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Resistance to *Dichelops melacanthus* (Hemiptera: Pentatomidae) in soybean genotypes of different maturity groups

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ABSTRACT: Some species of pentatomids stink bugs have global economic importance, damaging various plant species during the vegetative and reproductive phases. *Dichelops melacanthus* (Dallas) (Hemiptera: Pentatomidae), known as the green-belly stink bug, is part of the soybean stink bug complex in Brazil and has increasing importance in crops,with potential to reduce crop yield. This polyphagous stink bug has been registered in 29 plant species belonging to 10 plant families which include cultivated and non-cultivated plants. Plant resistance is a valuable tool in integrated pest management and may reduce insect populations below economic injury level. This study characterized the resistance of 17 soybean genotypes to the green-belly stink bug. All of the materials affected the biological performance of the green-belly stink bug, but PI 227687; 'IAC 100'; PI 171451; IAC 78-2318; D 75-10169; IAC 74-2832; 'IAC 23' and 'IAC 24' caused mortality above 80% in the second instar. 'IAC 17'; 'IAC 18'; PI 171451; PI 274454; 'Conquista' and 'IAC 19' decreased the longevity of adults of *D. melacanthus*, showing the same mechanism of resistance. PI 227687 did not allow any insects to complete the immature stage. These results are unprecedented for the species *D. melacanthus* and can assist breeding programs that focus on resistance to members of the stink bug complex in soybean.

Key words: [*Glycine max* (L.) Merrill], host plant resistance, green-belly stink bug.

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INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is the most cultivated crop in Brazil and one of the world's main agricultural crops. Stink bugs are major agricultural pests in this crop across the world (Chocorosqui and Panizzi 2004) and they are most often attracted to plants with developing seeds. Phytophagous pentatomids are insects of global economic importance to soybean due to their ability to feed directly on the developing seeds of many varieties (Panizzi 1997). In neotropical regions, these bugs can breed throughout the year, feeding on cultivated and non-cultivated plants and generating high populations in the field (Panizzi 1997).

The species *Dichelops melacanthus* (Dallas) (Hemiptera: Pentatomidae), commonly known as the green-belly stink bug, is an important pest of several crops in southern Brazil, especially north of Paraná State (Smaniotto and Panizzi 2015). This stink bug is considered a key-pest for corn [*Zea mays* (L.)], wheat [*Triticum aestivum* (L.)], and other grasses such as oat [*Avena strigosa* (Schreb.)] and triticale [*Triticum secale* (Wittm.)] (Silva et al. 2013a). However, in recent years, there has been a significant growth in the population of these insect pests in soybean, one of the most important crops in the country, with strong participation in exports due to their high productivity. Changes in the agricultural scenario, resulting from the no-tillage system and "off-season" maize cultivation, have contributed to the establishment of the green-belly stink bug in agriculture (Chocorosqui and Panizzi 2004).

The stink bugs species that are associated with the cultivation of soybean feed directly on the seed and cause damage from the pod formation period to the end of grain filling. When inserting the stylet into the pods and reaching grains, nymphs and adult insects suck out the nutrients, causing punctures in the seeds and the small appearance of dark spots (Panizzi and Silva 2009). Their feeding punctures on the grains seriously affect the yield and quality of soybean physiologically and transmit pathogens, such as the fungus *Nematospora coryli* (Pegliom 1901), which causes yeast spot disease (Panizzi 1997). Damaged grains become smaller, wrinkled, and hollow, with darker oil, reduced oil content, and increased protein content (Panizzi and Silva 2009). In addition, when the stink bug is fed, it injects toxins in soybean, causing a physiological disorder and impairing the maturation of the plant (Corrêa-Ferreira and Azevedo 2002). In soybean, the management of the stink bug complex has been achieved through chemical control. However, the widespread use of synthetic insecticides can eliminate beneficial insects, cause an imbalance in the environment, cause the reappearance of even higher populations of stink bugs or other pests, produce toxicity in humans, and generate insect resistance to select available active ingredients (Vieira et al. 2011). Thus, to reduce the impact of agriculture on the environment, it is important to evaluate control alternatives that are less aggressive but time-efficient and that are aligned with the principles of Integrated Pest Management (IPM).

Host plant resistance is an important tool for IPM, as it is low-cost, more durable, reduces the risk of the development of resistant pests to registered active ingredients, does not contaminate the grain, and is compatible with other control methods (Smith and Clement 2012). In insects, resistance can negatively influence the biology and behavior of insects, altering the plant's ability to withstand high populations of the pest without a significant reduction in yield (Painter 1951; Panda and Khush 1995; Smith 2005). Thus, when the plant adversely affects the biology of the insect, trying to use it as a host and interfering with its developmental cycle, reproduction and/or survival, resistance is known as antibiosis (Smith 2005). Common effects of antibiosis include high mortality at the early stages and reduced fertility in adults. In addition, individuals that survive the effects of antibiosis typically have reduced size and weight of larvae and nymphs, which can result in the prolongation of the immature stage and, therefore, of the life cycle (Panda and Khush 1995).

Although some studies have reported antixenosis and antibiosis expressions in soybean genotypes against some species of the soybean stink bug complex (Silva et al. 2013b; Silva et al. 2014), no study has evaluated the soybean resistance to the green-belly stink bug. To characterize the occurrence of antibiosis, this study evaluated several biological parameters of *D. melacanthus*, confined to green pods of 17 soybean genotypes belonging to different maturity groups.

MATERIAL AND METHODS

To assess the biological performance of *D. melacanthus* confined to different genotypes in the laboratory (T = 26 ± 2 °C, RH = 65 ± 10%, and photoperiod = 14 h), →

we used the methodology proposed by Silva et al. (2013b). We determined the duration of the nymphal instars (N2; N3; N4 and N5), the development period (egg to adult), the adult weight (24 h), the mortality at the nymphal stage, the mortality across the immature stage, and adult longevity. The soybean genotypes that were used in the experiments and their lineages are described in Table 1.

Dichelops melacanthus stock rearing

The stock rearing of green-belly stink bugs began with insects from DuPont company, Paulínia, São Paulo, Brazil. The insects were placed in plastic arenas (40 × 22 × 14 cm) that were closed with lids, each one containing a central cut out covered with cheesecloth to allow appropriate ventilation. The lower surface of each arena was covered with filter paper, equal to the arena background area, facilitating the absorption of excreta. To prevent the exit of insects during the maintenance of the colony and the movement of the bugs in the upper part, a solid layer of petroleum jelly (2 cm in width) was applied with a brush along the upper inner surface of the cage.

The nymphs and adult insects were kept in separate arenas and fed with a natural diet. In each arena, 5 fresh green bean pods [*Phaseolus vulgaris* (L.)], seeds of sunflower [*Helianthus annuus* (L.)], and raw shelled peanut [*Arachis hypogaea* (L.)], inside Petri dishes (4 cm Ø), were placed separately. Food was replaced every 7 days to prevent the growth of microorganisms. To meet the water requirement of stink bugs and retain moisture inside the arenas, cotton moistened with distilled water was placed inside Petri dishes (4 cm Ø).

In addition, cotton pads were placed along the side corners of the cage, for shelter and to serve as a substrate for oviposition by stink bugs. The postures were collected daily, thereby avoiding the consumption of eggs by the stink bugs themselves (Panizzi and Parra 1991). Eggs with up to 24 h of age were collected and placed in Petri dishes (8.5 cm Ø) that were lined with moistened filter paper at the bottom.

Bioassays

To start the tests, 5 nymphs of the second nymphal stage were transferred to Petri dishes (8.5 cm Ø) containing →

Table 1. Soybean genotypes used, grouped by phenology, genealogy, and resistance history.

Maturity	Genotype	Genealogy	Resistance history
Early	'IAC 17'	D72-9601-1 × 'IAC 8'	Antixenosis to *B. tabaci* biotype B (Silva et al. 2012; Valle and Lourenção 2002)
	'IAC 23'	BR-6 × IAC 83-23	Resistant to insects (Miranda et al. 2003)
	PI 171451	Japan	Resistant to stink bugs (Rossetto et al. 1986; Silva et al. 2013b)
	PI 229358	Tokyo, Japan	Resistant to stink bugs (Rossetto et al. 1986; Silva et al. 2013b)
	D 75-10169	'Govan' × (F4 'Bragg' × PI 229358)	Multiple insect resistance in its genealogy (Silva et al. 2013b); resistant to *B. tabaci* biotype B (Valle and Lourenção 2002)
	'Coodetec 208'	OC-4 × Williams 20	Commercial susceptible (Silva et al. 2013b)
Semiearly	'IAC 18'	D72-9601 × 'IAC 8'	Tolerant to stink bug complex (Lourenção et al. 2000)
	'IAC 24'	IAC80-1177 × IAC 83-288	Antixenosis to *B. tabaci* biotype B (Silva et al. 2012; Valle and Lourenção 2002)
	'IAC 100'	'IAC-12' × IAC 78-2318	Antibiosis to *P. guildinii* (Silva et al. 2013b)
	IAC 74-2832	'Hill' × PI 274454	Antibiosis to *P. guildinii* (Silva et al. 2013b)
	IAC 78-2318	D72-96-1 × IAC 73-227	Resistant to stink bugs (Rossetto et al. 1986; Lourenção et al. 1987; Silva et al. 2013b)
	PI 227687	Okinawa, Japan	Resistant to stink bugs (Rossetto et al. 1986; Silva et al. 2013b)
Late	'IAC 19'	D72-9601-1 × 'IAC 8'	Antixenosis to *B. tabaci* biotype B (Valle and Lourenção 2002); Antibiosis to *P. guildinii* (Silva et al. 2013b)
	PI 274453	Okinawa, Japan	Resistant to stink bugs (Rossetto et al. 1986; Silva et al. 2013b)
	PI 274454	Okinawa, Japan	Resistant to stink bugs (Rossetto et al. 1986; Silva et al. 2013b)
	L 1-1-01	BR-6 × 'IAC 100'	Antibiosis to *P. guildinii* (Silva et al. 2013b)
	'Conquista'	Lo76-44842 × Numbaíra	Commercial susceptible (Silva et al. 2013b)

a soybean pod of each genotype in phenological phase R5/R6 (Fehr and Caviness 1977). We used second-stage insects because the nymphs of this species present high nymphal mortality in the first instar (Chocorosqui and Panizzi 2008). In addition, first instar nymphs become aggregated at the beginning, feeding more than insects in the third stage (Panizzi and Silva 2009). Each Petri dish containing 5 insects corresponded to a repetition, for a total of 20 repetitions per genotype in a completely randomized design.

The pods were obtained from plants that were grown in 3-L pots in a greenhouse. Fertilized soil with loamy soil, sandy soil, and manure, in a 1:1:1 and pH adjusted, was used substrate as recommended for the crop (Mascarenhas and Tanaka 1997). The pots were sown in stages to provide pods (R5/R6) throughout the test.

Soybean was replaced every 2 days, and the plates were exchanged when necessary to avoid the accumulation of excrement. The filter paper in the background was dampened to meet the water requirement and was periodically changed.

The insects were evaluated daily and always at the same time during the morning. For the immature stage, the duration of the nymphal stages, the total nymphal period, the viability, and the total per stage were determined. In the adult stage, the insects were maintained under the same conditions, evaluating the longevity of each genotype and the weight of individuals who were 24 h old. Weighing was performed using an analytical balance (Marte AY 220, accuracy of 0.0001 g). For test maintenance, exuvia and dead insects were removed daily at the time of the assessments, using a metal clamp, with the tip wrapped in moistened cotton.

Statistical analyses

The data were submitted to an analysis of variance by F-test. The normality was verified by the Shapiro-Wilk test and homogeneity, by the Levene test. The significance of the treatment effects was determined, using the LSD to compare the means. For the analysis, we used the statistical package PROC MIXED-SAS 9.2 (SAS Institute 2001).

RESULTS AND DISCUSSION

The different genotypes significantly affected several biological parameters of the green-belly stink bug, indicating the occurrence of resistance (Painter 1951). According to Smith (2005), antibiosis-resistant carrier materials and those with steep antixenotic factors can have deleterious effects on the biology of insects, especially at the early stages of development. In this study, the genotypes PI 227687; 'IAC 100'; PI 171451; IAC 78-2318; D 75-10169; 'IAC 24'; IAC 74-2832 and 'IAC 23' caused mortality above 80% in the second instar, while L1-1-01 prevented only 43% of the insects, revealing this stage to be the most vulnerable of the insect (Figure 1). This result has already been reported in other studies involving soybean stink bug complex species (Piubelli et al. 2003; Silva et al. 2013b; Silva et al. 2014).

The eggs of *D. melacanthus* had an average incubation period of 5 days, while the average length of the first nymphal instar was 4 days, and they were not used for the duration of the total cycle rates of nymphs development. High mortality rates in the first nymphal instar of pentatomids stink bugs are relatively common, so the monitoring of the biological parameters of *D. melanthus* confined to different soybean genotypes has been started as from the second nymphal stage, once the first instar

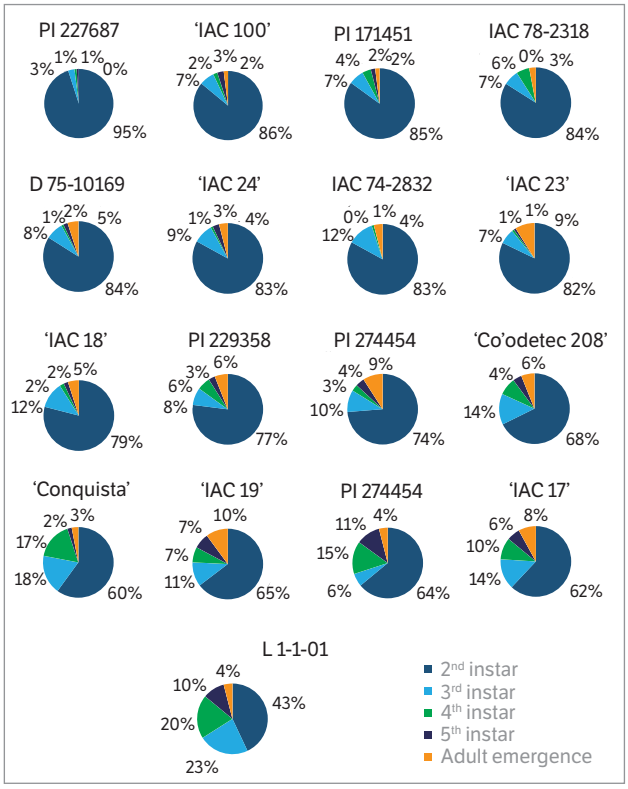

Figure 1. Mean percentages of nymphal mortality per instar and adult emergence of *D. melacanthus* on 17 soybean genotypes under laboratory conditions (14:10 L:D, 26 ± 2 °C, 65 ± 10% RH).

nymphs remain aggregated without feeding, surviving on food reserves from the embryonic stage during the first stage (Chocorosqui and Panizzi 2008). In addition to possible chemical compounds with antibiotic activity (Panizzi and Parra 1991), high mortality may also be related to antixenotic factors, such as the distance separating the grain from the pod wall, making food inaccessible (Panizzi and Silva 2009). This characteristic varies depending on the genotype used and mostly affects the younger phases of these sucking insects (Panizzi and Silva 2009).

Considering all of the genotypes, the average nymphal mortality was 95.06%, suggesting high levels of antibiosis and/or antixenosis (Panda and Khush 1995; Smith and Clement 2012). This ratio is much higher than that verified by Chocorosqui and Panizzi (2002), who obtained a mean mortality rate of 44% in soybean. However, in the study by those authors, the insects were confined to green pods and dry seeds of the genotype 'Paraná', which is considered extremely susceptible to the stink bugs complex (Rossetto et al. 1986), unlike in our research, in which we studied only the biology of the insects with green pods (R5/R6) from different soybean genotypes, whose majority were carriers of resistance against other insects that attack this crop (Silva et al. 2013b; Souza et al. 2016). It is possible that nymphal mortality occurs through the inclusion of other structures of soybean plants, but this poor performance may also be related to the poor nutritional quality of soybean for *D. melacanthus* individuals. Panizzi et al. (2007) reported a greater nymphal viability index of the green-belly stink bug when confined to reproductive structures of corn, compared to soybean and artificial diet. In addition, population surveys of the species of the soybean stinkbug complex indicate that *D. melacanthus* is less abundant in crops of this legume than are the species *Euschistus heros* (Fabr.), *Piezodorus guildinii* (West.), and *Nezara viridula* (L.) (Souza et al. 2016), which also suggests that this crop is not the ideal host for the development of this insect.

Based on the evaluated parameters, the genotypes PI 227687 (12.2 days) and IAC 74-2832 (11.3 days) prolonged the duration of the second stage (Table 2). In contrast, PI 227454 (6.9 days), L1-1-01 (7.0 days), 'IAC 24' (7.1 days), PI 171451 (7.2 days), and 'IAC 17' (7.3 days) had the lowest average values at this stage. There was no significant difference between genotypes for the third instar, for which the averages ranged from 5.0 to 9.1 days. In the fourth instar, PI 229358 (5.5 days) required the least amount of time to complete the phase. In the last nymphal instar, IAC 78-2318 (14.0 days) had the highest average duration. PI 227687 did not allow the nymphs to complete the fifth stage, causing 100% of mortality of individuals between the second and fifth instars. The duration of the last nymphal stage of *D. melacanthus* required more time for completion, regardless of which genotype served as the host (Table 2). This behavior has been observed for other species of the soybean stink bug complex (Silva et al. 2013b; Zerbino et al. 2015). Indeed, this behavior is a common feature in insects of the order Hemiptera - Heteroptera, which undergo significant physiological changes near maturity (Panizzi and Parra 1991). After assessing the time of nymphal duration under different photoperiods, Chocorosqui and Panizzi (2003) concluded that fifth instar nymphs fed on the cultivar 'Paraná' remained in this instar for 8.6 days, when subjected to a daily photoperiod of 11 h, and for 5.9 days, with a photoperiod of 14 h, indicating that the speed of nymphal development may be related to the photoperiod. The present study used a standardized photoperiod of 14 h so that the duration of instars (8.30 to 14.00 days) was only affected by feeding with different genotypes.

There was a wide variation among genotypes for the total nymphal period (N2 – N5), with the average ranging from 29.0 to 40.0 days (Table 2). Individuals confined to PI 171451 (40.0 days), 'Coodetec 208' (39.8 days), and L1-1-01 (39.2 days) showed a significant prolongation of the immature stage, differing from PI 229358 (29.0 days) and 'IAC 18' (31.0 days), which had shorter periods of immaturity. These values are higher than those obtained by Chocorosqui and Panizzi (2008), who used soybean pods of the 'Paraná' genotype and obtained averages of 25.5 and 29.3 days, using plants in the R5 and R6 stages, respectively. The extension of approximately 8 days in the nymphal period is probably due to the use of known resistant genotypes carrying antibiosis against stink bugs (Silva et al. 2013b), whose deleterious effects require a longer period for the insect to complete the immature stage (Smith and Clement 2012). However, the increase in the cycle duration may also be due to morphological factors involving grains and beans that prevent the insect's access to the energy supply (Panizzi and Silva 2009).

The nymphal viability ranged from 0 to 10% (Figure 2), with PI 227687 (0%), PI 171451 and 'IAC 100' (2%), IAC 78-2318 and 'Conquista' (3%), and L1-1-01, IAC 74-2832,

Table 2. Mean (± Standard error) of each nymphal instar and nymphal period (N2 – N5) of *D. melacanthus* in 17 soybean genotypes under laboratory conditions (14:10 L:D, 26 ± 2 °C, 65 ± 10% RH).

Genotype[2]	Days[1,3]				
	2nd instar	3rd instar	4th instar	5th instar	Nymphal period (N2 - N5)[4]
PI 227687 (SE)	12.2 ± 0.56 a (n = 5)	6.5 ± 0.16 (n = 2)	6.0 ± 0.00 ab (n = 1)	-	-
IAC 74-2832 (SE)	11.3 ± 0.59 ab (n = 17)	7.0 ± 0.42 (n = 5)	7.4 ± 0.37 ab (n = 5)	11.2 ± 0.64 abc (n = 4)	37.6 ± 0.31 ab (n = 4)
'IAC 23' (E)	10.0 ± 0.45 bc (n = 17)	7.6 ± 0.58 (n = 10)	7.4 ± 0.50 ab (n = 9)	9.8 ± 0.50 bc (n = 8)	34.8 ± 0.55 cde (n = 8)
D 75-10169 (E)	9.1 ± 0.67 cd (n = 16)	5.0 ± 0.14 (n = 8)	7.0 ± 0.51 ab (n = 7)	11.4 ± 0.51 ab (n = 5)	33.6 ± 0.44 de (n = 5)
PI 229358 (E)	8.8 ± 0.59 cd (n = 22)	6.7 ± 0.27 (n =15)	5.5 ± 0.26 b (n = 9)	8.3 ± 0.35 c (n = 6)	29.0 ± 0.46 f (n = 6)
'Conquista' (L)	8.4 ± 0.58 cde (n = 40)	7.0 ± 0.37 (n = 22)	8.1 ± 0.26 a (n = 5)	11.2 ± 0.08 abc (n = 3)	35.2 ± 0.40 bcde (n = 3)
'IAC 100' (SE)	8.4 ± 0.34 cde (n = 14)	6.9 ± 0.45 (n = 7)	8.2 ± 0.53 a (n = 5)	12.5 ± 0.16 ab (n = 2)	36.2 ± 0.40 abcd (n = 2)
IAC 78-2318 (SE)	8.1 ± 0.36 de (n = 17)	6.9 ± 0.21 (n = 9)	8.0 ± 0.00 ab (n = 3)	14.0 ± 0.39 a (n = 3)	37.4 ± 0.44 abc (n = 3)
'IAC 19' (L)	7.9 ± 0.44 de (n = 36)	7.0 ± 0.30 (n = 24)	8.8 ± 0.44 a (n = 17)	11.3 ± 0.58 ab (n = 10)	33.7 ± 0.50 de (n = 10)
PI 274453 (L)	7.8 ± 0.60 de (n = 37)	6.4 ± 0.20 (n = 30)	7.0 ± 0.26 ab (n = 15)	10.0 ± 0.45 bc (n = 5)	34.0 ± 0.36 cde (n = 5)
'Coodetec 208' (E)	7.7 ± 0.39 de (n = 33)	6.6 ± 0.46 (n = 18)	9.0 ± 0.52 a (n = 10)	11.9 ± 0.54 ab (n = 6)	39.8 ± 0.45 a (n = 6)
'IAC 18' (SE)	7.4 ± 0.17 de (n = 20)	5.6 ± 0.17 (n = 9)	7.7 ± 0.37 ab (n = 7)	11.6 ± 0.28 ab (n = 5)	31.4 ± 0.29 ef (n = 5)
'IAC 17' (E)	7.3 ± 0.34 e (n = 39)	7.1 ± 0.31 (n = 24)	9.6 ± 0.43 a (n = 14)	10.2 ± 0.47 bc (n = 8)	33.3 ± 0.58 de (n = 8)
PI 171451 (E)	7.2 ± 0.34 e (n = 15)	9.1 ± 0.62 (n = 8)	8.6 ± 0.34 a (n = 4)	13.0 ± 0.32 ab (n = 2)	40.0 ± 0.63 a (n = 2)
'IAC 24' (SE)	7.1 ± 0.42 e (n = 15)	5.8 ± 0.28 (n = 8)	8.6 ± 0.06 a (n = 7)	12.1 ± 0.39 ab (n = 4)	33.6 ± 0.33 de (n = 4)
L 1-1-01 (L)	7.0 ± 0.26 e (n = 57)	6.5 ± 0.52 (n = 36)	9.4 ± 0.57 a (n = 15)	13.7 ± 0.46 ab (n = 4)	39.2 ± 0.60 a (n = 4)
PI 274454 (L)	6.9 ± 0.23 e (n = 27)	7.0 ± 0.38 (n = 17)	8.6 ± 0.16 a (n = 14)	11.4 ± 0.40 ab (n = 10)	32.0 ± 0.48 de (n = 10)
p	< 0.001	0.2496	0.0045	0.0391	< 0.001

[1]Mean followed by the same lower case letter per column do not differ by LSD test ($p \leq 0.05$); [2]E= early; SE= semiearly; L= late; [3]n= number of evaluated insects; [4]N1= 1st instar provoked 4 day duration in all genotypes.

and 'IAC 24' (4%) being particularly notable. While there was no significant difference in the nymphal viability between materials (2 – 10%), there was a significant deleterious effect on the *D. melacanthus* nymphs. These data suggest that the low nutritional quality of the host does not address the nutritional needs for the development of the bug, which may explain the lower incidence of this population in an agriculture context (Souza et al. 2016). Although *D. melacanthus* is commonly associated with this crop (Smaniotto and Panizzi 2015), soybean is apparently not a primary host for the stink bug. The strong expansion of Brazilian agriculture, associated with no-tillage, maize planting, the presence of invasive plants, and rotation with soybean, has offered shelter and a constant food supply throughout the year. These factors have favored the incidence of *D. melacanthus* in areas with soybean cultivation (Smaniotto and Panizzi 2015).

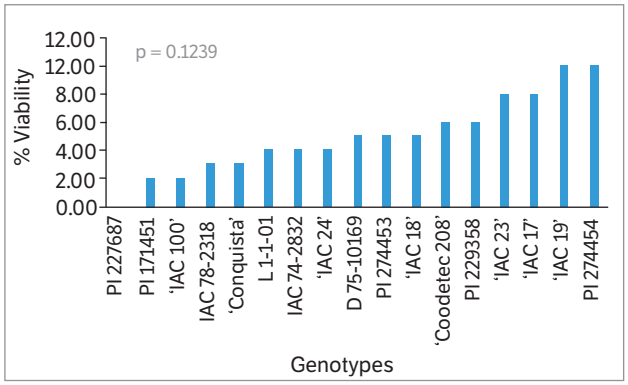

Figure 2. Mean (% ± Standard error) of nymphal viability of *D. melacanthus* on 17 soybean genotypes under laboratory conditions (14:10 L:D, 26 ± 2 °C, 65 ± 10% RH).

We also found wide variation (12.4 to 47.7 days) in the average adults longevity among the genotypes (Table 3). 'IAC 19' (12.4 days) had the lowest average adults' longevity, followed by 'Conquista' (14.0 days), PI 274454 (14.9 days), PI 171451 (15.0 days), 'IAC 18' (15.1 days), and 'IAC 17' (15.9 days). In contrast, L1-1-01 (47.7 days) and PI 229358 (30.6 days) provided insects with greater longevity. The average *D. melacanthus* adult weight ranged from 0.0485 to 0.0362 g (Table 3), with no difference between genotypes. In general, greater longevity is related to the most suitable nutrients during the immature stages of the insect and is generally observed in susceptible genotypes (Panda and Khush 1995). In contrast, shorter life spans are associated with exposure to toxic compounds (antibiosis) that are present in plants or strong food deterrents (antixenosis), shortening the adulthood of some species of insects (Smith 2005). These deleterious effects were more pronounced in 'IAC 19;' 'Conquista'; PI 274454; PI 171451; 'IAC 18;' 'IAC 17' and 'IAC 100', in which longevity was less than 20 days, differing from most other genotypes. Panizzi et al. (2007) reported an average longevity of 22.6 days for *D. melacanthus* using green soybean pods, while Chocorosqui and Panizzi (2008) reported 27.4 days using soybean seeds and the green pods of the cultivar 'Paraná'. The results of these authors are similar to those of the present study, in which the average longevity was 23.13 days.

Although there are genotypes with resistance against pentatomids (Silva et al. 2013b), and considering the *D. melacanthus* habit of foraging crop residues of soybean, corn, and wheat, the results of this study suggest that exclusive feeding with green pods is not suitable for *D. melacanthus*, because the average lifespan was significantly lower than that of other pentatomid soybean pests (Panizzi 2007) involved in no-till systems, suggesting a polyphagous food habit (Chocorosqui and Panizzi 2004, 2008).

Table 3. Mean (± Standard error) of longevity and adult weight of D. melacanthus in 17 soybean genotypes under laboratory conditions (14:10 L:D, 26 ± 2 °C, 65 ± 10% RH) .

Genotype	Longevity (days)	Adult weight (g)
L 1-1-01 (L)	47.7 ± 0.99 a (n = 4)	0.0362 ± 0.0011 (n = 4)
PI 229358 (E)	30.6 ± 0.92 b (n = 6)	0.0430 ± 0.0008 (n = 6)
'IAC 23' (E)	29.8 ± 0.61 bc (n = 8)	0.0465 ± 0.0019 (n = 8)
IAC 78-2318 (SE)	29.6 ± 0.34 bcd (n = 3)	0.0362 ± 0.0012 (n = 3)
PI 274453 (L)	27.1 ± 0.55 bcde (n = 5)	0.0430 ± 0.0020 (n = 5)
IAC 74-2832 (SE)	26.0 ± 0.48 cde (n = 4)	0.0408 ± 0.0011 (n = 4)
D 75-10169 (E)	24.8 ± 1.08 de (n = 5)	0.0403 ± 0.0012 (n = 5)
'Coodetec 208' (E)	24.7 ± 1.09 de (n = 6)	0.0403 ± 0.0014 (n = 6)
'IAC 24' (SE)	23.5 ± 0.68 ef (n = 4)	0.0389 ± 0.0019 (n = 4)
'IAC 100' (SE)	18.5 ± 0.47 fg (n = 2)	0.0485 ± 0.0017 (n = 2)
'IAC 17' (E)	15.9 ± 0.85 gh (n = 8)	0.0409 ± 0.0008 (n = 7)
'IAC 18' (SE)	15.1 ± 0.66 gh (n = 5)	0.0402 ± 0.0020 (n = 5)
PI 171451 (E)	15.0 ± 0.63 gh (n = 2)	0.0402 ± 0.0016 (n = 2)
PI 274454 (L)	14.9 ± 0.71 gh (n = 10)	0.0387 ± 0.0018 (n = 10)
'Conquista' (L)	14.0 ± 0.95 gh (n = 3)	0.0379 ± 0.0007 (n = 3)
'IAC 19' (L)	12.4 ± 0.78 h (n = 10)	0.0403 ± 0.0019 (n = 10)
p	< 0.001	0.6079

PI 227687 was excluded due to the total mortality of the nymphs; means followed by the same lowercase letter in the same column do not differ by the LSD test ($p \leq 0.05$); E = Early; SE = Semiearly; L = Late; n = Number of evaluated insects.

CONCLUSION

The results obtained in this study indicate that all the evaluated genotypes expressed resistance by antibiosis

and/or antixenosis to *D. melacanthus*. This should be the subject of future research, isolating the 2 resistance categories. Although in this study all materials compromised the biological performance of the green-belly stink bug, the genotypes PI 227687; 'IAC 100'; PI 171451; IAC 78-2318; D 75-10169; IAC 74-2832; 'IAC 23'; and 'IAC 24' caused mortality above 80% in the second instar, being, therefore, the most promising. PI 227687 did not allow any individual to complete the immature stage. Our results are unprecedented for the species *D. melacanthus* and can assist breeding programs that focus on resistance to stink bug complex in soybean.

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