

Scientific Note

New Records of Egg Parasitoids of Stink Bugs (Hemiptera: Pentatomidae) on Rice in Piauí, Brazil: Rate Parasitism, Incidence and Seasonality

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Edited by: Regiane Cristina de Oliveira

Received: February 17, 2021. Accepted: May 31, 2021. Published: July 25, 2021.

Abstract. This study was conducted to investigate parasitism of naturally occurring pentatomid eggs in rice crops in a Cerrado-Caatinga ecosystem during the rainy and dry seasons in Teresina, Piauí, Brazil. Also, it provides information on the incidence and seasonality of parasitoid species. Parasitism was registered only during the rainy season, where *Telenomus podisi* (Ashmead, 1893) parasitized *Oebalus poecilus* (Dallas, 1851), *Tibraca limbativentris* (Stal, 1860) and *Euschistus heros* (Fabricius, 1798) eggs. Additionally, *Trissolcus urichi* (Crawford, 1913) was collected from *O. poecilus* and *T. limbativentris* eggs. *Ooencyrtus anasae* (Ashmead, 1887) was found in *O. poecilus* eggs. Such findings provide information that can be used to supplement the management of pentatomid pests in the rice agroecosystems, in Piauí, Brazil.

Keywords: *Oryza sativa*, Scelionidae species, Climatic factors, Natural biological control.

Rice (*Oryza sativa* L.) is one of the most cultivated and economically important agricultural crops worldwide, and Brazil is the largest producer and consumer outside Asia (Brazilian Rice 2020). Rice yields are affected by several biotic and abiotic factors being insect-pests the major threat once they cause considerable crop losses.

Stink bugs (Hemiptera: Pentatomidae) are economically significant rice insect-pests in Brazil (Ferreira et al. 2001). Among them, pentatomids have a wide range of species registered in rice crop that can potential cause losses up to 80% during high infestations (Ferreira & Barrigossi 2006). An important tool for the management of pentatomids species complex is the use of egg parasitoids (Koppel et al. 2009; Laumann et al. 2010). However, investigations about these parasitoids that naturally attack stink bug eggs in rice have only now begun in Brazil.

An essential step to use these natural enemies in biological control programs is to collect and identify the species of pentatomid egg parasitoids in rice production systems. In addition, the influence of climate variables such as temperature, humidity, and precipitation, on the development and diversity of these stink bugs and parasitoids in this crop must also be determined. Thus, this study provides new records, with information on the incidence and seasonality, of egg parasitoid species from stink bugs in rice crops located in the state of Piauí, Brazil.

Data were collected weekly from rice crops in the experimental area of Embrapa Meio-Norte in Teresina, Piauí, Brazil (05°02' 21.36" S, 42°47' 22.44" W), during the rainy (February-May) and dry (July-October) seasons in 2015. The study area is situated in a humid tropical climate, with two climatic seasons the rainy season and the dry season (Köppen Aw' climate classification). The vegetation in this area was composed of Cerrado (tropical savanna) forests and Caatinga (dry forest) (Bastos & Andrade Jr 2008). Rice crops planting systems were irrigated by controlled flooding, in lowland soils, during dry seasons and upland rice, in cerrado soils, during the rainy seasons

Stink bug eggs were collected directly from the leaves through visual inspection of the plants. The samples were chosen randomly to obtain the greatest possible diversity. Collected egg masses were

placed individually in small glass tubes and remained under controlled conditions (25 ± 2 °C, RH 70 ± 10, 12:12 h L:D photoperiod) until the parasitoids or immatures stink bugs emerged. The emerged parasitoids were preserved in 70% alcohol for further identification.

The parasitoid species were identified according to Johnson (1984a, 1984b, 1985, 1987a, 1987b), Masner (1976) and Talamas et al. (2015). The voucher specimens were deposited in the insect collection at Embrapa Meio-Norte in Teresina, Piauí, Brazil.

To verify the influence of the climatic factors on the occurrence of stink bugs and egg parasitoids populations, a Pearson correlation analysis was performed ($P < 0.05$) using average monthly maximum and minimum temperatures (°C), average percent of monthly relative humidity (%), and monthly accumulated precipitation (mm) data from the Climate Station at the National Meteorology Institute (INMET), located in the experimental area. In addition, correlation was made between of eggs parasitoids population and the number of stink bug egg masses collected in rice crops. Data analyses were performed using the InfoStat software (Di Rienzo et al. 2011).

Parasitism was recorded in three species of Pentatomidae: *Oebalus poecilus* (Dallas, 1851), *Tibraca limbativentris* (Stal, 1860), and *Euschistus heros* (Fabricius, 1798). The species of egg parasitoids identified were *Telenomus podisi* (Ashmead, 1893), *Trissolcus urichi* (Crawford, 1913), and *Ooencyrtus anasae* (Ashmead, 1887) (Tab. 1).

Telenomus podisi was the most frequent and abundant species (Tab. 1). *Trissolcus urichi* was registered parasitizing eggs of *O. poecilus* and *T. limbativentris* (Tab. 1). *Ooencyrtus anasae* presented a sporadic occurrence compared to the other species being found in *O. poecilus* eggs (Tab. 1).

The parasitism of *O. anasae* in *O. poecilus* eggs and *T. podisi* in *E. heros* eggs in rice crops reported in this study are unheard. Previously, only the parasitism of *T. podisi* in *E. heros* eggs in other host plants, such as soybean had been reported (Pacheco & Corrêa-Ferreira 2000). In addition, this was the first report of stink bug egg parasitoids in rice crops in the state of Piauí. Previously, there were reports of egg parasitism in other phytophagous bugs and/or host plants in this state. *Telenomus podisi* was reported to parasitize *Piezodorus guildinii*

(Westwood, 1837), *Nezara viridula* (Linnaeus, 1758), and *E. heros* eggs in soybeans and *P. guildinii* in beans (Paz Neto et al. 2015; Sousa et al. 2019).

Table 1. Parasitism of stink bug eggs collected from rice in the Teresina, state of Piauí, Brazil.

Stink bug species	Number of postures		Parasitoids species	Parasitism (%)
	Collected	Parasitized		
<i>Oebalus poecilus</i>	53	18	<i>Telenomus podisi</i>	33.96
		5	<i>Trissolcus urichi</i>	7.55
<i>Tibraca limbativentris</i>	7	2	<i>Ooencyrtus anasae</i>	3.77
		4	<i>Telenomus podisi</i>	80
<i>Euschistus heros</i>	1	3	<i>Trissolcus urichi</i>	60
		1	<i>Telenomus podisi</i>	100

Telenomus and *Trissolcus* are the most important genus of Pentatomidae parasitoids in rice agroecosystems in Brazil (Maciel et al. 2007; Riffel et al. 2010; Farias et al. 2012; Idalgo et al. 2013). *Trissolcus urichi* has been reported parasitizing *T. limbativentris* eggs in the states of Maranhão, and Santa Catarina (Maciel et al. 2007; Riffel et al. 2010) and *O. poecilus* eggs in the state of Maranhão (Melo Neto et al. 2020).

Telenomus podisi is the parasitoid mostly associated with Hemiptera (Zerbino & Panizzi 2019). In rice, this parasitoid has been registered in *T. limbativentris* eggs (Maciel et al. 2007; Riffel et al. 2010; Idalgo et al. 2013), *Glypshemys adroguensis* Berg, 1891 (Farias et al. 2012), and *O. poecilus* (Margaría et al. 2009; Melo Neto et al. 2020). As for *O. anasae*, its occurrence is reported in other crops of agricultural importance (Paz-Neto et al. 2015) where it is an important biological control agent for stink bugs.

The occurrence of stink bug and eggs parasitoids in rice was registered only during the rainy season (Fig. 1), when the abundance of these stink bug was negatively correlated with maximum temperature ($r = -0.77$; $P < 0.05$) and was positively correlated with minimum temperature ($r = 0.43$; $P > 0.05$), precipitation ($r = -0.50$; $P > 0.05$) and relative humidity ($r = 0.61$; $P > 0.05$). The abundance of these egg parasitoids was negatively correlated with maximum temperature ($r = -0.8$; $P > 0.05$) and precipitation ($r = -0.32$; $P > 0.05$). There were positive correlations with minimum temperature ($r = 0.39$; $P > 0.05$) and relative humidity ($r = 0.62$; $P > 0.05$). The number of egg parasitoids was positively correlated with the number of stink bugs ($r = 0.98$; $P < 0.05$).

The occurrence of these stink bugs and species of egg parasitoids in rice crops only in the rainy season demonstrates that this season are more suitable for the development and survival of these insects, when compared to the dry season, due to the extreme climatic factors such as high temperature and low humidity, in the dry season (Fig. 1). Similar results were found by Sousa et al. (2019) where climatic conditions were more favorable for abundant hemipteran and egg parasitoids in bean crops during the rainy season at the same region of our study.

Our results contribute to advance the knowledge about stink bug egg parasitoids and their seasonality, thereby providing additional support for the natural biological control programs of stink bugs complex in the rice agroecosystems in Brazil.

Acknowledgements

The National Council for Scientific and Technological Development (CNPq) supported this study (No. 456197/2014-1). We are also grateful for valuable comments on the manuscript from anonymous reviewers and the editor of the journal.

Authors' Contributions

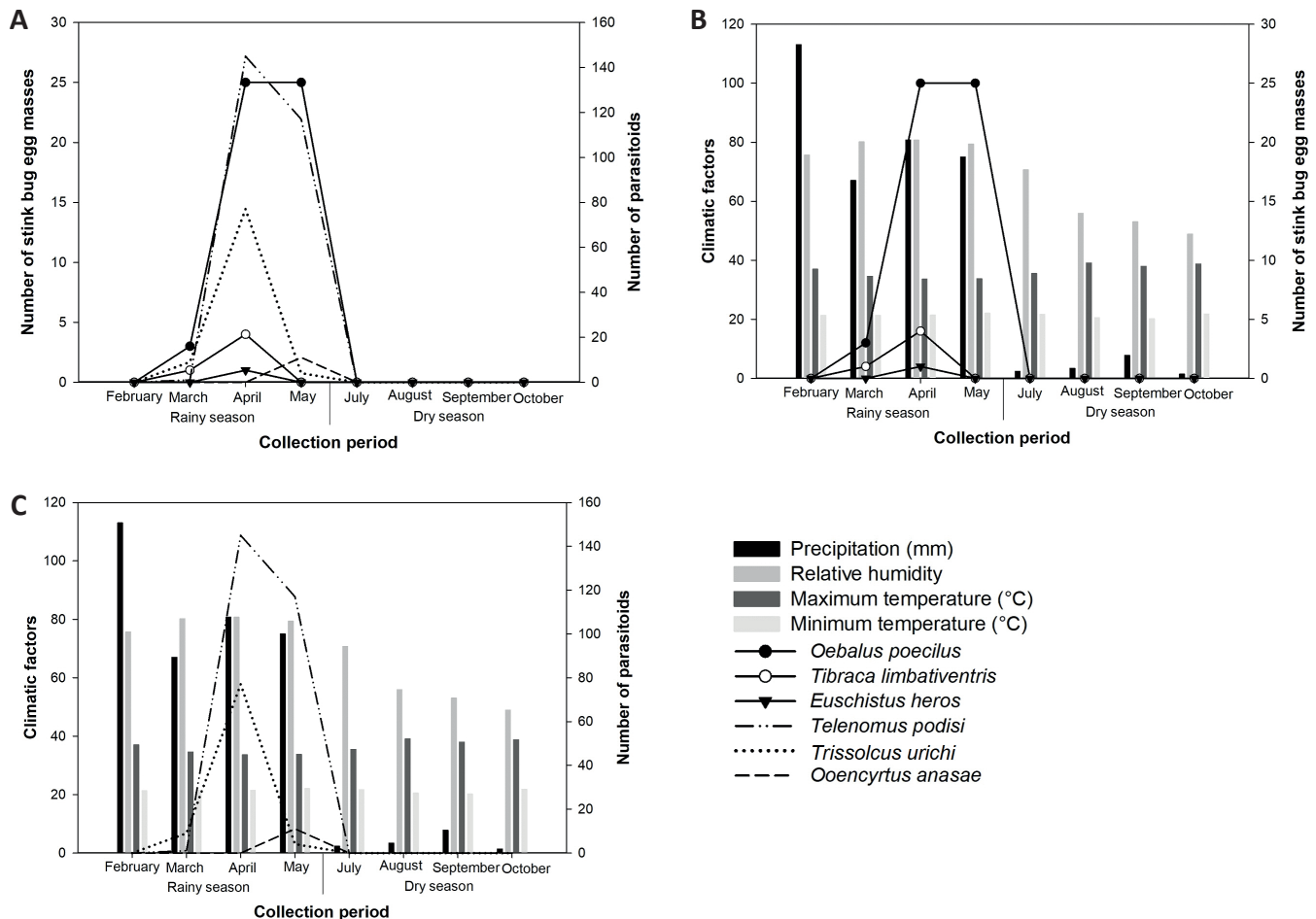


Figure 1. Incidence of egg parasitoids and stink bugs in rice crops during the wet and dry seasons, in Teresina, Piauí, Brazil (2015). (A) Fluctuation of stink bugs and parasitoids species in the seasons. (B) Stink bugs species and climatic factors. (C) Egg parasitoids species and climatic factors.

NNPS and KKAS performed the data collection. NNPS reviewed the literature and wrote the manuscript. RBQ contributed to the taxonomic identification of eggs parasitoids. PHSS and RBQ contributed to the revisions and adding content to the manuscript.

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