Rev. Biol. Trop., 47(4): 1007-1013, 1999
www.ucr.ac.cr www.ots.ac.cr www.ots.duke.edu

Parasitism of stink bug eggs (Hemiptera: Pentatomidae) of soybean fields in the Triângulo Mineiro, Minas Gerais, Brazil

Madelaine Venzon *[1] João A. M. Ferreira[2] & João G. Ripposati[1]

1 Agriculture and Livestock Research Enterprise of Minas Gerais (EPAMIG), 38001-970, Uberaba, Minas Gerais, Brazil.
Fax: (55) 34 333 6734, E-mail: venzon@bio.uva.nl.
2 Federal University of Viçosa, 36571-000, Viçosa, Minas Gerais, Brazil. E-mail: jam@alunos.ufv.br.
* To whom correspondence should be addressed.

Received 4-III-1999. Corrected 5-VIII-1999. Accepted 12-VIII-1999.

Abstract: A survey of the seasonal occurrence of stink bug egg parasitoids was carried out in soybean fields in the Triângulo Mineiro region, Minas Gerais state, Brazil. Collections of egg masses of stink bugs and monitoring of population levels of mobile stages were done weekly during the 1993/94 and 1994/95 soybean seasons. *Piezodorus guildinii* and *Euschistus heros* were the most abundant stink bugs throughout the survey. Rates of parasitism in *P. guildinii* eggs ranged from 50.2 to 77% in 1993/94 and from 31.3 to 44.1% in the 1994/95 soybean season. Parasitism in *E. heros* eggs ranged from 50.6 to 64.7 % in 1993/94 but no parasitized eggs were found in 1994/95. *Telenomus podisi* was the main parasitoid collected and the only species found to parasitize *E. heros* eggs. *Trissolcus brochymenae* and *Ooencyrtus* sp. were found attacking *P. guildinii* eggs, but at low levels. We discuss the contribution of egg parasitoids to natural control of stink bugs.

Key words: Soybean, Cerrado, Pentatomidae, *Euschistus heros*, *Piezodorus guildinii*, *Telenomus podisi*.

Pentatomids are the main soybean pests in almost all areas where the crop is grown in Brazil. Adults and nymphs of this pest complex may cause severe damage through seed-feeding thereby reducing the yield and seed quality (Gazzoni *et al.* 1994). In Brazil, the control of these pests has been done mostly by insecticides except in some areas in the states of Paraná and Rio Grande do Sul, where they are successfully controlled by releases of the egg parasitoid *Trissolcus basalis* (Wollaston) (Hymenoptera: Scelionidae) (Corrêa-Ferreira 1993).

Hymenopterous egg parasitoids are the most important factor of natural mortality of stink bugs worldwide (Hokyo *et al.* 1966, Yeargan 1979, Orr *et al.* 1986, Corrêa-Ferreira 1986, Jones 1988). Their high search and reproductive rates, their synchrony with host development rate, the possibility of mass production and the absence of hyperparasitoids make these insects suitable agents for biological control (Orr 1988). Besides the Brazilian program, there are examples of successful biological control programs of phytophagous

pentatomids by egg parasitoids in other countries (Orr 1988, Clarke 1990).

In the majority of cases, where oophagous parasitoids have been used to control stink bugs, the most common target species has been *Nezara viridula* (L.). Although this species is considered to be the most important pest of soybean in the southern temperate areas of Brazil, in the central tropical region, mainly in the Cerrado, *Piezodorus guildinii* (Westwood) and *Euschistus heros* (Fabricius) are the most abundant pentatomid soybean pests (Corrêa *et al.* 1977, Jones 1988, Gazzoni *et al.* 1994). In contrast to comprehensive reports on natural enemies of stink bugs in the traditional soybean region in the South of Brazil (Panizzi and Smith 1976; Villas Boas and Panizzi 1980, Corrêa-Ferreira 1986, Moreira and Becker 1986, Foester and Queiroz 1990, Corrêa-Ferreira and Moscardi 1995), there is little information related to stink bug enemies for soybean areas in the Brazilian Cerrado. Kobayashi and Cosenza (1987) report on the release of an egg parasitoid species from Japan, *Trissolcus mitsukurii* (Ashmead), in the Brazilian Cerrado for improvement of the control by native parasitoids, the scelionids *T. basalis* and *Telenomus podisi* Ashmead (cited as *Telenomus mormidae*). They show that egg parasitism increased by about 20% after the introduction of the exotic species and the total percentage of parasitism was as high as 70%. High rates of parasitism in *E. heros* eggs by *T. podisi* were observed by Ávila and Godoy (1995) in surveys conducted in soybean fields in the Cerrado area of Mato Grosso do Sul. *Telenomus podisi* was also reported by Medeiros *et al.* (1997) as the main parasitoid of *E. heros* eggs in sunflowers, which is cultivated after the soybean season, in the Cerrado of the Federal District, Brazil.

There are no data available for natural mortality of stink bugs in soybean areas in the state of Minas Gerais. In the Triângulo Mineiro, a region located in the Cerrado and responsible for 58% of soybean production in the state (EMATER, unpublished), pest species of economic importance are *P. guildinii* and *E. heros* (Correia 1982, Venzon and Martins Filho 1995). To obtain more information about the species composition of egg parasitoids of stink bugs, we carried out surveys on their seasonal occurrence in soybean fields in the Triângulo Mineiro region.

MATERIALS AND METHODS

Egg masses of stink bugs were collected weekly during the growing season from soybean fields in the region of the need space Triângulo Mineiro, Minas Gerais state. In 1993/94 the masses were collected from fields in Uberaba, Conquista and Sacramento. In 1994/95 samples were collected from Conquista and Uberaba. Each soybean field measured 1.0 ha. Standard cultivation practices were used in all fields, but no pesticides were applied. The sampling procedure consisted of collecting pentatomid eggs found on five row-sections of soybean plants. Each section was 5 m long. The sections were chosen randomly throughout the field and care was taken to choose different sections in the following weeks. Egg masses were placed individually in glass tubes (2.5 x 8.5 cm) containing moist filter paper in the bottom. The tubes were sealed with Parafilm and kept in the laboratory at ambient conditions. The numbers of parasitoids and stink bug nymphs which emerged were scored daily. Intact eggs were dissected and examined for parasitoids after three weeks. Total parasitism was defined as the sum of eggs from which parasitoids emerged and eggs that were parasitized but did not result in parasitoid emergence. All parasitoids, naturally emerged or removed from intact eggs, were separated by collection site, date and host species, and kept in alcohol for identification. The population level of stink bugs was monitored in all fields by applying the ground cloth method (Gazzoni *et al.* 1994). The samples were taken before the egg masses were collected from the same five sections of row mentioned above. We considered only large nymphs (> 0.5 cm) and adults of stink

bugs in our survey because younger stages do not damage the seeds and are not taken into account when the economic threshold is calculated (Gazzoni *et al.* 1994).

RESULTS

Two stink bug species were found consistently during the survey: *P. guildini* and *E. heros*. Although other pentatomids were observed during monitoring, they were not included in the study, either because their numbers were very low or because no egg masses of these species were found. Only one egg mass from *N. viridula* was collected in Conquista in 1993/94 and it was not parasitized.

A total of 118 egg masses was collected in Conquista in the 1993/94 season. Of these, 26.3% were of *E. heros* and 73.7% of *P. guidinii* (Table 1). In 1994/95, the total number of egg masses collected was 39: 10.2% of *E. heros* and 89.7% of *P. guildinii* (Table 2). The population level of both species was higher during the first year of the study than during the second. Numbers of *P. guildinii* were higher than those of *E. heros* in 1993/94, but both population reached similar numbers in 1994/95 (Fig. 1ab). *Telenomus podisi* was the only species that successfully attacked *E. heros* eggs: it parasitized 62.9% of all eggs in 1993/94, but no parasitized eggs were found in 1994/95. A total of 810 (50.2%) and 182 (31.3%) eggs of *P. guildinii* were parasitized in 1993/94 and 1994/95 respectively. The predominant parasitoid species was *T. podisi*, but we also found *Trissolcus brochymenae* (Ashmead) and *Ooencyrtus* sp. attacking the stink bug eggs.

In Uberaba, the situation was similar to that in Conquista. *Piezodorus guildinii* was predominant both in the number of egg masses and in the number of nymphs and adults sampled (Fig.2ab). A total of 85 egg masses was collected in 1993/94 consisting of 4.7% *E. heros* and 95.3% *P. guidinii*. The parasitoid identified in eggs of the former species was *T. podisi*, whereas in the second host species we found both *T. podisi* and *T. brochymenae* (Table 1). Only one of 15 egg masses collected in 1994/95 was from *E. heros* and it was not parasitized. In parasitized eggs of *P. guidinii* (44.1%) in 1994/95 we only found *T. podisi*.

TABLE 1

Parasitism of stink bug eggs collected in the 1993/94 soybean season in the Triângulo Mineiro, state of Minas Gerais, Brazil.

Host species Locality	Total number of egg masses collected	Egg masses parasitized (%)	Total number of eggs collected	Eggs parasitized (%)	Parasitoid species composition[1]	
					Tp	Tb
Euschistus heros						
Conquista	31	61.3	120	62.5	100.0%	-
Uberaba	4	75.0	17	64.7	100.0%	-
Sacramento	169	53.8	626	50.6	100.0 %	-
Piezodorus guildinii						
Conquista	87	71.3	1613	50.2	90.5%	9.5%
Uberaba	81	72.8	1500	59.7	94.4%	5.6%
Sacramento	48	77.1	479	77.0	100.0 %	-

[1] Tp = *Telenomus podisi* and Tb = *Trissolcus brochymenae*

TABLE 2

Parasitism of stink bug eggs collected in the 1994/95 soybean season in the Triângulo Mineiro, state of Minas Gerais, Brazil.

Host species Locality	Total number of egg masses collected	Egg masses parasitized (%)	Total number of eggs collected	Eggs parasitized (%)	Parasitoid species composition[1]	
					Tp	Osp
Euschistus heros						
Conquista	4	0	17	0	-	-
Uberaba	1	0	2	0	-	-
Piezodorus guildinii						
Conquista	35	45.7	581	31.3	91.8 %	8.2 %
Uberaba	14	50.0	245	44.1	100.0%	-

[1] Tp = *Telenomus podisi* and Osp = *Ooencyrtus* sp.

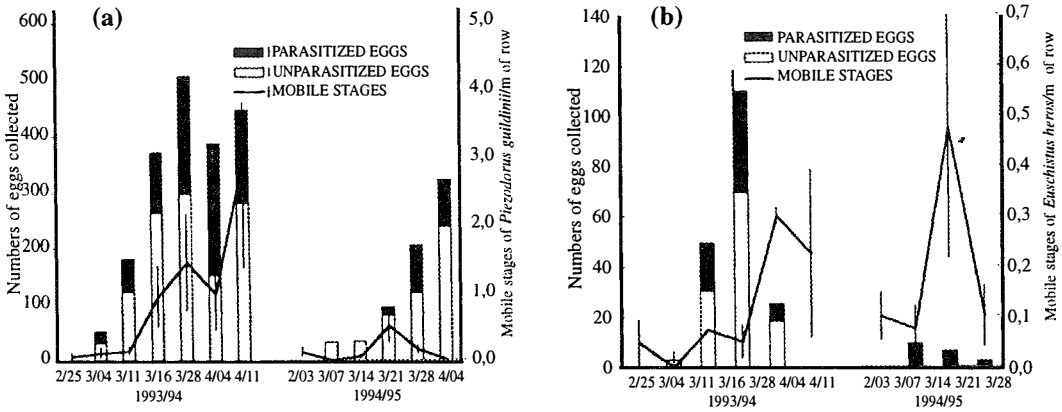

Fig. 1. Seasonal abundance of eggs and mobile stages of stink bugs (nymphs > 0.5 cm and adults sampled with the ground cloth) in soybean fields at Conquista, Minas Gerais, Brazil. (a) *Piezodorus guildinii*. (b) *Euschistus heros*. Note the different scale of the two graphs.

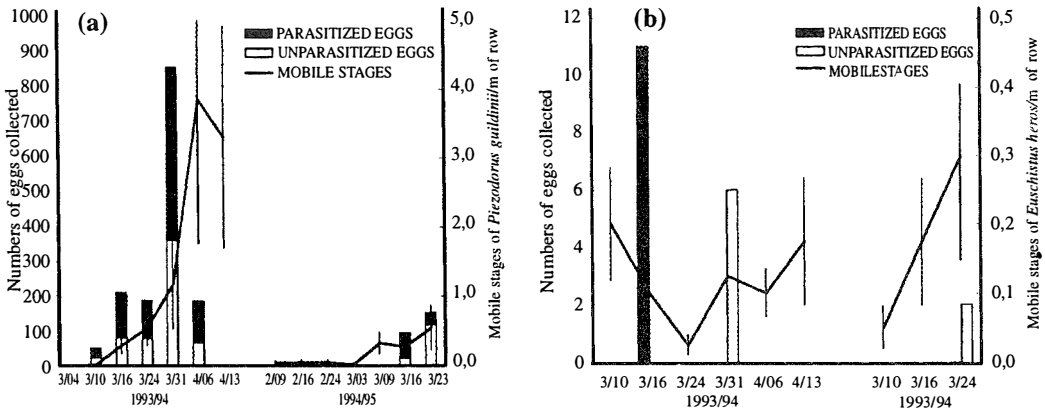

Fig. 2. Seasonal abundance of eggs and mobile stages of stink bugs (nymphs > 0.5 cm and adults sampled with the ground cloth) in soybean fields at Uberaba, Minas Gerais, Brazil. (a) *Piezodorus guildinii*. (b) *Euschistus heros*. Note the different scale of the two graphs.

In Sacramento, the survey was carried out only during the 1993/94 soybean season (Fig.3ab), and unlike the two previous places, *E. heros* was the predominant stink bug, representing 77.6% of egg masses. The parasitoid species identified from all parasitized host eggs was *T. podisi*.

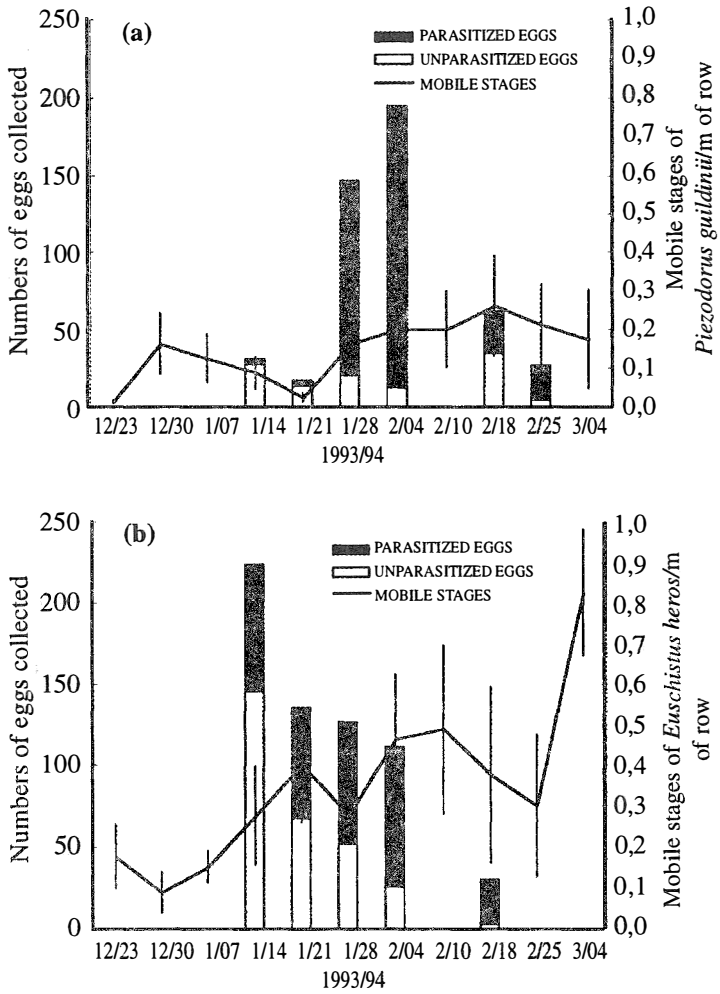

Fig. 3. Seasonal abundance of eggs and mobile stages of stink bugs (nymphs > 0.5 cm and adults sampled with the ground cloth) in soybean fields at Sacramento, Minas Gerais, Brazil. (a) *Piezodorus guildinii*. (b) *Euschistus heros*.

DISCUSSION

Telenomus podisi was the most abundant parasitoid collected in our study and the only species found to parasitize *E. heros* eggs. This scelionid was also reported as the predominant parasitoid attacking eggs of *E. heros* in south and central Brazilian soybean areas, as well as eggs of other *Euschistus* species in the United States (Yeargan 1979, Orr *et al.* 1986, Foester and Queiroz 1990, Corrêa-Ferreira and Moscardi 1995, Ávila and Godoy 1995, Medeiros *et al.* 1997). Despite its predominance, it is not the only species reported in *E. heros* eggs. Multiparasitism and the occurrence of other

Scelionidae (*T. basalis*, *T. brochymenae*, *Trissolcus urichi* Crawford, *Trisssolcus teretis* Johnson, *Trissolcus scuticarinatus* Costa Lima, *Trissolcus* sp. and *Gryon obesum* Masner), Encyrtidae (*Ooencyrtus* sp.), Eurytomidae (*Neorileya* sp.) and Eupelmidae (*Eupelmus* sp.) species were also found in the eggs of this host (Corrêa-Ferreira 1986, Foester and Queiroz 1990, Corrêa-Ferreira and Moscardi 1995, Ávila and Godoy 1995, Medeiros *et al.* 1997).

Telenomus podisi was responsible for 94% of parasitism of all parasitized eggs of *P. guildinii*. Similar percentages were observed by Panizzi and Smith (1976), Corrêa-Ferreira (1986) and Foester and Queiroz (1990) in surveys carried out in the state of Paraná. However, in a more recent survey conducted in the same area, Corrêa-Ferreira and Moscardi (1995) found that *T. podisi* was responsible for only 40% of the observed parasitism whereas *T. basalis* caused 44% of it. The authors suggested that the increased field releases of *T. basalis* in that region were responsible for the change in composition of parasitoid species attacking *P. guildinii* eggs.

Parasitism of *P. guildinii* eggs by *Ooencyrtus* sp. and *T. brochymenae* was very low and was absent in *E. heros* eggs. This suggests that both parasitoids use other hosts rather than *P. guildinii*, and they probably use the latter as an alternative host. *Ooencyrtus* species have been reported as having a wide host range, including both phytophagous and predatory Pentatomidae, Coreidae and Rhopalidae (Jones 1988) and all of these insects occur in the Cerrado soybean agroecosystem in Minas Gerais state (Venzon, unpublished). *Trissolcus brochymenae* was mostly reported attacking predators and phytophagous pentatomid eggs, but always as a minor component of the parasitoid complex (Jones 1988, Corrêa-Ferreira and Moscardi 1995, Torres *et al.* 1996).

The total percentage of parasitism is a useful indicator for identifying species of parasitoids attacking specific host species at particular locations, at specific times, and it can be used to rank the relative commonness of the species observed, but it is usually inadequate to assess the impact of parasitoids on the population dynamics of the host (van Driesche 1983). To attempt this one may look at the seasonal distribution of parasitized eggs and mobile stages of hosts. Although more data are needed to show any parasitoid-stink bug population correlation, as an example we can look at the samples taken from Conquista (Fig.1). For *P. guildinii* in the 1993/94 season, we observed that since the first eggs were found (Fig.1a), some of them (40.4%) were already parasitized and the percentage of eggs parasitized increased in the subsequent sampling date. But if we look at population level of *P. guildinii* we also see an increase of number of mobile stages towards the end of the cropping season. The initial portion of eggs that were not parasitized yield juvenile and adults that will remain harmful to the crop at least during 60 days (Cividanes and Parra 1994). A higher percentage of parasitized eggs from the beginning of the appearance of stink bugs in the fields seems to keep their population at low level. For this reason, for biological control of stink bugs by oophagous parasitoids it is advised to release parasitoids during the soybean flowering period, when the first hosts start to colonize the fields (Corrêa-Ferreira 1993).

ACKNOWLEDGMENTS

We thank FAPEMIG (Minas Gerais State Research Foundation) for financial support, José Henrique Viríssimo for his technical assistance, Jonadan Hsuan Min Ma and César Adalberto Piraja Figueiredo for providing the work areas. We are grateful to Beatriz S. Corrêa-Ferreira from CNPSo/EMBRAPA for identification of the parasitoid species, Sam Elliot and Arne Janssen from the University of Amsterdam for comments and review of the manuscript.

REFERENCES

Ávila, C.J & K.B. Godoy. 1995. Levantamento quali-quantitativo de parasitismo de ovos de percevejos *Piezodorus guildinii* e *Euschistus heros* na região de Dourados, MS. 17º Reunião de pesquisa de soja da região central do Brasil, EMGOPA, Goiânia. p.141.

Cividanes, F.J. & Parra, J.R.P. 1994. Biologia em diferentes temperaturas e exigências térmicas de percevejos pragas da soja. III. *Piezodorus guildinii* (West., 1837) (Heteroptera: Pentatomidae). Científica 22: 177-186.

Clarke, A.R. 1990. The control of *Nezara viridula* L. with introduced egg parasitoids in Australia: A review of a landmark example of classical biological control. Aust. J. Agric. Res. 41: 1127-1146.

Corrêa-Ferreira, B.S. 1986. Ocorrência natural do complexo de parasitóides de percevejos da soja no Paraná. An. Soc. Entomol. Brasil 15:189-199.

Corrêa-Ferreira, B.S. 1993. Utilização do parasitóide *Trissolcus basalis* (Wollaston) no controle de percevejos da soja. EMBRAPA/CNPSo, Londrina, Circ. Téc.11. 40p.

Corrêa-Ferreira, B.S. & F. Moscardi. 1995. Seasonal occurrence and host spectrum of egg parasitoids associated with soybean stink bugs. Biol. Control 5: 196-202.

Corrêa, B.S., A.R. Panizzi, G.G. Newman & S.G. Turnipseed. 1977. Distribuição geográfica a abundância estacional dos principais insetos-pragas da soja e seus predadores. An. Soc. Entomol. Brasil 6: 40-50

Correia, A. C. B. 1982. Manejo Integrado de Pragas. Inf. Agropec. 8: 47-56.

Foerster, L.A. & J.M. Queiroz. 1990. Incidência natural de parasitismo em ovos de pentatomídeos da soja no Centro-Sul do Paraná. An. Soc. Entomol. Brasil 19: 221-232.

Gazzoni, D.L., D.R. Sosa Gómez, F. Moscardi, C.B. Hoffmann-Campo, B.S. Corrêa-Ferreira, L.J. Oliveira & I.C. Corso. 1994. Insects, p. 81-108. In EMBRAPA-CNPSo (ed), Tropical soybean: improvement and production. Rome, FAO Plant Production and Protection Series 27.

Hokyo, N., K. Kiritani, F. Nakasuji & M. Shiga. 1966. Comparative biology of two scelionid egg parasites of *Nezara viridula* L. (Hemiptera: Pentatomidae). Appl. Entomol. Zool. 1: 94-102.

Jones, W.A. 1988. World review of the parasitoids of the southern green stink bug, *Nezara viridula* (L.) (Heteroptera: Pentatomidae). Ann. Entomol. Soc. Am. 81: 262-273.

Kobayashi, T. & G.W. Cosenza. 1987. Integrated control of soybean stink bugs in the Cerrados. Japan Agric. Res. Q. 20: 229-236.

Medeiros, M.A., F.V.G. Schimidt, M.S. Loiácono, V.F. Carvalho & M. Borges. 1997. Parasitismo e predação em ovos de *Euschistus heros* (Fab.) (Heteroptera: Pentatomidae) no Distrito Federal, Brasil. An. Soc. Entomol. Brasil 26: 397-401.

Moreira, G.R.P & M. Becker. 1986. Mortalidade de *Nezara viridula* (Linnaeus, 1758) (Heteroptera: Pentatomidae) no estágio de ovo na cultura da soja: II - Parasitóides. An. Soc. Entomol. Brasil 15: 291-308.

Orr, D. B. 1988. Scelionid wasps as biological control agents: a review. Fla Entomol. 71: 506-528.

Orr, D.B., J.S. Russin, D.J. Boethel & W.A. Jones. 1986. Stink bug (Hemiptera: Pentatomidae) egg parasitism in Lousiana soybeans. Environ. Entomol. 15: 1250-1254.

Panizzi, A.R. & J.G. Smith. 1976. Observações sobre inimigos naturais de *Piezodorus guildinii* (Westwood, 1837) (Hemiptera: Pentatomidae) em soja. An. Soc. Entomol. Brasil 5: 11-17.

Torres, J.B., J.C. Zanuncio, P.R. Cecon & W.L. Gasperazzo. 1996. Mortalidade de *Podisus nigrispinus* (Dallas) por parasitóides de ovos em áreas de eucalipto. An. Soc. Entomol. Brasil 25: 463-471.

van Driesche, R.G. 1983. Meaning of "percentage parasitism" in studies of insect parasitoids. Environ. Entom. 12: 1611-1622.

Venzon, M. & S. Martins Filho. 1995. Abundância de insetos-pragas e seus inimigos naturais na cultura da soja no Triângulo Mineiro. Rev. Agric. Trop. 1: 79-91.

Villas-Bôas, G.L & A.R. Panizzi. 1980. Biologia de *Euschistus heros* (Fabricius, 1798) em soja (*Glycine max* (L.) Merril). An. Soc. Entomol. Brasil 9: 105-113.

Yeargan, K.V. 1979. Parasitism and predation of stink bugs eggs in soybean and alfafa fields. Environ. Entomol. 8: 715-719.