



## SELECTION OF SIGNAL GRASS GENOTYPES FOR RESISTANCE TO *Collaria oleosa* (DISTANT, 1883) (HEMIPTERA: MIRIDAE)

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### ABSTRACT

The bug *Collaria oleosa* (Distant, 1863) has frequently been found attacking forage crops, where it causes leaf damage in the form of whitish striae, leading to a reduction in photosynthesis. The aim of this study was to select signal grass, *Brachiaria ruziziensis*, genotypes that show resistance to *C. oleosa*. Adult insects were collected from a greenhouse at Embrapa Dairy Cattle Research Center, Brazil. Insects were sexed and held in acrylic cages in a laboratory; eggs produced were placed in Petri dishes and housed in a climatic chamber until the nymphs hatching, that were isolated in plastic containers (2.5cm × 2.5cm) until the fourth instar, and then transferred to Petri dishes (5.0cm × 2.5cm). One adult pairs were placed in mating cages and fed on the same diet as the developing nymphs. Our study incorporated a fully randomized design with seven replicates, using 26 genotypes of *B. ruziziensis* and a marandu cultivar (*Brachiaria brizantha*). The duration and viability of each instar and the nymphal stage, adult longevity, and the number of eggs/female was evaluated. Significant differences were found for each instar duration, nymphal stage, adult longevity, and fecundity of *C. oleosa* on different plant genotypes. The genotypes CNPGL BR 07, CNPGL BR 14, CNPGL BR 43, CNPGL BR 76, CNPGL BR 91, CNPGL BR 100, and *B. brizantha* were selected as having influenced *C. oleosa* biology cycle, and are recommended as the most appropriate lines to follow in the breeding programs of *B. ruziziensis*.

**Keywords:** bug (*Collaria oleosa*), signal grass, breeding program.

### INTRODUCTION

Signal grass is an important constituent of animal feeds that are fed to livestock used in the production of milk and meat. In Brazil, 70% of the area used for agricultural production (and 20% of the whole country) is used to cultivate this forage grass (IBGE, 2006), which is unrivalled in terms of its adaptation to low soil fertility, easy establishment, considerable biomass production, and providing excellent ground cover (Timossi *et al.*, 2007).

Among the many phytophagous insects that feed on grasses, the occurrence of *Collaria oleosa* (Distant, 1883) (Hemiptera: Miridae) warrant particular attention. Damage by this bug is frequently observed in pastures of signal grass and elephant grass, limiting their production. However, producers and technicians seldom associate the damage with the actual causative agent.

*C. oleosa* is potentially pest of forage grass, causing injuries to the leaves in the form of whitish striae, which lead to a decrease in photosynthesis (Auad *et al.*, 2011). In plants that are severely attacked, the striae coalesce, causing total or partial dryness of the young leaves, which compromises both yield and nutritional value of the forage (Menezes, 1990). At high densities, this bug can induce shoot death and lead to a reduction in dry mass and forage quality. These mirids are present in South America and several regions of Brazil, infesting economically important crops such as wheat, barley, oats, and other grass species (Silva *et al.*, 1994), with each of the different developmental stages contributing to the damage (Carlessi *et al.*, 1999).

Recent studies in Brazil have sought to better understand the damage caused by this insect. Barboza

(2009) reported that *Collaria scenica* causes severe damage in oats and ryegrass, and Auad *et al.* (2011) have carried out studies on the biology of *C. oleosa* in elephant grass and signal grass.

Because *C. oleosa* feeding directly affects the production of dry mass from pastures, and consequently leads to a reduction in the production of milk and meat, further studies on this insect are essential. Surprisingly, there is still a lack of data on the incidence and population densities of *C. oleosa*, and its damage to pasture.

Alternative control strategies for pests in forage are limited, and resistant plants are regarded as the most viable way to avoid economic damage. The *Brachiaria ruziziensis* genotypes used in breeding programs at Embrapa Dairy Cattle Research Center, Brazil, would benefit from being evaluated for their susceptibility to *C. oleosa* attack, with the aim of selecting clones that are resistant to the mainly species that actually have been problem in forage, *C. oleosa* and spittlebug.

Because of the lack of information on pesticides for the control this bug, combined with annual increases in population densities, the selection of resistant grasses may provide a viable alternative to be used in conjunction with other strategies in the management this bug. The aim of this study was thus to select *B. ruziziensis* genotypes that are resistant to nymphs and adults of *C. oleosa*, in order to support signal grass breeding programs in the control of this insect.



## MATERIALS AND METHODS

The experiment was conducted at the Embrapa Dairy Cattle Research Center, Brazil. Adult insects were collected from a greenhouse and taken to the laboratory where they placed into an acrylic cage (60 × 30 × 30cm) containing an elephant grass plant as a feeding and oviposition site. Eggs were removed from the leaves using a fine-tipped paintbrush and placed in Petri dishes lined with filter paper. The Petri dishes (8.5cm diameter) were then covered with organza, secured with a rubber band, and maintained in a controlled climate chamber (14:10 photoperiod, 25°C, 70 ± 10% RH) until the nymphs were ready to hatch.

Nymphs up to 12 hours old were housed individually in cylindrical plastic containers (2.5cm diameter × 2.5cm height) until the 3<sup>rd</sup> instar, and then transferred to Petri dishes (5cm diameter) in the fourth instar. In both rearing environments, a layer of agar (approximately 1cm thick) was placed below of foliar discs to maintain leaf turgidity. The rearing containers holding the nymphs were covered with organza to prevent escape. Leaves were changed every 2 days, following the methods of Auad *et al.* (2011).

Adults were sexed upon emergence, and one pair of *C. oleosa* were transferred to plastic cages (20cm diameter × 60cm high), covering the top with organza and securing with a rubber band. For feeding and oviposition used the same plant genotypes on which immatures had been fed. Plants were maintained in glass vessels containing water to maintain leaf turgidity, and were changed every 2 days.

The experiment was fully randomized over seven replicate trials, using 26 genotypes of *B. ruziziensis* and the marandu cultivar, *Brachiaria brizantha*. Plants were selected on the basis of high genetic diversity and agronomic favorable characteristics, as determined by

field experiments at the Embrapa Dairy Cattle Research Center (Tables 1 and 2).

For each of the different signal grass genotypes, we recorded the duration (days) and survival (%) of each instar of the nymphal phase of *C. oleosa*, together with adult longevity and fecundity. The data were examined using analysis of variance analysis and the means were compared using the Scott-Knott test ( $p < 0.005$ ).

## RESULTS

Nymphs of *C. oleosa* developed through five stadia, regardless of the *B. ruziziensis* genotypes on which they had fed (Table-1). The duration of the first instar was shorter (by an average of 2.6 days) when nymphs were fed on the genotypes CNPGL BR 21, CNPGL BR 42, CNPGL BR 49, and CNPGL BR 100. The CNPGL BR 07 and CNPGL BR 58 genotypes increased the duration of the first instar by 0.90 days, differing significantly from the others genotypes, in which intermediate values were observed, with an average increase of 0.42 days (Table-1). In the second instar, the longest duration was observed in nymphs feeding on the genotypes CNPGL BR 06, CNPGL BR 07, CNPGL BR 14, CNPGL BR 21, CNPGL BR 29, CNPGL BR 36, CNPGL BR 42, CNPGL BR 43, CNPGL BR 44, CNPGL BR 46, CNPGL BR 49, CNPGL BR 58, and CNPGL BR 63, and also on *B. brizantha*, with a mean duration of 2.4 to 2.9 days. For the other genotypes, the mean duration was shorter (2.2 days), giving rise to two distinct mean groupings (Scott-Knott test; Table-1). Nymphs housed with the genotypes CNPGL BR 06, CNPGL BR 21, CNPGL BR 29, CNPGL BR 36, CNPGL BR 43, CNPGL BR 49, and CNPGL BR 58 had a greater mean third instar duration (from 2.5 to 2.7 days), with other genotypes averaging around 1.95 days. No significant differences were found for the duration of fourth and fifth instars when nymphs were fed on different signal grass genotypes (Table-1).

**Table-1.** Mean duration (d) ( $\pm$  SE) of each instar and nymphal stage, longevity and number of eggs of adult *C. oleosa* kept in different genotypes of *B. ruziziensis*.

Genotypes	Instars					Nymphal stage	Adults	Eggs / female
	1 <sup>o</sup>	2 <sup>o</sup>	3 <sup>o</sup>	4 <sup>o</sup>	5 <sup>o</sup>			
CNPGL BR 06	3.1 $\pm$ 0.14 b	2.9 $\pm$ 0.14 b	2.5 $\pm$ 0.22 b	3.0 $\pm$ 0.32 a	3.6 $\pm$ 0.24 a	15.2 $\pm$ 0.37 c	32.7 $\pm$ 10.48 b	87.0
CNPGL BR 07	3.7 $\pm$ 0.33 c	2.7 $\pm$ 0.60 b	-	-	-	-	-	-
CNPGL BR 14	3.0 $\pm$ 0.00 b	2.5 $\pm$ 0.22 b	-	-	-	-	-	-
CNPGL BR 21	2.6 $\pm$ 0.24 a	2.4 $\pm$ 0.24 b	2.5 $\pm$ 0.50 b	2.7 $\pm$ 0.25 a	3.5 $\pm$ 0.29 a	13.7 $\pm$ 0.48 a	7.0 $\pm$ 2.08 a	11.0
CNPGL BR 25	3.0 $\pm$ 0.00 b	2.2 $\pm$ 0.20 a	2.0 $\pm$ 0.00 a	2.8 $\pm$ 0.20 a	3.4 $\pm$ 0.24 a	13.4 $\pm$ 0.24 a	18.4 $\pm$ 3.31 a	89.0
CNPGL BR 29	3.2 $\pm$ 0.17 b	2.8 $\pm$ 0.20 b	2.5 $\pm$ 0.29 b	2.7 $\pm$ 0.25 a	3.5 $\pm$ 0.29 a	14.5 $\pm$ 0.65 b	24.7 $\pm$ 10.28 a	43.0
CNPGL BR 32	3.0 $\pm$ 0.00 b	2.0 $\pm$ 0.00 a	2.2 $\pm$ 0.17 a	2.7 $\pm$ 0.21 a	3.7 $\pm$ 0.21 a	13.5 $\pm$ 0.22 a	12.2 $\pm$ 5.29 a	9.0
CNPGL BR 36	3.2 $\pm$ 0.20 b	2.6 $\pm$ 0.24 b	2.7 $\pm$ 0.25 b	2.7 $\pm$ 0.48 a	3.0 $\pm$ 0.0 a	14.5 $\pm$ 0.50 b	35.0 $\pm$ 13.93 b	70.0
CNPGL BR 39	3.0 $\pm$ 0.00 b	2.2 $\pm$ 0.20 a	1.8 $\pm$ 0.20 a	2.8 $\pm$ 0.20 a	3.2 $\pm$ 0.20 a	13.0 $\pm$ 0.00 a	24.4 $\pm$ 7.63 a	92.0
CNPGL BR 41	3.0 $\pm$ 0.00 b	2.0 $\pm$ 0.00 a	2.0 $\pm$ 0.00 a	3.0 $\pm$ 0.00 a	3.7 $\pm$ 0.21 a	13.7 $\pm$ 0.21 a	23.0 $\pm$ 4.9 a	125.0
CNPGL BR 42	2.6 $\pm$ 0.20 a	2.6 $\pm$ 0.20 b	2.0 $\pm$ 0.00 a	3.3 $\pm$ 0.33 a	3.3 $\pm$ 0.30 a	14.0 $\pm$ 0.58 a	23.3 $\pm$ 1.79 a	23.0
CNPGL BR 43	3.0 $\pm$ 0.00 b	2.7 $\pm$ 0.25 b	2.2 $\pm$ 0.25 b	4.0 $\pm$ 0.41 a	4.0 $\pm$ 0.00 a	16.0 $\pm$ 0.71 c	12.7 $\pm$ 1.55 a	-
CNPGL BR 44	3.0 $\pm$ 0.00 b	2.8 $\pm$ 0.20 b	2.0 $\pm$ 0.00 a	3.0 $\pm$ 0.00 a	3.7 $\pm$ 0.25 a	14.5 $\pm$ 0.50 b	23.2 $\pm$ 6.74 a	96.0
CNPGL BR 46	3.0 $\pm$ 0.00 b	2.6 $\pm$ 0.24 b	1.8 $\pm$ 0.20 a	2.5 $\pm$ 0.29 a	3.7 $\pm$ 0.25 a	13.7 $\pm$ 0.63 a	33.7 $\pm$ 9.31 b	13.0
CNPGL BR 49	2.4 $\pm$ 0.24 a	2.8 $\pm$ 0.20 b	2.2 $\pm$ 0.25 b	2.5 $\pm$ 0.29 a	3.7 $\pm$ 0.25 a	13.5 $\pm$ 0.64 a	29.2 $\pm$ 4.87 b	66.0
CNPGL BR 58	3.3 $\pm$ 0.33 c	2.5 $\pm$ 0.22 b	2.5 $\pm$ 0.24 b	3.0 $\pm$ 0.00 a	4.0 $\pm$ 0.00 a	15.4 $\pm$ 0.40 c	30.4 $\pm$ 8.15 b	17.0
CNPGL BR 60	3.0 $\pm$ 0.00 b	2.0 $\pm$ 0.00 a	2.0 $\pm$ 0.00 a	2.6 $\pm$ 0.24 a	3.6 $\pm$ 0.24 a	13.2 $\pm$ 0.20 a	25.2 $\pm$ 7.34 a	94.0
CNPGL BR 63	3.0 $\pm$ 0.00 b	2.4 $\pm$ 0.40 b	2.0 $\pm$ 0.00 a	2.2 $\pm$ 0.25 a	3.5 $\pm$ 0.29 a	12.7 $\pm$ 0.25 a	46.7 $\pm$ 1.18 b	21.0
CNPGL BR 70	3.0 $\pm$ 0.00 b	2.2 $\pm$ 0.20 a	2.0 $\pm$ 0.00 a	3.0 $\pm$ 0.58 a	3.3 $\pm$ 0.33 a	13.7 $\pm$ 0.67 a	17.0 $\pm$ 7.64 a	52.0
CNPGL BR 74	3.0 $\pm$ 0.00 b	2.0 $\pm$ 0.00 a	2.0 $\pm$ 0.00 a	2.7 $\pm$ 0.21 a	3.2 $\pm$ 0.20 a	12.8 $\pm$ 0.37 a	29.0 $\pm$ 8.35 b	48.0
CNPGL BR 75	3.0 $\pm$ 0.00 b	2.2 $\pm$ 0.17 a	2.2 $\pm$ 0.17 a	3.2 $\pm$ 0.20 a	3.5 $\pm$ 0.29 a	13.7 $\pm$ 0.48 a	17.5 $\pm$ 9.87 a	30.0
CNPGL BR 76	3.0 $\pm$ 0.00b	2.0 $\pm$ 0.00 a	2.0 $\pm$ 0.00 a	-	-	-	-	-
CNPGL BR 83	3.0 $\pm$ 0.00b	2.0 $\pm$ 0.00 a	2.0 $\pm$ 0.00 a	2.5 $\pm$ 0.22 a	3.5 $\pm$ 0.22 a	13.0 $\pm$ 0.26 a	18.3 $\pm$ 2.16 a	32.0
CNPGL BR 91	3.0 $\pm$ 0.00 b	2.2 $\pm$ 0.25 a	1.7 $\pm$ 0.33 a	-	-	-	-	-
CNPGL BR 97	3.0 $\pm$ 0.00 b	2.2 $\pm$ 0.20 a	1.8 $\pm$ 0.20 a	3.0 $\pm$ 0.00 a	3.2 $\pm$ 0.20 a	13.2 $\pm$ 0.20 a	24.0 $\pm$ 7.27 a	25.0
CNPGL BR 100	2.8 $\pm$ 0.20 a	2.2 $\pm$ 0.41 a	2.0 $\pm$ 0.40 a	2.3 $\pm$ 0.33 a	3.0 $\pm$ 0.00 a	12.3 $\pm$ 0.33 a	20.3 $\pm$ 5.49 a	-
<i>B. brizantha</i>	3.0 $\pm$ 0.00 b	2.5 $\pm$ 0.29 b	1.7 $\pm$ 0.33 a	-	-	-	-	-
P	0.0001	0.002	0.009	0.014	0.159	0.000	0.003	-
F	2.279	2.232	2.006	2.018	1.374	5.042	2.397	-

Means values followed by the same letter in the column are not are not significantly different ( $P < 0.05$ )

"-" Insufficient data for analysis. Eggs/female: Insufficient number of replicate for analysis.

The nymphal stage duration of *C. oleosa* was longest with genotypes CNPGL BR 06, CNPGL 43, and CNPGL BR 58. The other genotypes (11.11%) (CNPGL BR 29, CNPGL BR 36, and CNPGL BR 44) were classified as intermediate (14.5 days duration), and 81.48% were observed with average values below 14.0 days for the nymphal duration, classing them as having increased susceptibility (Table-1).

With regard to *C. oleosa* survival when fed on different *B. ruziziensis* genotypes, no significant

differences were observed during each instar and nymphal stage (Table-2). Genotypes CNPGL BR 7 and CNPGL BR 14 from third instar; and CNPGL BR 76, CNPGL BR 91, and the *B. brizantha* cultivar from fourth instar, had a lower insect survival, this could therefore not be included in the statistical analysis (Table-2). Nymphal stage survival was lower than 43% on genotypes CNPGL BR 42, CNPGL BR 70, and CNPGL BR 100. In the other genotypes the averages were above 57.0% (Table-2).

**Table-2.** Average survival (%) of the stadia and the nymphal stage of *C. oleosa* kept in genotypes *B. ruziziensis*.

Genotypes	Instars					Nymphal stage
	1°	2°	3°	4°	5°	
CNPGL BR 06	100.0 ± 0.0	100.0 ± 0.0	85.7 ± 14.3	83.3 ± 16.7	100.0 ± 0.0	71.4 ± 18.4
CNPGL BR 07	42.80 ± 20.2	100.0 ± 0.0	-	-	-	-
CNPGL BR 14	85.7 ± 4.3	100.0 ± 0.0	-	-	-	-
CNPGL BR 21	71.4 ± 8.4	100.0 ± 0.0	80.0 ± 20.0	100.0 ± 0.0	100.0 ± 0.0	57.1 ± 20.2
CNPGL BR 25	71.4 ± 18.4	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	71.4 ± 18.4
CNPGL BR 29	71.4 ± 18.4	100.0 ± 0.0	80.0 ± 20.0	100.0 ± 0.0	100.0 ± 0.0	57.1 ± 20.2
CNPGL BR 32	85.7 ± 14.3	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	85.7 ± 14.3
CNPGL BR 36	71.4 ± 18.4	100.0 ± 0.0	80.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	57.1 ± 20.2
CNPGL BR 39	100.0 ± 0.0	71.4 ± 18.4	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	71.4 ± 18.4
CNPGL BR 41	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	85.7 ± 14.3	100.0 ± 0.0	85.7 ± 14.3
CNPGL BR 42	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	42.9 ± 20.2	100.0 ± 0.0	42.8 ± 20.2
CNPGL BR 43	85.7 ± 14.3	66.7 ± 21.1	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	57.1 ± 20.2
CNPGL BR 44	85.7 ± 14.3	83.3 ± 16.7	100.0 ± 0.0	80.0 ± 20.0	100.0 ± 0.0	57.1 ± 20.2
CNPGL BR 46	71.4 ± 18.4	100.0 ± 0.0	100.0 ± 0.0	80.0 ± 20.0	100.0 ± 0.0	57.1 ± 20.2
CNPGL BR 49	71.4 ± 18.4	100.0 ± 0.0	80.0 ± 20.0	80.0 ± 20.0	100.0 ± 0.0	57.1 ± 20.2
CNPGL BR 58	85.7 ± 14.3	100.0 ± 0.0	83.3 ± 16.7	100.0 ± 0.0	100.0 ± 0.0	71.4 ± 18.4
CNPGL BR 60	100.0 ± 0.0	100.0 ± 0.0	85.7 ± 14.3	83.3 ± 16.7	100.0 ± 0.0	71.4 ± 18.4
CNPGL BR 63	71.4 ± 18.4	100.0 ± 0.0	80.0 ± 20.0	100.0 ± 0.0	100.0 ± 0.0	57.1 ± 20.2
CNPGL BR 70	71.4 ± 18.4	100.0 ± 0.0	80.0 ± 20.0	75.0 ± 25.0	75.0 ± 0.0	42.8 ± 20.2
CNPGL BR 74	100.0 ± 0.0	85.7 ± 14.3	100.0 ± 0.0	100.0 ± 0.0	83.3 ± 16.7	71.4 ± 18.4
CNPGL BR 75	85.7 ± 14.3	100.0 ± 0.0	100.0 ± 0.0	83.3 ± 16.7	80.0 ± 20.0	57.1 ± 20.2
CNPGL BR 76	71.4 ± 18.4	100.0 ± 0.0	100.0 ± 0.0	-	-	-
CNPGL BR 83	100.0 ± 0.0	85.7 ± 14.3	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	85.7 ± 14.3
CNPGL BR 91	71.4 ± 18.4	100.0 ± 0.0	60.0 ± 24.5	-	-	-
CNPGL BR 97	71.4 ± 18.4	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0	71.4 ± 18.4
CNPGL BR 100	71.4 ± 18.4	80.0 ± 20.0	100.0 ± 0.0	75.0 ± 25.0	100.0 ± 0.0	42.8 ± 20.2
<i>B. brizantha</i>	57.1 ± 17.7	100.0 ± 0.0	75.0 ± 24.4	-	-	-
P	0.498	0.296	0.722	0.251	0.636	0.975
F	0.979	1.156	0.806	1.223	0.863	0.473

Means values compared in the column are not significantly different ( $P < 0.05$ ).

"-" Insufficient data for analysis

Adult longevity in *C. oleosa* was influenced by host-plan genotypes. Insects that fed on genotypes CNPGL BR 06, CNPGL BR 36, CNPGL BR 46, CNPGL BR 49, CNPGL BR 58, CNPGL BR 63, and CNPGL BR 74 had an average longevity of between 29.0 and 46.7 days, whereas for the other genotypes, we observed a lower average (25.2 days) (Table-1). The average longevity of males was significantly greater (33.8 days) than females (15.7 days), regardless of the plant genotype offered

When *C. oleosa* females were fed on genotypes CNPGL BR 06, CNPGL BR 41, CNPGL BR 44, CNPGL BR 49, CNPGL BR 60, and CNPGL BR 70, an average of more than 52 eggs were laid. A range of 8 to 32 eggs/female were observed for insects fed on genotypes CNPGL BR 21, CNPGL BR 32, CNPGL BR 42, CNPGL BR 46, CNPGL BR 58, CNPGL BR 63, CNPGL BR 75, CNPGL BR 83, and CNPGL BR 97. In 25.9% of the genotypes (CNPGL BR 07, CNPGL BR 14, CNPGL BR 43, CNPGL BR 76, CNPGL BR 91, CNPGL BR 100) and *B. brizantha*, egg number was not recorded due to lack of

*C. oleosa* pairs, as a result of the deleterious effects during the nymphal stage (Table-1).

## DISCUSSIONS

The rearing methods can influence the number of instars, through factors such as nutrition and temperature, as well as factors intrinsic to the species (Parra and Haddad, 1989). We found no evidence that different signal grass genotypes influenced the number of instars of *C. oleosa* during development, being consistent with previous studies on this species (Menezes, 1990; Silva *et al.*, 1994; Auad *et al.*, 2011), and also for *Collaria scenica* fed on either forage or wheat (Carlessi *et al.*, 1999).

Although the plants contain all the nutritional requirements for the development of this herbivore, the absolute and relative amounts of nutrients can be highly variable (Schoonhoven *et al.*, 2005). Variation in nutrients is most notable between different plant species, but it also occurs within the same species as a result of genotypic differences and environmental conditions (Behmer, 2009). Our study found significant differences in the duration of the first, second, and third instars of *C. oleosa*, as a result



of feeding on different food sources. The lengthening of the developmental period allows larvae to survive on poor nutritional substrates by extending the length of the feeding period, such that they can acquire sufficient food to complete growth (Shafiei *et al.*, 2001).

No significant differences were found for the duration of fourth and fifth instars when nymphs were fed on different signal grass genotypes, suggesting a greater sensitivity in first, second, and third instar nymphs, where certain plant genotypes can shorten *C. oleosa* development. The influence of food quality in early instar development has previously been reported (Scriber *et al.*, 1975; Slansky, 1979), indicating that experiments testing the effects of food quality and other factors should begin with early instars, where the effects may be greatest, due food utilization efficiency tends to decline as the instars progress.

The nymphal stage duration of *C. oleosa* was longest in some genotypes, suggesting a lower nutritional quality for insect development and thus resistance in these genotypes. The other genotypes were classified as intermediate and susceptibility. Santos *et al.* (2000) report that the food source that provide shorter life cycle is considered the best for the biological development of the insect, so, the most suitable foods provide shorter phases duration and increased survival, which are considered susceptible to pests insect.

Despite no significant differences was observed in the *C. oleosa* survival when fed on different *B. ruziziensis* genotypes, we verified a high mortality in the genotypes CNPGL BR 7, CNPGL BR 14, CNPGL BR 76, CNPGL BR 91 and *B. brizantha* which affected the biology of insect and prevented it from completing its life cycle. This may have been caused due some species accumulate high levels of compounds which function as biochemical defences through their toxicity, or their physical properties (Jander *et al.*, 2001).

Adult longevity in *C. oleosa* was influenced by host-plant genotypes. The influence of diet on adult longevity has been reported in other insect species (Pratisoli *et al.*, 2008). The same, however, was not verified by Auad *et al.* (2007) studying other phytophagous hemipterans, spittlebugs, for which no significant differences in longevity were found when adults were fed on different plant cultivars.

The longevity of males was significantly greater than females, regardless of the plant genotype offered, suggesting that this difference may be a biological characteristic of the species. Male longevity is greater than females has been shown in other bugs (Sulbaran and Chaves, 2006), and this may occur as a result of a trade-off between reproduction and longevity (Sulbaran and Chaves, 2006; Reznick, 1985), indicating a cost of reproduction. Longevity may also be related to abiotic factors to which the insects are exposed (Lira and Batista, 2006).

The fecundity of *C. oleosa* could be related to the nutritional quality of host-plant in the nymphal and/or adult stage, and our result corroborates those observed by

Parra (1991) and Carvalho and Souza (2000) who reported that the quality of food provided during the immature stages can effect of the biology of the adult stage. This implies that food substrate can have a deleterious effect on the fecundity of *C. oleosa*.

Our results indicate that certain genotypes represent poorer nutritional substrates for the *C. oleosa* adults. Johansson (1964) and Santos *et al.* (2005) reported that reproductive parameters such as egg production can be influenced by physical or chemical differences in the diet, or the amount ingested during the larval stage. A range of 8 to 32 eggs/female where observed for insects fed on some genotypes; this implies that food substrate can have a deleterious effect on the fecundity of *C. oleosa*, and suggests that these genotypes may be promising candidates for reducing population peaks in subsequent generations of *C. oleosa*. However in 25.9% of the genotypes (CNPGL BR 07, CNPGL BR 14, CNPGL BR 43, CNPGL BR 76, CNPGL BR 91, CNPGL BR 100) and *B. brizantha*, egg number was not recorded due to lack of *C. oleosa* pairs, as a result of the deleterious effects during the nymphal stage. These genotypes were selected as having affected the biology of *C. oleosa*, and would be suitable for breeding programs seeking desirable agronomic characteristics for resistance to insect pests

The effect of *Brachiaria* genotype on the duration of each instar, nymphal stage, adult longevity, and oviposition suggests the existence of variability in *C. oleosa* resistance among the genotypes tested. Our result agrees with Panizzi and Parra (1991), who report that the quantity and quality of food consumed by insects during the nymphal stage can affect growth rate, development time, insect weight, survival, fecundity, and longevity. In addition, insects that feed on resistant plants may become less active and weak, making them more susceptible to environmental changes, predators, and insecticides (Pathak, 1970).

Here, we have selected 25.9% of the tested signal grass genotypes as suitable candidates for breeding programs for signal grass resistance to *C. oleosa*. Given that there are currently no alternative control strategies, we believe our results will be a breakthrough in the management of this insect pest.

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