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Original Article

Biology of *Glyphepomis dubia* Campos & Souza, 2016 (Hemiptera: Pentatomidae) and the parasitoids *Telenomus podisi* Ashmead, 1893 and *Trissolcus basalis* (Wollaston, 1858) (Hymenoptera: Platygastridae) on rice

Biologia de *Glyphepomis dubia* Campos & Souza, 2016 (Hemiptera: Pentatomidae) e dos parasitoides *Telenomus podisi* Ashmead, 1893 e *Trissolcus basalis* (Wollaston, 1858 (Hymenoptera: Platygastridae) em arroz

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Abstract

The life cycle of stink bug, *Glyphepomis dubia* and the development of two egg parasitoids (*Telenomus podisi* and *Trissolcus basalis*) were studied at the Federal University of Maranhão, at 26 ± 2ºC, relative humidity (RH) of 60 ± 10% and 12h photophase. Individuals used in the study were collected from seven rice fields located around the municipality of Arari, Maranhão, Brazil, and maintained in greenhouse and laboratory for the life cycle studies. From egg to adult, *G. dubia* took 35.2 days to complete the life cycle. The oviposition period was 37 days, with egg masses of about 12 eggs each and viability of 93.1%. Longevity was 53 and 65 days for females and males, respectively. The egg parasitoids *Te. podisi* and *Tr. basalis* parasitized and developed in *G. dubia* eggs; however, the biological characteristics of *Tr. basalis* were affected. Emergence of the parasitoids was higher for *Te. podisi* (83.5%) compared to the records for *Tr. basalis* (50.4%). Therefore, *G. dubia* may potentially achieve a pest status and *Te. podisi* is a promising biological control agent for *G. dubia* management in Brazil due to its higher longevity and better reproductive parameters.

Keywords: Heteroptera, *Oryza sativa*, egg parasitoids, rice stink bugs, control biology.

Resumo

O ciclo de vida do percevejo, *Glyphepomis dubia* e a biologia de dois parasitoides de ovos (*Telenomus podisi* e *Trissolcus basalis*) foram estudados na Universidade Federal do Maranhão, a 26 ± 2ºC, umidade relativa (UR) de 60 ± 10% e fotofase de 12h. Sete indivíduos de *G. dubia* foram coletados em lavoura de arroz localizada no município de Arari, Maranhão, Brasil e mantidos em casa de vegetação e laboratório para estudos de ciclo de vida. Do ovo ao adulto, *G. dubia* levou 35.2 dias para completar o ciclo de vida. O período de oviposição foi de 37 dias com massas de ovos com cerca de 12 ovos/massa e viabilidade de 93.1%. A longevidade foi de 53 e 65 dias, respectivamente, para fêmeas e machos. Os parasitoides de ovos, *Te. podisi* e *Tr. basalis* parasitaram e se desenvolveram em ovos de *G. dubia*, no entanto as características biológicas de *Tr. basalis* foi afetada. A emergência dos parasitoides foi maior para *Te. podisi* (83.5%) em comparação com o registrado para *Tr. basalis* (50.4%). Portanto, *G. dubia* poderá apresentar potencial para atingir o status de praga e *Te. podisi* é um promissor agente de controle biológico para ser utilizado no manejo de *G. dubia* no Brasil, pois apresentou maior longevidade e os melhores parâmetros reprodutivos.

Palavras-chave: Heteroptera, *Oryza sativa*, parasitoides de ovos, percevejos do arroz, controle biológico.

1. Introduction

The State of Maranhão is the eighth largest rice producer in Brazil and the second in the Northeast region, with estimates for 2020/2021 harvest pointing to a total cultivated area of 8.4 thousand hectares, production of 5.690 thousand tons and average productivity of 2.753 kg/ha (CONAB, 2021). In spite of the privileged position of the

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State with regard to rice production in the Northeast region, this cereal faces phytosanitary problems that may damage crop productivity.

The incidence of pests such as the species of Pentatomidae in agricultural crops emerges as a limiting factor, since they interfere with productivity and grain quality, resulting in economic losses. Pentatomidae is one of the most abundant families of stink bugs attacking rice crops in Brazil (Acosta et al., 2017). The rice stem bug *Tibraca limbativentris* Stål and the small rice stink bug *Oebalus poecilus* (Dallas) (Heteroptera: Pentatomidae) have been reported as the most economically important phytophagous stink bugs found in rice crops (Ferreira et al., 1997; Ferreira, 1998, 2006).

Glyphepomis dubia Campos & Souza was described by Bianchi et al. (2016) from specimens collected in the municipality of Arari, Maranhão (03º27'13"S and 44º46'48"W). The authors presented a detailed morphological description of the species, relating it to other stink bugs belonging to the same genus occurring in different Brazilian regions. However, the article only provides its taxonomic description and distribution based on the location where specimens were collected there is no information besides those present in the original description.

Glyphepomis spinosa and *Glyphepomis adroguensis* Berg have been reported as potentially harmful to rice crops compared to other relevant species belonging to the Pentatomidae complex of rice pests in Brazil (Alves et al., 2012; Farias et al., 2012). Although *Glyphepomis* is a widely distributed genus in the Neotropical Region, only a few studies have been conducted to evaluate it, including biological studies on *G. spinosa* in rice (Alves et al., 2012), a description of immature individuals (Pollo et al., 2012) and a record of *G. adroguensis* as an egg parasitoid (Farias et al., 2012). *Glyphepomis dubia* biology and ecology remain unknown, and further studies are needed as a basis to reinforce the integrated pest management in rice.

The management of rice stink bugs in Brazil is based on the use of chemical insecticides (Martins et al., 2009; Pazini et al., 2015), without considering the principles of integrated pest management (Martins et al., 2009). The conservation of beneficial insects in rice stands out as an important component in modern integrated pest management (IPM) (Rahaman and Stout, 2019). For biological control, there are several studies involving surveys of natural enemies (e.g. Idalgo et al., 2013; Maciel et al., 2007; Riffel et al., 2010; Zachrisson et al., 2014a; Zachrisson et al., 2018) and application the *Metarhizium anisopliae* (Metchnikoff) Sorokin (Fungi: Hypocreales: Clavicipitaceae) in rice (Martins et al., 2004).

Regarding to parasitoids, eggs of different species of stink bugs the rice are parasitized by *Telenomus podisi* Ashmead and *Trissolcus basalis* (Wollaston) (Hymenoptera: Platygastridae). In Brazil, the specie *Te. podisi* was reported including *T. limbativentris* (Idalgo et al., 2013; Maciel et al., 2007; Riffel et al., 2010), *O. poecilus* (Dallas) (Melo Neto et al., 2020) and *G. adroguensis* (Farias et al., 2012). In Panama, in addition to *Te. podisi* em ovos de *Euchistus nicaraguensis* Rolston (Zachrisson et al., 2018), *Tr. basalis* has been reported parasitizing eggs of *T. limbativentris* (Zachrisson et al., 2014a) and *Oebalus insularis* Stål (Zachrisson et al., 2014b).

The trophic interaction between the host (as a potential pest) and the egg parasitoid species may provide relevant information for rice IPM in Brazil. The present study aims to assess the biology of *G. dubia* and the parasitoids *Te. podisi* and *Tr. basalis* on rice.

2. Materials and Methods

2.1. Host rearing

Seven adults of *G. dubia* were collected (four females and three males) in rice in the municipality of Arari, Maranhão, Brazil (03º 27 '13" S, 44º 46 '48" W) in April and May 2012. The identification of the species *G. dubia*, was made by Dr. Luiz Alexandre de Campos, from the Department of Zoology, of the Universidade Federal de Rio Grande do Sul, Porto Alegre, Brazil that used the work of Bianchi et al. (2016).

Studies were performed in a greenhouse and laboratory at the Federal University of Maranhão, Chapadinha campus, Brazil. In the greenhouse, rice plants *Oryza sativa* L. (BR IRGA 409) grown in eight-liter plastic pots were used for stink bug feeding and reproduction. Plants were replaced every 20 days. The pots were inspected daily, egg masses collected daily from the plants to avoid egg parasitization (Alves et al., 2012) every two or three days and incubated in transparent plastic boxes (11 x 11 x 3.5 cm, Adria Laboratórios, Londrina, Paraná, Brazil) lined with water-moistened filter paper (26 ± 2ºC, 60 ± 10% RH, 12h photophase) until second instar.

When the nymphs reached the second instar, they were confined to rice plants grown in pots in a greenhouse covered with cage made with "*voile*" (0.60 x 1.45 x 0.60m). The nymphs were followed daily until the adulthood.

2.2. Biology of Glyphepomis dubia

Thirty egg masses with approximately 16 eggs each, totalizing 480 eggs were taken to the laboratory, placed into Petri dishes (9 × 1.5 cm), and kept under the same conditions described before. For each egg mass, the number of eggs and the oviposition date were recorded to determine the incubation period (in days), the viability of the eggs and the duration of the first instar (in days).

Upon reaching the second instar, nymphs were transferred to 45-day-old rice plants in a greenhouse and were reared until the end of the study. The development of each individual nymph was followed throughout the instars until reaching the adult stage by daily inspections, with counting and registration of the alive, dead and any missing individual. The time of development of each stage was determined, and survival ratio was calculated as the difference between the number of individuals alive in two consecutive stages.

The sex ratio was determined by dividing the number of emerged females by the total number of emerged adults. Survivorship and longevity the adult were determined using twenty five, couples individually kept in rice plants in a greenhouse. Each couple was observed daily to verify the egg masses, the presence of alive or dead individuals, and determine the periods of pre-oviposition and oviposition (in days).

Based on these daily observations, the egg masses of each couple were transferred to Petri dishes, kept in the laboratory the incubation period and viability (%) were determined. In addition, the number of egg masses/female/day, eggs/egg masses, incubation period, viability eggs (%) and longevity of females and males was also observed.

2.3. Biology of Telenomus podisi and Trissolcus bassalis on Glyphepomis dubia eggs

Thirty *G. dubia* egg masses containing about 16 eggs (<24h old) were individually glued to a white carton (3 x 6 cm) with paper glue (Tenaz, Henkel). Then, each carton containing a glued egg mass was introduced in a 5 mL test tube (model K30-1275PP transparent, 12 x 75 mm, Kasvi, Olen, São José dos Pinhais, Paraná, Brazil) covered with plastic film and held horizontally. In each tube containing one egg mass, a couple of virgin *Te. podisi* or *Tr. basalis* (one male and one female, both acquired from Embrapa Soja, Londrina, Paraná, Brazil) was introduced. These species of parasitoids were chosen because both perform well parasitizing eggs of most of pentatomids and they are easily reared in laboratory.

The parasitoids were allowed to stay in contact with the egg mass for 24 hours, and then were removed. Cards with eggs were transferred to similar tubes and kept in a climate room at 26 ± 2ºC, relative humidity of 60 ± 10% and photophase of 14 hours until the emergence of the parasitoids. Parasitism was evaluated individually for each species. The following biological variables were determined: parasitism (%), emergence (%), non-emerged parasitized eggs (%), egg-to-adult period (in days), sex ratio and longevity of females and males without food (in days).

Parasitism was species determined by observing the eggs to detect any dark color and later by checking the emergence of adult parasitoids or stink bug nymphs (Pastori et al., 2010). All non-emerged eggs were dissected under the microscope to confirm the parasitism (Pacheco and Corrêa-Ferreira, 2000).

The egg-to-adult period (in days) was determined by computing the number of days starting from the day the wasps' eggs were laid to the emergence of the parasitoids. All emerged parasitoids were sexed according to the morphological characteristics of the antennae and the sex ratio (number of females/number of females + number of males) was calculated according to the equation reported by Pastori et al. (2010). Longevity of parasitoids was determined by following them since their emergence until the death (Doetzer and Foerster, 2007).

The differences in parasitism (%), emergency (%), non-emerged parasitized eggs (%), egg-to-adult period (in days), sex ratio, and longevity of females and males (in days) were obtained through analysis using the Mann-Whitney Test (U test) at 5% significance level. This test was chosen because Shapiro-Wilk test showed a non-normal distribution of the data.

The analyses was performed using PAST 4.05 statistical program, January 2021 version (Hammer et al., 2001).

3. Results

3.1. Biology of Glyphepomis dubia

Eggs of *G. dubia* are initially light green becoming reddish and/or dark brown in a more advanced stage. Females lay their eggs on the upper face of the rice leaves and on the stalks of rice plants as well.

To complete one generation in rice, *G. dubia* requires 49.9 days. The egg incubation period for *G. dubia* was 5.9 ± 0.05 days and egg viability was 91.5 ± 2.1% (Table 1). *Glyphepomis dubia* nymphs and adults feed by inserting their mouth parts into the stalk of the rice plant in a characteristic "upside down" position (Figure 1).

The fourth and fifth instars were the longest, lasting 6.3 ± 0.22 and 10.4 ± 0.10 days, respectively, while the first instar was the shortest with 3.1 ± 0.04 days; the nymphal period lasted 29.3 ± 0.32 days and the survivorship of the

Table 1. Instar-specific duration (mean ± SE) for *Glyphepomis dubia* kept under laboratory conditions (26 ± 2ºC; relative humidity of 60 ± 10% and 12 h photophase). Chapadinha, State of Maranhão, Brazil, 2012.

Stage	Stadium	Duration (days)	Range (days)
Egg[1]	Incubation time	5.9 ± 0.05	5-6
	Egg viability (%)	91.5 ± 2.10	58-100
Nymph	First instar	3.1 ± 0.04	3-4
	Second instar	4.7 ± 0.15	5-7
	Third instar	4.8 ± 0.22	5-6
	Fourth instar	6.3 ± 0.22	6-9
	Fifth instar	10.4 ± 0.10	10-11
	Nymphal time	29.3 ± 0.32	28-32
	Nymph survivorship (%)	39.0 ± 5.00	9-16
	Egg-adult	35.2 ± 0.35	27-36

[1]Results based on 30 egg masses with mean of 16 eggs.

nymphs was 39 ± 5% (Table 1). *G. dubia* took 35.2 ± 0.35 days from egg deposition to adult (Table 1), with 151 adults from which 96 males and 55 females, resulting in a sex ratio of 0.4 ± 0.05 (Table 2).

Glyphepomis dubia lays eggs in groups arranged in double rows. The female started the oviposition at 5 ± 0.4 days of adult stage and remained laying eggs for 37 ± 2.5 days (Table 2). Each female showed average number of eggs per egg lay was 12 ± 1, with a range from 7 to 13 eggs/egg masses (Table 2). Regarding egg viability, 93 ± 3% of the eggs were viable (Table 2). Adult females lived 53 ± 4.5 days, ranging from 21 to 74 days, while males lived 65 ± 2.9 days, ranging from 49 to 82 days (Table 2).

Figure 1. Adult the *Glyphepomis dubia* feeding on stems of rice in characteristic "upside down" position. Chapadinha, MA. 2012.

3.2. Biology of Telenomus podisi and Trissolcus basalis in Glyphepomis dubia eggs

Telenomus podisi and *Tr. basalis* parasitized and developed in *G. dubia* eggs (Table 3). The was significant differences for emergence (%), non-emerged parasitic eggs (%), egg-to-adult period (in days), sex ratio, longevity of females and males (in days) (Table 3). The parasitoid emergence was higher for *Te. podisi* (83.5 ± 6.2%), compared to those registered for *Tr. basalis* (50.4 ± 5.0%) and the rate of non-emerged parasitized eggs was 3.8 ± 1.4% for *Te. podisi* and 48 ± 5.0% for *Tr. basalis* (Table 3).

From egg to adult, *Te. podisi* required 11.74 ± 0.08 days to develop in *G. dubia* eggs, while *Tr. basalis* required 9.9 ± 0.38 days under the same conditions. The sex ratios of *Te. podisi* and *Tr. basalis* progenies were 0.6 ± 0.01 and 0.7 ± 0.05, respectively (Table 3). The longevities of *Te. podisi* and *Tr. basalis* were 2.74 ± 0.08 and 1.5 ± 0.1 days for females, while for males the longevity rates were 2.6 ± 0.06 and 1.9 ± 0.19 days, respectively (Table 3).

Table 2. Biological variables (mean ± SE) for adults of *Glyphepomis dubia* kept under laboratory (26 ± 2ºC, relative humidity of 60 ± 10% and 12h photophase) and greenhouse (25 ± 7°C, relative humidity of 60 ± 20% and 14:10 L:D photoperiod) conditions. Chapadinha, State of Maranhão, Brazil, 2012.

Variables	Mean ± SE	Range
Sex ratio[1]	0.4 ± 0.05	0.25-0.78
Pre-oviposition period[2]	5 ± 0.40	1-8
Oviposition period[2]	37 ± 2.50	20-60
Eggs/egg masses[2]	12 ± 1.00	7-13
Egg viability (%)[2]	93 ± 3.00	68-100
Female longevity (days)[3]	53 ± 4.50	21-74
Male longevity (days)[3]	65 ± 2.90	49-82

[1]Results based on 191 individuals (96 males and 55 females); [2]Results based on 480 eggs; [3]Results based on 25 couples.

Table 3. Biological variables obtained by the Test Mann-Whitney (mean ± SE) for *Telenomus podisi* and *Trissolcus basalis* developed in *Glyphepomis dubia* eggs in laboratory (26 ± 2ºC, relative humidity of 60 ± 10% and 14h photophase). Chapadinha, State of Maranhão, Brazil, 2012.

Biological variables[1]	Mean ±SE		Mann-Whitney	Valor de p
	Telenomus podisi	***Trissolcus basalis***		
Parasitism (%)	85 ± 6.30	98 ± 1.00	380	0.14124
Emergency (%)	83.5 ± 6.2	50.4 ± 5.00	148	**0.00000616**
Non-emerged parasitized eggs (%)	3.8 ± 1.40	48 ± 5.00	45	**8.5745E-06**
Egg-to-adult period (days)	11.74 ± 0.08	9.9 ± 0.38	91	**1.4143E-07**
Sex ratio	0.6 ± 0.01	0.7 ± 0.05	272.5	**0.0347**
Female longevity (days)	2.74 ± 0.08	1.5 ± 0.10	82	**3.119E-08**
Male longevity (days)	2.6 ± 0.06	1.9 ± 0.19	248	**0.002142**

[1]Results based on 430 eggs. Values in bold are significantly different.

4. Discussion

This study provides information about a Brazilian endemic species that is not found in the literature available on biological cycles, host plants and natural enemies. The occurrence of *G. dubia* in rice (*Oryza sativa* L.) is being recorded for the first time, opening perspectives for an update of Pentatomidae and egg parasitoid species and thus reinforcing rice integrated pest management in Brazil.

Glyphepomis contains seven species that are morphologically similar (Bianchi et al., 2016), and only a few studies have investigated them, including biology studies of *G. spinosa* in rice (Alves et al., 2012) and the occurrence of parasitism by *Te. podisi* on *G. adroguensis* (Farias et al., 2012).

No studies have been carried out to evaluate the biology of *Te. podisi* and *Tr. basalis* in eggs of any *Glyphepomis* species in Brazil. The literature reports several surveys of *Te. podisi* and *Tr. basalis* parasitizing eggs of other pentatomids in rice fields (Idalgo et al., 2013; Maciel et al., 2007; Zachrisson et al., 2014a, b).

In the cages, nymphs and adults were observed feeding on the stalks of rice with upside down position. This behavior was also verified for other rice stink bugs, *T. limbativentris* (Ferreira et al., 1997; Ferreira, 2006), *G. spinosa* (Alves et al., 2012), *G. adroguensis* (Farias et al., 2012) and also in corn with *Diceraeus melacanthus* (Dallas) (Panizzi and Lucini, 2019).

Throughout the experiment, rice plants proved to be important nutritional sources for the development of immatures and adults of. *G. dubia,* it can be inferred that the feed used was adequate in because it provided an expressive viability of the eggs obtained. Egg incubation time and viability are close to those observed for *G. spinosa* (Alves et al., 2012). Matesco et al. (2009) also found a high percentage of egg viability in *Chinavia longicorialis* (Breddin) fed green bean pods (*Phaseolus vulgaris* L.) under controlled conditions. The high egg viability observed in this study indicates that if the population of *G. dubia* increases in rice fields, significant yield losses can occur due to the high fertility of adults in the field.

The oviposition site is preferably the upper surface of the leaves or stems of rice that can facilitate both chemical or biological management carried out by natural enemies. The eggs of *G. dubia* are barrel-shaped, light green and similar in shape to those of *G. spinosa* (Pollo et al., 2012) and *Cyptocephala alvarengai* Rolston (Barrigossi et al., 2017) right at this stage of development in field conditions may make it difficult to identify *G. dubia* when other rice stink bugs occur in the crop.

The survival rates of nymphs are influenced by temperature according to Oliveira et al. (2019) in studies with *Corythucha gossypii* Fabricius (Hemiptera: Tingidae). The low survival of *C. alvarengai* nymphs in the second instar has also been reported by Barrigossi et al. (2017), with lower mortality in the subsequent instars; also, high mortality from the second to the fifth instar was observed in *C. longicorialis* (Matesco et al., 2009).

Several factors may be associated with the low survival of pentatomid nymphs, such as food source (Matesco et al., 2009), biological mortality from natural enemies, temperature (Alves et al., 2012) and relative humidity (Alves et al., 2012; Hirose et al., 2006). As there is no other data available on alternative food sources or any reports in other host plants, it might be difficult to point out whether the survival of *G. dubia* nymphs will be low.

As for the incidence of natural enemies, this factor was not observed in the study as the plants were protected by cages and the eggs were removed daily to avoid parasitism. It was therefore not possible to observe other factors that may have influenced nymph behavior. Thus, further research on temperature and relative humidity is needed to better explain the low survival of *G. dubia* nymphs.

Considering the egg-to-adult development and the pre-oviposition period, the duration of one generation was about 49.9 days, similar to those observed for *G. spinosa* (Alves et al., 2012) and close to those observed for *T. limbativentris* (Bolton et al., 1996), a chronic rice pest in South America (Martins et al., 2009). In the State of Maranhão, Brazil, the preference of farmers is for rice varieties with intermediate to long life cycles (>85 to 110 days), suggesting that *G. dubia* can have up to two generations per growing season.

Telenomus podisi seems to be a promising natural regulator of *G. dubia* eggs in rice fields, as it can successfully parasitize and develop in all stages of *G. dubia* embryonic development. This parasitoid has been also reported by Farias et al. (2012) in Brazil, with *G. adroguensis* and *T. limbativentris* as hosts (Maciel et al., 2007; Riffel et al., 2010), and by Zachrisson et al. (2018) in Panama with *E. nicaraguensis* as a host in a rice field.

The eggs parasitized by *Tr. basalis* showed an emergency of only 50.4%. The host on which the female parasitoid oviposits is an important variable to be studied, and this factor was observed in the present study as the emergency was affected.

Parasitoid larval development may be dependent on specific nutrients from the host egg that are essential for embryonic development (Nettles Júnior, 1990), since during the development of immature forms the host is the only nutritional source available (Zhou et al., 2014). These nutrients are tissue components and if they are not present in the host egg the development of the parasitoid embryo is discontinued (Vinson, 1997), and low emergence rates or death of larvae can occur (Gomes, 1997).

The presence of dead pupae inside the eggs, seen by the number of parasitized eggs that did not emerge during egg dissection, indicates the occurrence of parasitism of *Tr. basalis* on *G. dubia*, although it may be influenced by factors that limit parasitoid development.

If the host is appropriate for the development of the parasitoid, the mortality of young forms is low (Rodrigues et al., 2003). The nutritional quality is a hypothesis that could explain the pupal mortality of *Tr. basalis* in *G. dubia* eggs, however further studies should be carried out for a better understanding of this effect, as according to Queiroz et al. (2018) there are only a few published studies available.

From egg to adult, *Te. podisi* and *Trissolcus brochymenae* (Ashmead) took 14 days at 13.2°C and 16 days at 14.1°C to complete their cycle in *Piezodorus guildinii* (Westwood) eggs (Cividanes et al., 1998). For *Tr. basalis* in *Nezara viridula* (L.)

eggs the duration was 11.45 days at 26°C (Corrêa-Ferreira, 1993). *Telenomus podisi* took 10.1 days at 25°C to develop in *T. limbativentris* eggs (Riffel, 2007), a time close to that observed in our study examining *G. dubia* eggs under the same temperature conditions.

The sex ratio of *Te. podisi* was similar to that obtained by Riffel (2007), when *T. limbativentris* eggs were used as host. In biological control programs, sex ratio is an important attribute considering that the higher proportion of females obtained from the offspring is decisive for the establishment of the parasitoid during the crop season (Navarro, 1998).

In general, the longevity of a parasitoid species is directly associated with a high parasitism rate, host and food supply (Corrêa-Ferreira, 1993; Pacheco and Corrêa-Ferreira, 1998; Riffel, 2007). Prolonged longevity was observed in females of *Te. podisi*, what can be an advantage for the species in view of the greater efficiency in the host's eggs observed by parasitism and emergence occurring in this study. Riffel (2007) reported a longevity of 5.97 days for *Te. podisi* in *T. limbativentris* eggs, while Corrêa-Ferreira (1993) reported 3.0 and 4.7 days for females and males of *Tr. basalis*, respectively, in *N. viridula* eggs.

The biological characteristics of *G. dubia* are similar to those observed in other species of stink bugs found in rice crops, including their feeding behavior and development time. This allows us to conclude that this species may potentially achieve a pest status and, therefore, the monitoring of rice planting areas is highly recommended. Furthermore, *Te. podisi* is a promising biological control agent for *G. dubia* management in Brazil due to its higher longevity and better reproductive parameters.

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