Neotrop Entomol (2013) 42:141–145
DOI 10.1007/s13744-012-0104-2

ECOLOGY, BEHAVIOR AND BIONOMICS

Population Dynamics of *Dichelops melacanthus* (Dallas) (Heteroptera: Pentatomidae) on Host Plants

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Keywords
Green belly stink bug, corn, soybean, wheat, wild hosts

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Edited by Wesley AC Godoy – ESALQ/USP

Received 19 April 2011 and accepted 26 November 2012
Published online 18 January 2013

Abstract
The stink bug *Dichelops melacanthus* (Dallas) has become one of the major pests of corn and wheat in Brasil, mainly after a shift from the conventional tillage system to the no tillage cultivation system. This fact may be due to the simultaneous occurrence of second planting corn with wheat cultivation, and the presence of wild hosts. This study aimed to evaluate the population dynamics of *D. melacanthus* on wild hosts adjacent to areas cultivated with corn, wheat, and soybean during the season and off-season of soybean cultivation. Weekly surveys were conducted in the region of Londrina, PR, Brasil from the beginning of July 2007 up to the end of June 2008 using the square meter method. Corn (*Zea mays*), soybean (*Glycine max*), tropical spiderwort (*Commelina benghalensis*), hairy indigo (*Indigofera hirsuta*), crotalaria (*Crotalaria pallida*), wheat (*Triticum aestivum*), and signal grass (*Brachiaria decumbens*) were identified as hosts of *D. melacanthus*. Signal grass was the host in which stink bug adults were found in higher numbers, while nymphs and adults were consistently collected on tropical spiderwort. Although nymphs completed their development on tropical spiderwort seeds, this host was found less suitable than soybean seeds.

Introduction

Phytophagous pentatomids are usually seed feeders, attacking plants during the reproductive period and are of economic importance worldwide (Panizzi 1997, McPherson & McPherson 2000). In some areas, such as in the neotropics, stink bugs can reproduce throughout the year, feeding on cultivated and on noncultivated plants which may be of great importance in building up of insect pest populations (Panizzi 1997).

The Neotropical pentatomid *Dichelops melacanthus* (Dallas) is an important pest of several crops in southern Brasil. This stink bug has been considered a secondary pest of soybean (*Glycine max*) for several years, but has recently become a key pest of corn (*Zea mays*) and wheat (*Triticum aestivum*; Manfredi-Coimbra *et al* 2005) and was also reported on black oat (*Avena strigosa*) and triticale (*Tritico secale*; Chocorosqui, unpublished). The simultaneous occurrence of second planting maize with wheat and the stink bug wild hosts provide good conditions for the survival and rapid proliferation of this insect. Recent massive adoption of the no-tillage cultivation system in southern Brasil contributed for changes in the entomofauna since some species can be favored by crop debris, such as *Euschistus heros* (F.) and *D. melacanthus* (Panizzi & Niva 1994, Chocorosqui & Panizzi 2004). Therefore, given the importance of wild hosts in supporting populations of *D. melacanthus* and its occurrence as a new pest to corn and wheat, we aimed to access the occurrence of this stink bug on corn, wheat, and soybean fields and on adjacent wild host plants during the season and off-season of soybean cultivation. We also wanted to compare the development of *D. melacanthus* on soybean and on tropical spiderwort (*Commelina benghalensis*) seeds, as immature and adults of this insect were found feeding on this plant in the field.

Material and Methods

Occurrence of D. melacanthus *on cultivated and on noncultivated host plants*

Nymphs and adults were weekly collected in Londrina, northern of the state of Paraná, Brasil (latitude 23°18'S), on cultivated plants (soybean, wheat, and corn) during the 2007/2008 crop season, and on the noncultivated plants, tropical spiderwort, hairy indigo (*Indigofera hirsuta*; Fabaceae), crotalaria (*Crotalaria pallida*; Fabaceae), and signal grass (*Brachiaria decumbens*; Poaceae), from July 2007 to June 2008. Samples consisted of counting the number of insects (nymphs and adults) in an area selected at random using a 1 m square iron frame. Ten sample units were taken on a weekly basis from each area, and the number of bugs (on the plants and on the soil underneath debris) was recorded. The mean (±SEM) number of bugs/sample was calculated from each sampling date.

Insect colony

During December 2007 to January 2008, adults of *D. melacanthus* were collected at the Embrapa (Empresa Brasileira de Pesquisa Agropecuária) Farm in Londrina from soybean fields and from tropical spiderwort plants. They were taken to the laboratory and couples (n=50) were individually placed in clear plastic boxes (25×20×20 cm), and provided with pods of green beans, *Phaseolus vulgaris*, and raw-shelled peanuts, *Arachis hypogaea*. Food was replaced every other day. Egg masses were collected every 2 days and placed into plastic boxes (11×11×3.5 cm), containing a moistened filter paper to prevent desiccation. Nymphs were fed as previously described. Nymphs at the premolt to the fifth instar were transferred to plastic boxes (25×20×20 cm) to complete development. Insect rearing was conducted under controlled conditions (26±1°C, 70±10% RH, 14 h photoperiod).

Nymph development

On the first day of the second instar, nymphs (n=20) were selected from the established laboratory colony, individually placed in Petri dishes (9.0×1.5 cm) with moistened filter paper, and fed with soybean (cv. BRS 257) or tropical spiderwort seeds, and kept under controlled conditions (26±1°C, 70±10% RH, 14 h photoperiod). Insects were daily observed for data collection, but the food and filter paper were changed every 2 days. The nutritional quality of tropical spiderwort seeds as compared to soybean seeds was assessed by evaluating the developmental time and mortality from second instar to adult and for each instar, and the fresh body weight of newly-emerged adults.

Data analysis

Data on developmental time of each instar, and on the fresh body weight of male and female were subjected to the analysis of variance and compared by means of the t test (P<0.05) using the SAS 8.2 software (SAS Institute 1981, Zar 1984).

Results and Discussion

Occurrence of D. melacanthus *on cultivated host plants*

Nymphs and adults of *D. melacanthus* were observed in soybean fields from February to April 2008, during the reproductive stage of plants (R4 to R8; Fehr & Caviness 1977; Fig 1a). Adults peaked (1.5 insects/m^2) in the last stage of

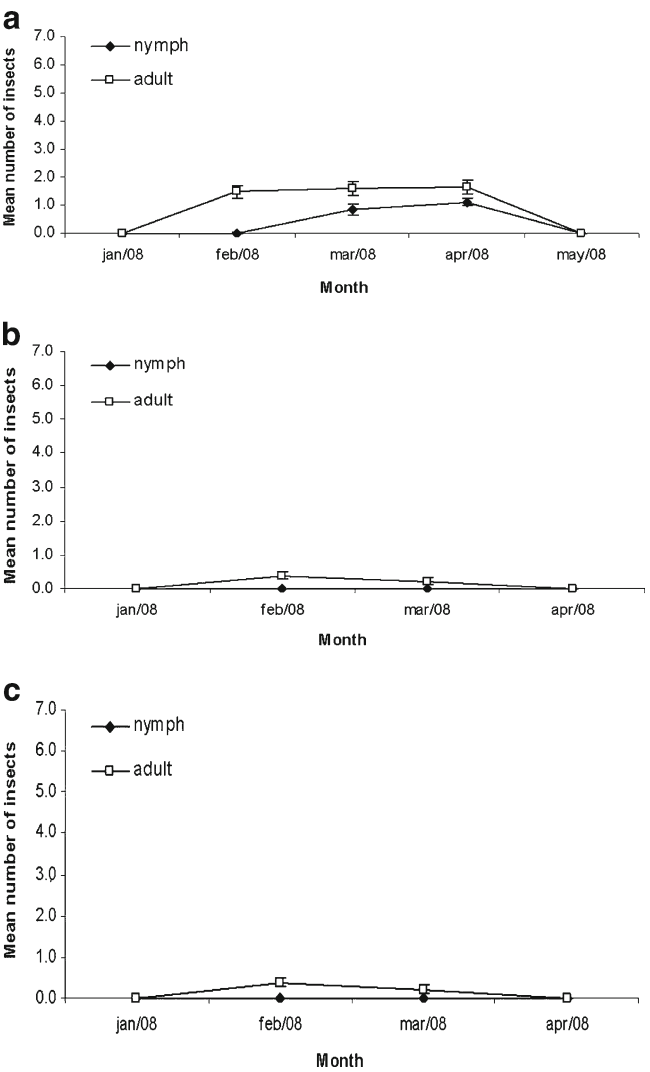

Fig 1 Occurrence of *Dichelops melacanthus* on cultivated host plants in Londrina, state of Paraná, Brasil. **a** Soybean, **b** wheat, and **c** corn.

soybean development (R8). Immatures and adults of *D. melacanthus* were observed on wheat from May to June 2008, with a peak (1.1 insect/m^2) in July (Fig 1b). Nymphs were not found in corn fields, but adults were observed from February to April 2008 (on seedlings), with a peak (0.5 insect/m^2) during the vegetative stage (Fig 1c). Probably *D. melacanthus* moved to corn (adults) and wheat (nymphs and adults) looking for shelter and water sources. *D. melacanthus* is a seed feeding bug and wheat plants probably do not provide suitable food, although damage may be severe. In a previous study, *D. melacanthus* also was reported on corn and wheat fields (seedlings) but decreased in numbers close to the reproductive period (Ávila & Panizzi 1995, Carvalho 2007).

Occurrence of D. melacanthus *on noncultivated host plants*

Adults of *D. melacanthus* were observed in crotalaria only from May to September 2008 (Fig 2a), with a peak (0.7 insect/m^2) in July. High mortality of nymphs on crotalaria pods, with about 27% of nymphs reaching adulthood was reported (Chocorosqui & Panizzi 2008).

In hairy indigo, adults *D. melacanthus* were observed during almost the entire sampling period (except for February to April 2008), while nymphs were occasionally found (Fig 2b). Hairy indigo is a wild plant distributed in small clusters near roads, river banks, and riparian vegetation. Another pentatomid, the red-banded stink bug, *Piezodorus guildinii* (Westwood), is also hosted by this plant (Panizzi 1992). Both are seed-sucker species pests of soybean and control measures applied on these plant clusters could eventually contribute to the management of these two pests.

The alternative host plant with the highest number of adults sampled was signal grass (5.4 adults/m^2; Fig 2c), indicating this plant as an important host. In many areas, it does not cover completely the soil, forming clumps. These "spots" of green vegetation provide shelter and water. Similarly, high occurrence of *D. melacanthus* was recorded on other grasses, such as the southern sandbur *Cenchrus echinatus*, the grass-of-rhodes *Chloris gayana*, and the guinea grass *Panicum maximum* in surveys conducted in Dourados, state of Mato Grosso do Sul (Carvalho 2007). Probably, these grasses also provide shelter, water, and even some nutrients.

On tropical spiderwort, a constant amount of nymphs and adults was observed during the sampling period (means of 1.92 adults and 1.05 nymphs/m^2; Fig 2d). These results suggest an eventual development of *D. melacanthus* on this host plant despite that nymphs provided with stems of spiderwort did not develop (development on seeds was not studied; Chocorosqui & Panizzi 2008). These findings confirm previous suppositions that tropical spiderwort play an important role in the increasing *D. melacanthus* populations in the field (Bianco 2005). These plants

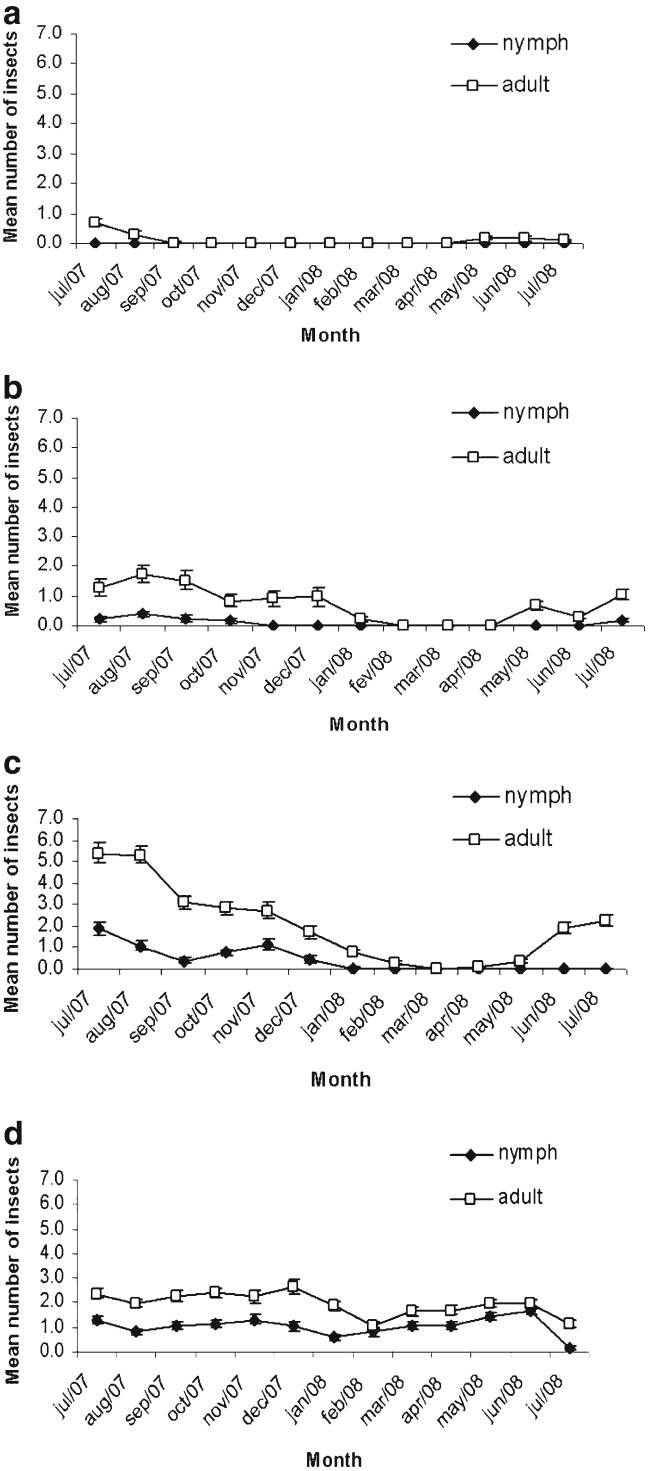

Fig 2 Occurrence of *Dichelops melacanthus* on noncultivated host plants in Londrina, state of Paraná, Brasil. **a** Crotalaria, **b** hairy indigo, **c** signal grass, **d** tropical spiderwort.

together with soybean seeds and crop residues on the ground would provide alternative food resourses to insect maintenance and development. The occurrence of *D. melacanthus* on tropical spiderwort plants (no distinction of

Table 1 Mean (±SE) of nymph developmental time (in days) of *Dichelops melacanthus* feeding on soybean mature seeds and tropical spiderwort seeds.

Food	Mean of nymph developmental time[a]				2nd–5th instars	
	2nd	3rd	4th	5th	Female	Male
Soybean seed	4.6±0.14 a [20][a]	5.8±0.17 a [18]	6.1±0.52 a [14]	7.3±0.40 a [12]	22.9±1.26 a [7]	24.4±1.57 [5]
Tropical spiderwort seed	6.9±0.32 b [16]	8.6±0.72 b [10]	10.3±0.99 b [6]	12.8±1.01 b [6]	39.6±1.98 b [5]	35.0[c] [1]

[a] Means followed by the same letter in each column do not differ significantly using the *t* test ($P>0.05$).

[b] Number of insects in brackets.

[c] Statistical comparison was not performed because only one value was obtained.

nymphs and adults) was also previously recorded in Dourados, MS, Brasil (Carvalho 2007).

Nymph development

Twenty-five percent of nymphs reared on tropical spiderwort seeds reached adulthood, while in soybean 35% of them reached the adult stage. The development time for females (from the second instar to adult) was longer for nymphs reared on tropical spiderwort (ca. 39.6 days) than those reared on soybeans (ca. 22.9 days) (Table 1). Nymphs took 17 days longer to develop into adult females when on spiderwort than on soybean seeds. For males, the developmental time of the single adult on tropical spiderwort lasted 11 days more than those on soybean. Body weight of females was significantly reduced on the tropical spiderwort (52.4±1.96 mg) in comparison with those on soybean seeds (41.2±0.96 mg; $P<0.05$). Mean weight of adult males on soybean seeds was 43.3 and the single male on tropical spiderwort was 36.0 mg. These results show that tropical spiderwort is not a suitable food for *D. melacanthus* as soybean, but during the off season it may support its survival and development. Besides the alternative feeding resources, a reproductive oligopause induced by a short photoperiod was characterized for adults of *D. melacanthus* (Chocorosqui & Panizzi 2003). The association of these strategies may be favoring the buildup of populations during the overwinter period.

Crop rotation of corn and soybean with signal grass has been proposed mostly in central Brasil to improve soil management (Salton *et al* 2001). *D. melacanthus* have been found on grasses but nymphs did not survive when feeding just on these plants which also are far less preferred when compared to leguminous plants (Chocorosqui & Panizzi 2008). The association of *D. melacanthus* with signal grass could provide conditions to the natural increase of populations of *D. melacanthus* since other food sources like soybean seeds on the ground and spiderwort are available close to the field.

The data showed that tropical spiderwort provides conditions to the development of *D. melacanthus* and the elimination of these plants may be tested to manage this species. Spiderwort and signal grass could be tested as trap crops on the edge of field crops to attract the bugs and kill them with local insecticide applications.

In summary, *D. melacanthus* was found on soybean (reproductive period) and corn and wheat (vegetative period). Hosts of spontaneous vegetation included hairy indigo, clotalaria, and mostly signal grass and tropical spiderwort on which, development was completed although being a less suitable resource than soybean.

Acknowledgments This study was sponsored by Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA) and by Universidade Estadual de Londrina (UEL).

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