of egg-groups at the first date they were detected in the random samples. The data is based on 152 egg-groups.

TABLE 1 - Preference for oviposition sites in *Solanum sisymbriifolium* L. by *Spartocera lativentris* Stal based on 152 randomly sampled egg-groups in the field, 1979 (Morro Santana, Porto Alegre, RS).

Site	Number observed	% of total
Leaf petiole	113	74.3
Leaf main vein	12	7.9
Stem (main or secondary)	9	5.9
Stem and leaf petiole	7	4.6
Leaf blade	5	3.3
Fruit pedicel	3	2.0
Flower pedicel	3	2.0

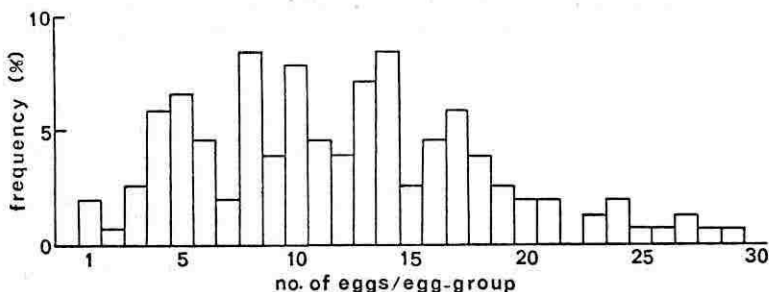


FIGURE 1 - Sizes and frequencies of egg-groups of *Spartocera lativentris* Stal in the field, 1979. (Morro Santa na, Porto Alegre, RS).

Figure 2 illustrates the female internal reproductive organs. There are seven ovarioles per ovary. The ovariole forms a pedicel that opens at the long, elastic lateral oviduct. The common oviduct is very short, a small spermatheca lying between it and a pair of glands. In the fully mature female there is a considerable increase in size of the ovaries and of the lateral oviducts. As shown in figure 2-B, each lateral oviduct can harbour 12 to 13 fully mature oocytes. Whitish nodular remains of corpora lutea are visible in the pedicels of ovarioles in which ovulation has taken place.

Figure 3 illustrates natality in the field based on 400 randomly sampled plants in each week. The oviposition period extended from mid January to the beginning of April, with peak oviposition in mid February. The egg groups in the field were distributed at random, the Poisson distribution giving a very good fit to the data.

#### Mortality

The successive observation of the same cohorts permitted to measure mortality directly since each egg-group, oviposited at the same occasion, represents a natural cohort.

Parasitism in the field was assessed directly by the examination of *S. lativentris* eggs. Studies carried out in the previous season in terms of careful observations and successive dissections of the host egg permitted to ascertain the presence of microhymenoptera inside the egg of *S. lativentris*. Such eggs are easily detected by their distinguishing darker color which is intensified as development of the parasite proceeds. In case emergence of the parasite had taken place in the interval of two consecutive observations the characteristic exit made by the parasite was easily detected. This is made at the opercular area where the parasite bites its

way off leaving a circular hole with serrate edges. Remains of the exuviae in the egg shell can also be used as an additional index of parasitism.

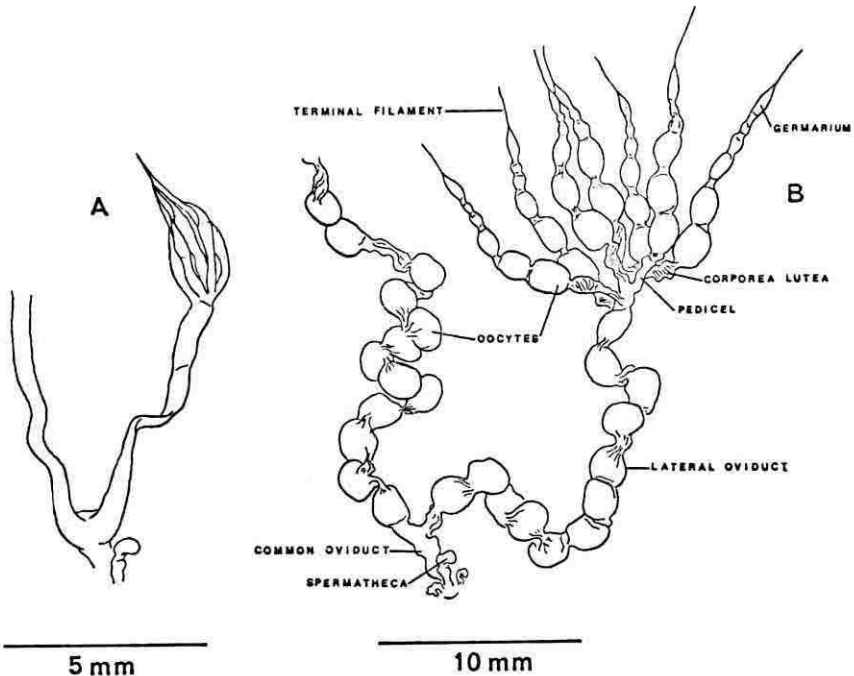


FIGURE 2 - Female reproductive organs of *Spartocera lativentris* Stal: A, immature; B, mature.

Two different species of egg parasites occurred in the field. Both were reared from eggs brought to the laboratory or obtained in the sleeve cages. The most frequent was *Gryon gallardoii* (Brethes, 1913) (Scelionidae) followed by *Neorileya ashmeadi* Crawford, 1913 (Eurytomidae). Out of a total of 1830 *S. lativentris* eggs studied in the season 895 eggs were killed by parasites. For both species, only one parasite occurs per host egg.

Throughout the season one or more eggs from most of the egg-groups disappeared between two consecutive observations. Such losses for each egg-group were gradual in most of the cases as could be assessed by the weekly counting of the remanent eggs. Apart from predation, the loss of eggs could be conceivably attributed to eggs

falling off due to the action of rain or wind-blown foliage, to the hatching of *S. lativentris* nymphs, to the hatching of parasites or to defficiency in the cementing substance. The exclusion techniques described above were adopted to ascertain the causes of egg losses. One hundred and fifteen eggs belonging to egg-groups that had been gradually loosing eggs were protected as follows: muslin sleeves - subsequent observations showed that in all cases the number of caged eggs remained constant as well as the empty shells later on; sticky barriers - just as well all eggs remained "in situ" thereafter. The missing of eggs, therefore, was attributed to predation by removal. The field experiments were not designed to discover the actual identity of the egg predators of *S. lativentris*.

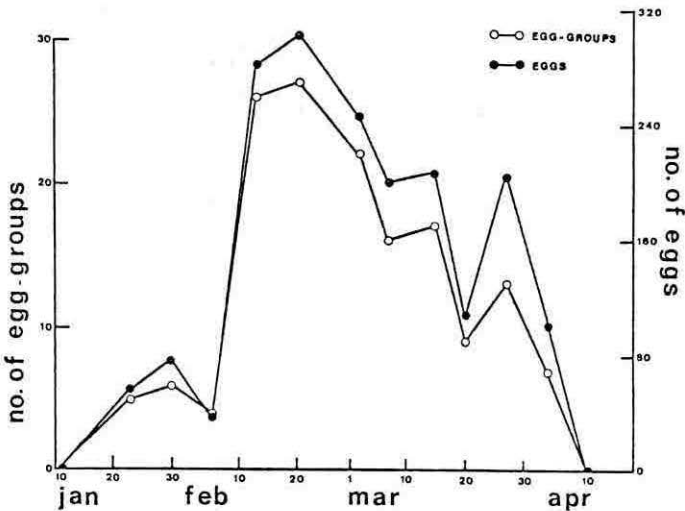


FIGURE 3 - Natality of *Spartocera lativentris* Stal in the field, 1979: weekly numbers of egg-groups and total number of eggs per 400 plants of *Solanum sisymbriifolium* L. (Morro Santana, Porto Alegre, RS).

Predation of eggs "in situ" was also observed, though it was not common. Such eggs had either a slit cut along the chorion or, still in smaller numbers, the egg-group was covered by a spider web.

A negligible number of eggs failed to hatch, the same happening to parasitized eggs.

In computing mortality caused by predation eggs were not taken into account when either protected by exclusion techniques or when

brought to the laboratory. The same applied to the computation of successful hatching of nymphs or of parasites. In the protected situation hatching took place where an expected number would certainly have been destroyed if unprotected from predators.

Figure 4-A illustrates the fate of *S. lativentris* egg population in the field based on 1538 eggs. The fate of parasitized eggs (701) is shown in figure 4-B and that of parasite-free eggs (837) in figure 4-C.

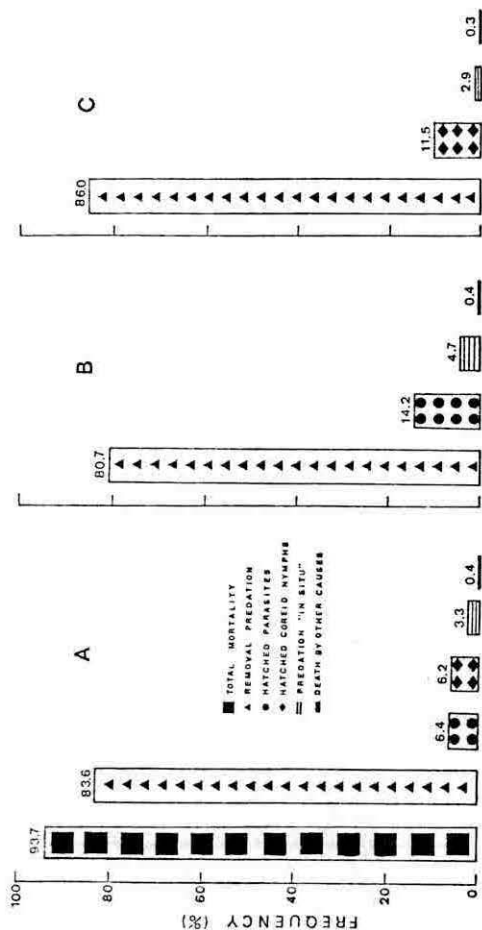


FIGURE 4 - Fate of *Sparitocera lativentris* Stal eggs in the field, 1979: A, total number of eggs (1538); B, eggs parasitized by *Gryon gallar doti* (Brethes) and by *Neorileya ashmeadi* Crawford (701); C, parasite-free eggs (837) (Morro Santana, Porto Alegre, RS).



The main causes of egg mortality throughout the season are shown in figure 5. Numbers killed by removal predation are plotted one day before the sampling date since they represent a total figure for predation for the interval between two consecutive observations. The data is transformed to base 10 logarithms since we are interested with proportions killed rather than actual numbers.

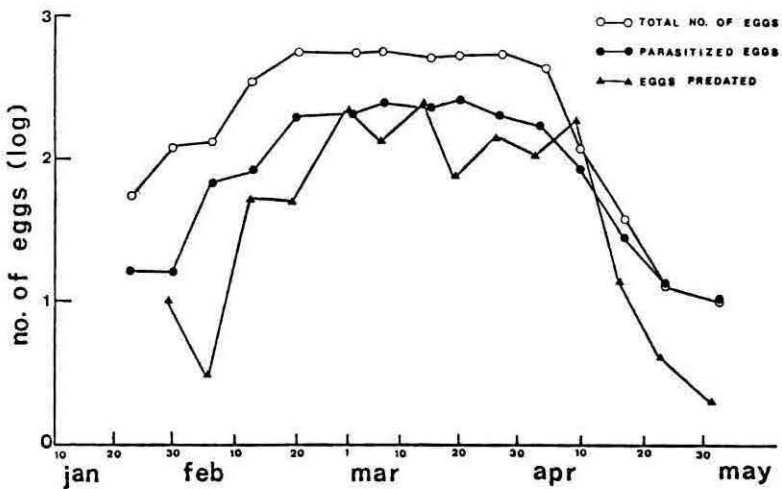


FIGURE 5 - Main causes of egg mortality in *Spartocera lativen* *tris* Stal in the season, 1979 (Morro Santana, Porto Alegre, RS).

## DISCUSSION

Strictly, the small area where these population processes were taking place can not be considered as a natural habitat. Due to ploughing, it had an abrupt start in ground that was cleared of other vegetation so that continuity was disrupted, the establishment of *S. sisymbriifolium* was favoured accordingly; diversity of plant species was lessened as well as the intraspecific diversity. In these respects it mimicked man-made agricultural habitats (SOUTHWOOD & WAY, 1970). On the other hand it is less of an artificially simplified community when one considers the small size of the stand in relation to its undisturbed surroundings (WATT, 1968). To some extent, therefore, the results obtained can be taken as representative of a natural habitat.

The strongly flattened distribution of frequency of size of

egg-groups suggests that when egg-groups were detected for the first time in most of the cases predation by removal had already been taking place. Data available for oviposition under laboratory conditions is insufficient to estimate a valid mean size for *S. lativentris* egg-groups. The make-up of the female reproductive organs as shown in figure 2-B suggests that at least as many as 20 eggs can be deposited at a time. This figure or higher was obtained in the laboratory and in field samples it accounted for 11.4% of the total frequency. Removal predation is gradual and took place throughout the season, what may explain the lack of consistency in the size of such egg-groups. If so, mortality by removal predation was actually higher than that measured. Accordingly, natality and parasitization in the field might have been underestimated. If predation took place at the early stages of parasitization such eggs, being undistinguishable from parasite-free ones, were classified in this last category.

Detection of egg parasitism is straightforward at nearly all stages. In contrast, unless the act of predation is seen in the field, removal predation can only be detected if successive observations on a cohort are made. Hardly any evidence is left of the previous presence of *S. lativentris* eggs. The sticky barrier suggests that the predator is a non-flier arthropod or, conversely, a flying arthropod that does not alight directly on the prey. Also, that the predator is either able to detect and avoid the barrier or that it needs direct contact to detect the prey since any likely predator was found trapped to it. Detection of the actual predator is particularly difficult and time consuming. In Brazil data on egg predation are scarce. CORREA-FERREIRA & OLIVEIRA (1982) report the loss of up to 75% of *Nezara viridula* (L.) eggs within 48 hours of exposure to field conditions in Paraná, the losses being attributed to predation by unidentified species of ants and crickets. Elsewhere, removal predation in appreciable numbers has been detected and quantified such as: eggs of the pentatomid *Bathycolia thalassina* (H.-S.) in Ghana by unidentified species of spiders and by the ants *Pheidole* spp. and *Crematogaster* spp. (OWUSU-MANU, 1976); hornworm eggs by unidentified predators and the larvae by several species of the vespid wasp *Polistes* in the United States (LAWSON, 1959); codling moth eggs probably by the earwig *Forficula auricularia* L. in England (GLEN, 1975). There is a single record of removal predation in *Spartocera*: BRETHES (1918) reared *S. brevicornis* Stal in Argentina from nymphs found in the nest of the sphecid wasp *Bicyrtes discisa* (Taschenberg) together with other living nymphs of heteropteran bugs.

Predation also caused a heavy mortality in the microhymenopteran population inside the eggs. The probability that an egg will be eaten by a predator before it hatches depends on the number of days it is exposed to predation. *G. gallardoi*, as shown in labora

tory tests, is able to parasitize *S. lativentris* eggs in different stages of embryonic development. Thus, such parasitized eggs are likely to be exposed to predation for a rather longer period than the parasite-free ones. New egg-groups of *S. lativentris* were available for parasite attack for eleven consecutive weeks in the field. Laboratory tests have shown that at least for *G. gallardo*i newly emerged adults are already able to attack the host egg. In the absence of predation a higher rate of parasitism could be expected. Under field conditions it is not safe to decide which eggs were parasitized by *G. gallardo*i or by *N. ashmeadi* since only just prior to the emergence of the adult will they markedly differ. A rough estimate can be made based on parasites bred out in the laboratory from randomly taken egg-groups. Out of the total bred 2/3 were *G. gallardo*i and 1/3 was *N. ashmeadi*.

So far, no egg parasites have been mentioned for any of the *Spartocera* species in Brazil. There are a number of references in the literature for species of the cosmopolitan genus *Gryon* Haliday as parasites of eggs of Heteroptera, specially the Coreidae. Only a few of them refer to the Neotropics. DE SANTIS (1967) mentions *G. gallardo*i for Argentina as a parasite of Hemiptera, no genus being cited. Other references concern different species of *Gryon* such as: *G. molinai* (Blanchard) in eggs of *Anasa guttifera* Berg in Argentina (BLANCHARD, 1927); *G. rugosithorax* Ashmead in eggs of *Athawana*s *laetus* Mayr in Surinam (CARTER, 1949); for Brazil the records are for *G. barbiellini* (Lima) in eggs of *Diactor bilineatus* (Fabricius) (LIMA, 1940a), *Gryon* sp. in eggs of the pentatomid *Antiteuchus tripterus* (Fabricius) (LIMA, 1949) and *G. brasiliensis* (Lima) in eggs of a species of Coreidae (DE SANTIS, 1980).

The present studies do not support HAGEN's (1964) assertion that the eurytomid *Neorileya* is an egg predator. They confirm GI RAULT's (1970) assertion that they are true egg parasites in the sense that development of the parasite occurs completely in the host egg and gives rise to an adult. Literature on *Neorileya* species in the Neotropics is particularly scanty. GAHAN (1927) described *N. meridionalis* bred out in Costa Rica from eggs of the pentatomid *Chlorocoris atrispinus* Stal; LIMA (1940b) mentions a species probably belonging to the genus *Neorileya* that parasitizes eggs of the pentatomid *Edessa* sp. in Brazil; DE SANTIS (1980) mentions *N. flavipes* Ashmead for Mato Grosso and Paraná, no host species being cited; CORREA-FERREIRA (1981) reports the occurrence of an unidentified species of *Neorileya* parasitizing eggs of *Nezara viridula* (L.) in soybean fields in Paraná. So far, these are the only references available in literature for *Neorileya* as an egg parasite in Brazil.

The overall results indicate that a high mortality can be inflicted to the egg population of *S. lativentris* by its natural enemies. Arthropod predation was shown to be the main cause of egg mortality though its action was more unstable throughout the season

as compared to that of the wasps as shown in the log plot of fig.5.

## ACKNOWLEDGEMENTS

Thanks are due to Dr. W. Dolling of the British Museum (Natural History) for the identification of *Spartocera lativentris* Stal; to Dr. L. de Santis and Dr. M. Loiacono de Silva, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, for the identification of *Neorileya ashmeadi* Crawford and *Gryon gallardoi* (Brethes), respectively.

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## ABSTRACT

The natality and natural mortality of second generation eggs of *Spartocera lativentris* Stal, 1870 were studied in the field, 1979. Natality was estimated by weekly counts of eggs in 400 randomly sampled plants of *Solanum sisymbriifolium* L. Density of the randomly distributed egg-groups in the field was low throughout the season. Mortality in the field was estimated by successive observations of egg-groups. Predation by removal of eggs was shown to be the main cause of egg mortality in the season, followed by parasitism by the scelionid wasp *Gryon gallardoii* (Brethes) and the eurytomid wasp *Neorileya ashmeadi* Crawford. The female internal reproductive organs of *S. lativentris* Stal are described and illustrated.