Field evaluation of maize resistance of tolerance type to the green-belly stink bug *Dichelops melacanthus* (Hemiptera: Pentatomidae)

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ABSTRACT

This study aimed to evaluate the resistance of tolerance type of four maize genotypes to the green-belly stink bug, *Dichelops melacanthus* (Hemiptera: Pentatomidae) in a field bioassay. The genotypes SCS 154 Fortuna, SCS 155 Catarina, 2B512 PW and 2B610 PW were sowed in plots, and infested with *D. melacanthus* adults for seven days. After this period, an injury score was attributed to plants that were infested, and the height of plants at V5 stage, at tasseling and of cob insertion was measured at full bloom. Grain yield was also estimated at physiological maturation. Plants free of infestation were also evaluated and the reduction on the aforementioned parameters was calculated. The injury score in all genotypes was similar. The height of plants at V5 stage was significantly reduced in around 30% in all genotypes, however plants presented a recovery, and no significant difference between infested and non-infested plants was verified in the height at tasseling, height of cob insertion and yield from all genotypes. The genotypes had similar response and none stood out as tolerant to *D. melacanthus.*

Key-words: *Zea mays*, initial pest, host plant resistance, integrated pest management.

INTRODUCTION

The green-belly stink bug, *Dichelops melacanthus* (Dallas) (Hemiptera: Pentatomidae), is among the main pests that can attack maize in the initial phase of development (Bortolotto et al., 2016). The occurrence of this species in maize is becoming more common due to massive adoption of no tillage cultivation system, late sowing maize, the continuous presence of cultivated and wild hosts along the year and the increase of *Bt* maize cultivation, in which spray of insecticides is usually unnecessary (Panizzi, 2000; Silva et al., 2013).

D. melacanthus inserts its stylet on maize stem for feeding, injecting toxic saliva, which can cause severe injuries like reduction in plant growth, development of unproductive tillers and winding of 'whorl' leaves, with consequent losses on grain yield and even death of plants in case of severe attacks (Rosa-Gomes et al., 2011).

The seed treatment with insecticides, anticipation of desiccation from predecessor crop and spray of registered insecticides at maize post emergence are the most usual practices adopted for *D. melacanthus* management. In addition, the use of maize genotypes that can tolerate the attack of *D. melacanthus* is a promising option to reduce damage caused by this species on maize crops; however, information about the response of maize genotypes to this pest are still scarce.

Since plant resistance is an important component of Integrated Pest Management (IPM), this study aimed to evaluate the resistance of tolerance type of maize genotypes against *D. melacanthus.*

MATERIAL AND METHODS

Field assays were carried out at the experimental station of Epagri in Chapecó, SC (27º05'04"S; 52º38'12"W), in 2017/2018 crop year. The genotypes evaluated were the open pollinated SCS 154 Fortuna and SCS 155 Catarina, and the *Bt* hybrids 2B512 PW and 2B610 PW.

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The genotypes were sowed in experimental plots of 20 m^2 (4 m width x 5 m length), spacing 0.8 m between rows with average sowing density of five seeds per meter. Five plots were used for each genotype, in a random distribution.

Approximately eight days after emergence, when plants reached the V1 stage, a pair of 'voile' fabric cages with 1 m^2 (1 m length × 1 m width × 0.5 m height) were installed in each plot. Each cage covered five selected plants (~1 row meter). One of the cages was infested with two adults of *D. melacanthus*/plant, while another cage was kept free of infestation. The stink bugs were confined with plants for seven days. After that period, the cages were removed, and plants were identified with tags. To assure elimination of the infested stink bugs, all plots were sprayed with the insecticide thiamethoxam + lambda cyhalothrin (Engeo Pleno®), at dosage of 250 mL. ha^{-1}.

Seven days after cages removal, when plants were at V5 stage, the height of infested and non-infested plants was measured, and an injury score was attributed to infested plants based on visual scale of injuries (0 to 4), where: 0 = plant without injuries; 1= plant with few punctures and no reduction in size; 2= plant with lot of punctures and slightly reduction in size; 3= plant with whorl partially damaged, some tillering and moderate reduction on size; 4= plant with high reduction on size, tillering and winding of whorl (Bianco et al., 2001). At full bloom, the height of cob insertion and plant height from soil to tassel was measured. Moreover, at physiological maturation, cobs were harvested and grain yield corrected at 13% humidity was calculated.

For each genotype, data from infested and non-infested plants were compared by Student's t-test ($p < 0.05$), and the damage score was submitted to F test, using the statistic software 'R', version 3.5.1 (R Core Team 2018).

RESULTS AND DISCUSSION

The damage score of *D. melacanthus* on the maize genotypes ranged from 1.7 to 2.0, and no significant difference was observed among them (Table 1). Some authors report that conventional genotypes are more affected than transgenic ones (Michelotto et al., 2017), however, this tendency was not observed in our study, where the open pollinated genotypes had similar damage score than *Bt* hybrids. Crosariol Netto et al. (2015), when evaluating the damage of *D. melacanthus* on five maize hybrids, also didn't find significant differences in attack symptoms between the different genotypes and between transgenic and conventional isolines.

Table 1. Injurie score (± SE) of *Dichelops melacanthus* on different maize genotypes

Genotypes	Damage score
SCS 155 Catarina	1.7 ± 0.2^{ns}
SCS 154 Fortuna	2.0 ± 0.1
2B512PW	1.9± 0.3
2B610PW	2.0 ± 0.2

ns = no significant by F Test ($p = 0.637$)

The height at V5 stage from infested plants significantly differed from non-infested ones in all genotypes evaluated (Table 2). Among the parameters evaluated, this was the only significantly harmed, with an overall reduction around 30%. At full bloom, the height of cob insertion and height of plants up to tassel didn't differ significantly among infested and non-infested plants in all genotypes. The reductions on these two parameters were not higher than 6% (Table 2), demonstrating that maize plants attacked by *D. melacanthus* had a recovery capacity depending on damage intensity. As stated by Bianco (2016), maize has a recovery potential of 100% and 90%, when they are in the damage score 2 and 3, respectively, especially in the absent of drought and complementary nitrogen fertilization. Our results are in agreement with Bridi et al. (2016), who also didn't verify reduction on height at tasseling stage on maize plants infested with *D. melacanthus*.

Table 2. Effect of *Dichelops melacanthus* attack on different parameters of the evaluated maize genotypes

Genotypes	Non-infested	Infested	*p* value	Reduction (%)[1]
....................*Plants height at V5 (cm)*....................				
SCS 155 Catarina	55.4 ± 2.2	38.8 ± 2.8	0.002*	29.9
SCS 154 Fortuna	48.3 ± 2.1	33.7 ± 1.6	0.001*	30.2
2B512PW	54.4 ± 3.1	38.0 ± 2.6	0.004*	30.2
2B610PW	58.8 ± 3.5	38.9 ± 1.8	0.002*	34.0
....................*Cob insertion height (cm)*....................				
SCS 155 Catarina	131.8 ± 5.0	132.3 ± 2.7	0.938	-0.4
SCS 154 Fortuna	120.5 ± 5.8	113.7 ± 6.0	0.446	5.6
2B512PW	113. ± 5.2	112.0 ± 3.1	0.874	0.9
2B610PW	123.7 ± 3.3	134.4 ± 3.7	0.064	-8.6
....................*Plant height (tassel)*....................				
SCS 155 Catarina	243.0 ± 4.7	231.4 ± 3.6	0.091	4.8
SCS 154 Fortuna	220.6 ± 7.2	210.1 ± 6.7	0.324	4.8
2B512PW	213.9 ± 3.9	207.1 ± 4.8	0.300	3.2
2B610PW	221.0 ± 3.1	224.7 ± 5.6	0.580	-1.7
....................*Grain Yield (g/cob)*....................				
SCS 155 Catarina	142.8 ± 13.7	141.2 ± 13.3	0.934	1.1
SCS 154 Fortuna	169 ± 25.5	144.1 ± 10.9	0.420	14.7
2B512PW	162.5 ± 9.1	146.6 ± 17.6	0.453	9.8
2B610PW	200.8 ± 12.9	179.8 ± 10.2	0.238	10.5

*Significant difference between infested and non-infested plants by Student's t-test at 5% of significance.
[1]Reduction (%) = 100 - (100 x I / N.I), where: I = value obtained on infested plants and N.I = value obtained on non-infested plants.

The plant yield from infested and non-infested plants didn't differ significantly in any genotype, and the lowest reduction was observed for the open pollinated SCS 155 Catarina (Table 2). According to Queiroz et al. (2018), maize plants can tolerate damage scores 1 and 2 without reducing its productivity, which is in line with our results, where the average damage score observed for the genotypes was close to 2. An average reduction of 21.07% on grain yield of several maize cultivars infested with *D. melacanthus* was observed by Cruz et al. (2016), value higher than those obtained in our study, which can be explained by the higher density of infestation used by the authors (one insect/plant).

The response of the evaluated genotypes to *D. melacanthus* attack was similar, and despite the lower damage score and yield reduction in SCS 155 Catarina, additional studies in different sites and with different infestation densities are necessary, in order to obtain a more precise information about the resistance of tolerance type of maize genotypes to this pest.

CONCLUSION

All genotypes had similar response to *D. melacanthus* attack, and it was not possible to identify any that stands out as tolerant to this pest.

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