Scientific Note

Co-occurrence and frequency of *Leptodelphax maculigera* and *Dalbulus maidis* in maize and weeds in the Minas Gerais state, Brazil[1]

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ABSTRACT

The occurrence of African planthopper *Leptodelphax maculigera* (Stål 1859) (Hemiptera: Delphacidae) was first reported in Brazil in the Central-West region, Goiás state, Brazil, in 2023. However, it is important to analyze its dispersion in the country, frequency of occurrence and the sites of emergence in maize crop environments. This study reports the co-occurrence of *L. maculigera* and *Dalbulus maidis* in the Minas Gerais state and their frequencies in the maize agroecosystem, including the weed community. In addition, it reports the presence of parasitized *L. maculigera* individuals, suggesting the adaptation of local natural enemies to this species. In relation to *D. maidis*, which has a high frequency in maize crops, *L. maculigera* showed a low frequency in the crop and a moderate frequency in the weed communities. The proportion of African planthopper, at field level, along the maize developmental stages V1 to V7 presented an average frequency 97 % smaller than that of *D. maidis*.

KEYWORDS: *Zea mays* L., African planthopper, corn stunt disease complex.

RESUMO

Co-ocorrência e frequência de *Leptodelphax maculigera* e *Dalbulus maidis* em milho e plantas daninhas no estado de Minas Gerais, Brasil

A ocorrência da cigarrinha africana *Leptodelphax maculigera* (Stål 1859) (Hemiptera: Delphacidae) foi relatada pela primeira vez no Brasil na região Centro-Oeste, estado de Goiás, Brasil, em 2023. No entanto, é importante analisar sua dispersão no país, frequência de ocorrência e onde está presente na cultura do milho. Este trabalho relata a co-ocorrência de *L. maculigera* e *Dalbulus maidis* no estado de Minas Gerais e suas respectivas frequências na cultura do milho e na comunidade de plantas daninhas. Além disso, relata a presença de indivíduos de *L. maculigera* parasitados, indicando a adaptação de inimigos naturais locais a esta espécie. Em relação a *D. maidis*, que tem alta frequência na cultura do milho, *L. maculigera* apresentou baixa frequência na cultura e frequência moderada em comunidades de plantas daninhas. A proporção de cigarrinha africana, em nível de campo, ao longo dos estágios de desenvolvimento do milho V1 a V7 apresentou frequência média 97 % menor que a de *D. maidis.*

PALAVRAS-CHAVE: *Zea mays* L., cigarrinha africana, doenças do complexo do enfezamento do milho.

Ferreira et al. (2023) first reported the occurrence of African planthopper *Leptodelphax maculigera* (Stål, 1859) (Hemiptera: Delphacide) in the Central-West region of Brazil (Goiás state) in species of agronomic importance, such as maize, brachiaria, elephant grass, the BRS Capiaçu cultivar and bean. Then, Bortolotto et al. (2023) reported *L. maculigera* in the southern region of Brazil, where samples collected from maize and wheat fields carried the Maize Rayado Fino Virus (MRFV). Also, Canale et al. (2024) detected Maize Bushy Stunt Phytoplasma (MBSP) in the Santa Catarina state and MRFV and Maize Striate Mosaic Virus (MSMV) in African planthopper samples in maize fields. Stürmer et al. (2024) detected MRFV and MBSP in *L. maculigera* populations in the Rio Grande do Sul state.

MBSP (Bedendo et al. 2000), MRFV (Hammond & Bedendo 2005) and MSMV (Fontenele et al. 2018) are associated with corn stunt complex in maize, with the *Dalbulus maidis* (DeLong & Wolcott 1923) (Hemiptera: Cicadellidae) leafhopper being their main vector in maize crops (Oliveira et al. 2013).

Although *L. maculigera* carries these pathogens, studies are needed to verify whether it

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has the ability to transmit them to maize. It is also important to conduct studies on its dispersion in Brazil, its frequency of occurrence and the sites of occurrence in maize crop environments. Thus, this study reports the co-occurrence of *L. maculigera* and *D. maidis* in the Minas Gerais state and their frequencies in the maize agroecosystem, including the weed community, with Sete Lagoas being the first place where the African planthopper was found in a field with volunteer maize where *D. maidis* population was low.

Figures 1 and 2 show *L. maculigera* species according to Bartlett (2020). During the survey in Sete Lagoas, four individuals were obtained parasitized by Dryinidae, evidenced by the typical external larval sac (Martins & Domahovski 2022),

Figure 1. Male adults of *Leptodelphax maculigera* (Hemiptera: Delphacidae) (A) and *Daubulus maidis* (Hemiptera: Cicadellidae) (B) in dorsal and ventral view. In *L. maculigera*, the top arrow indicates the clip with a black spot and the bottom arrow indicates the spur on the tibia characteristic of this family. In *D. maidis*, the top arrow indicates two distinct round black spots and the bottom arrow indicates the row of spines on the tibia characteristic of this family.

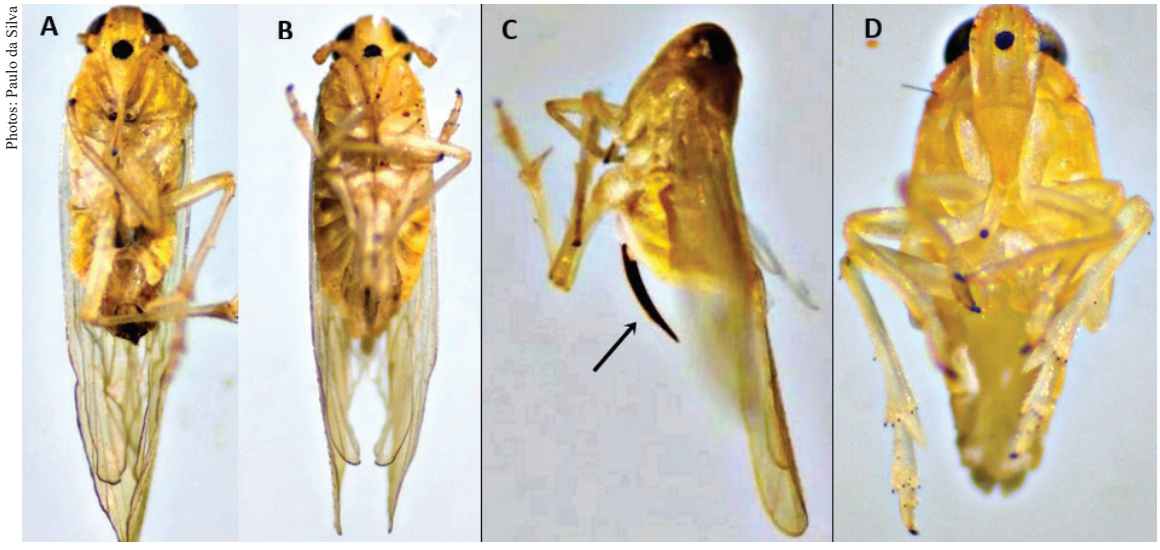

Figure 2. Male (A) and female (B) adults of *Leptodelphax maculigera* and their genitalia in ventral view. Female adult of *L. maculigera* in lateral view. The arrow indicates the pointed and elongated ovipositor (C). Nymph of *L. maculigera* in ventral view (D).

suggesting activity of biological control agents (Figure 3). Unfortunately, these individuals died, what did not allow confirmation of the parasite species. All insect photos were taken using a stereo microscope with a magnification of 30x.

Due to this identification, this study sought different maize production areas in the south-center region of the Minas Gerais state (Figure 4). The insect samples were collected using a sweep net with six strokes, over 10 linear meters, and repeated three times. The sampling survey was carried out once at the south-center municipalities from April 16 to 19, 2024, in maize and wheat crops, volunteer maize, and brachiaria or weed plants at the crop edge (Table 1). Among the sampled areas, the African planthopper was collected in maize crop at the R1 stage and in wheat crop at the vegetative stage, in the municipality of São João del Rei, and at the vegetative stage in wheat in the municipality of Madre de Deus de Minas. The ratios of *D. maidis* to *L. maculigera* individuals were 24:1, 1:1 and 0:1, respectively.

The occurrence and frequency of *D. maidis* and *L. maculigera* and weed community were evaluated in a 5-ha experiment with three maize hybrids (AG7098 TRE, BM953 PRO4 and AG8480 PRO3) at the V5 to V8 developmental stages and the BR 451 cultivar (V1 to V7) during March and May 2024, at the Embrapa Milho e Sorgo, in Sete Lagoas, Minas Gerais state (Tables 2, 3 and 4; Figure 5).

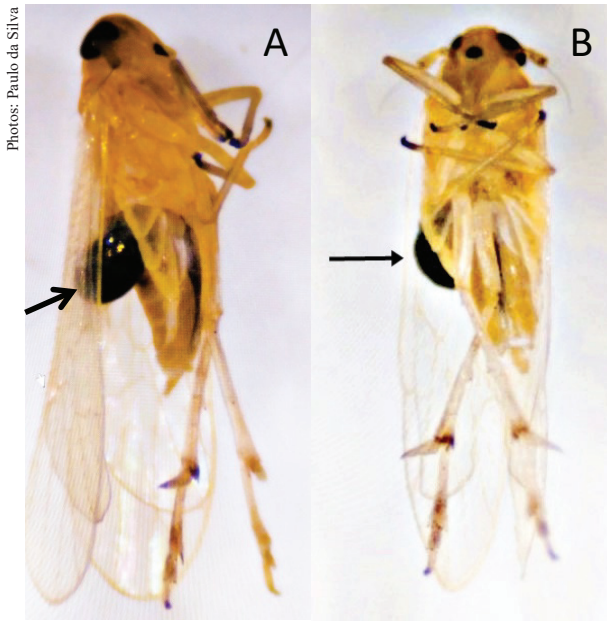

Figure 3. Lateral (A) and ventral (B) view of a parasitized female adult of *Leptodelphax maculigera*. The arrows indicate the external larval sac of the parasitoid (Hymenoptera: Dryinidae).

The crop treatments were carried out according to the technical recommendations for the crop (Cruz et al. 2010). The insect sampling was performed weekly in the morning, using an entomological net with ten blows in pendular forward movements (180 º) at 12 random points to sweep the plant canopy and weed plants. The weed community in the crops was at the V4 stage of the maize plants. These evaluations were performed by randomly throwing 25 times a 0.5-m^2 metal sheet across the useful area of each plot. The weed plants were collected and separated by species. The density and dry mass values were determined. The plants were sectioned close to the ground and dried in an oven with forced air circulation at a temperature of 70 ºC, until constant mass.

Twenty weed species belonging to nine botanical families were identified: Amaranthaceae, Asteraceae, Commelinaceae, Convolvulaceae, Euphorbiaceae, Poaceae, Portulacaceae, Rubiaceae and Solanaceae (Table 3). The Poaceae and Asteraceae families presented the greatest diversity of species. In addition to quantifying the species and the total number of individuals per sampled area, the following phytosociological parameters were calculated: relative frequency, relative density, relative dominance and relative importance index, as proposed by Silva et al. (2005) and Concenço et al. (2013) (Table 4). The phytosociological analysis showed that *Amaranthus* spp., *Cenchrus echinatus*, *Panicum maximum* and *Parthenium hysterophorus* were the species with the highest relative importance index in the maize crops.

The frequency of *D. maidis* was higher in the AG7098 TRE, BM953 PRO4 and AG8480 PRO3 maize hybrids and in the BR 451 cultivar than in the weeds. The opposite occurred for *L. maculigera*, with low frequency in the maize and a moderate frequency in the weeds (Table 2; Figure 5).

Stürmer et al. (2024) evaluated the population level of *D. maidis* and *L. maculigera* during the 2023/2024 maize crop season in South Brazil, Rio Grande do Sul state, and reported a low frequency for African planthopper. These findings suggest that, despite being present in the environment where maize grows, the African planthopper does not occupy the niche of the maize leafhopper *D. maidis* within the plant's whorl. Furthermore,

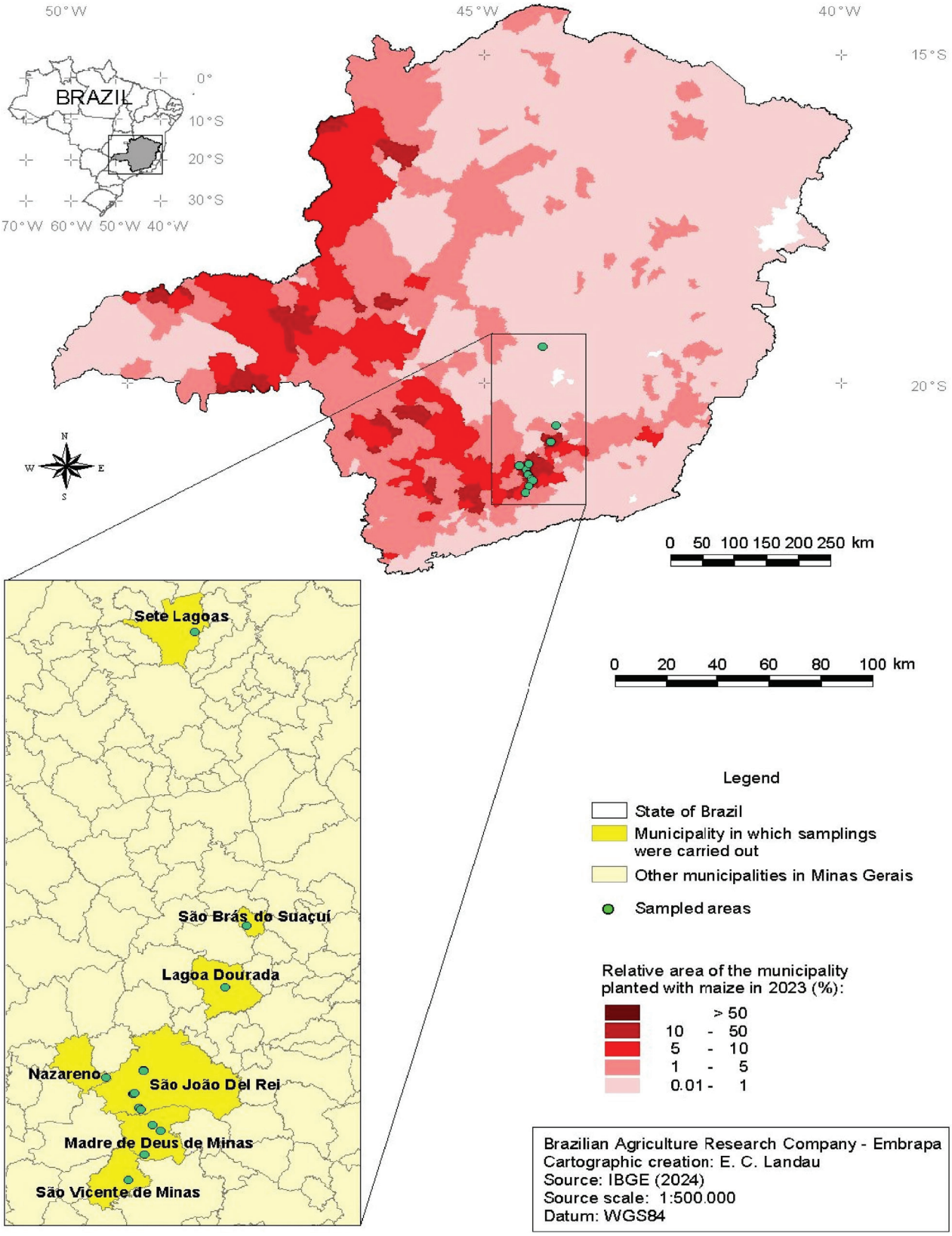

Figure 4. Municipalities of the Minas Gerais state sampled for *Dalbulus maidis* and *Leptodelphax maculigera* from April 16 to 19, 2024. Green dots indicate the sampled areas in each municipality.

Table 1. Number of *Dalbulus maidis* and plant species sampled once at maize producing municipalities in the south-center of Minas Gerais, from April 16 to 19, 2024.

Da*lbulus maidis* (Number)	Plant species	Municipality, Minas Gerais state
11	Maize at R1 stage	São João del Rei
7	Maize at R1 stage	São João del Rei
24 (24:1)*	Maize at R1 stage	São João del Rei
17	Maize at R1 stage	São João del Rei
7	Maize at R1 stage	São João del Rei
7	Weeds in maize crop	São João del Rei
15	Weeds in maize crop	São João del Rei
45	Weeds in maize crop	São João del Rei
35	Maize at V4 stage	São João del Rei
32	Maize at V4 stage	São João del Rei
3	Weeds in maize crop	São João del Rei
8	Weeds in maize crop	São João del Rei
29	Volunteer maize at V6-V7 stage	São João del Rei
3	Weeds	São João del Rei
1 (1:1)*	Wheat at vegetative stage	São João del Rei
1	Brachiaria at crop edge	São João del Rei
0	Brachiaria at crop edge	Nazareno
0	Weeds at crop edge	Nazareno
34	Maize at V5 stage	Nazareno
36	Maize at V7 stage	Nazareno
60	Maize at V7 stage	Nazareno
1	Wheat at vegetative stage	Nazareno
8	Weeds in maize crop	Nazareno
7	Weeds in maize crop	Nazareno
5	Wheat at vegetative stage	Nazareno
49	Maize R1 stage	Madre de Deus de Minas
10	Brachiaria in maize crop	Madre de Deus de Minas
9	Volunteer maize at V6 stage in bean crop	Madre de Deus de Minas
4	Maize at V7-V8 stage	Madre de Deus de Minas
0 (0:1)*	Wheat vegetative stage	Madre de Deus de Minas
20	Volunteer maize	Madre de Deus de Minas
36	Volunteer maize in bean crop	Madre de Deus de Minas
25	Maize at V8 stage	São Vicente de Minas
15	Weeds in maize crop	São Vicente
6	Maize at harvest	Lagoa Dourada
3	Brachiaria at crop edge	Lagoa Dourada
22	Maize at V9 stage	Lagoa Dourada

* Regions where the *Leptodelphax maculigera* was found, with the parenthesis indicating the ratio of *D. maidis* to *L. maculigera*.

the proportion of *L. maculigera* African planthopper at field level along the developmental stages V1 to V7 of the BR 451 maize cultivar had an average frequency 97 % smaller than that for *D. maidis*. The frequency of this insect was low in the maize plants and moderate in the weed community, with prevalence of the Poaceae species. Although the African leafhopper counts maize as one of its hosts (Bonfils et al. 1994), its low frequency did not show a significant variation in fluctuation throughout the maize crop development.

Considering the low frequency of *L. maculigera* in the maize and the moderate frequency in the weeds, associated to the fact that this insect carries the pathogens of the corn stunt complex MBSP and the MRFV and MSMV viruses (Bortolloto et al. 2023, Canale et al. 2024, Stürmer et al. 2024), further studies are needed to verify whether it is a vector of pathogens. For the development of an integrated management program with effective actions, studies are necessary on insect bioecology and weeds management, in order to reduce the population density of this insect in crops.

Table 2. Number and frequency of the *Dalbulus maidis* leafhopper and the *Leptodelphax maculigera* planthopper sampled in maize crops at different developmental stages and in weeds found in the crop (Embrapa Milho e Sorgo, Sete Lagoas, Minas Gerais state, Brazil).

Maize hybrids/Weeds	Developmental stage	*Dalbulus maidis*		*Leptodelphax maculigera*	
		Nº	Frequency (%)	Nº	Frequency (%)
AG7098 TRE	V5/V6	41	62.12	7	10.61
Weeds		4	3.15	30	23.62
AG8480 PRO3	V5/V6	37	80.43	2	4.35
Weeds		6	6.25	25	26.04
BM953 PRO4	V5/V6	99	87.61	12	10.62
Weeds		5	9.26	14	25.93
AG7098 TRE	V6-V7	131	81.37	9	5.59
Weeds		19	7.95	19	7.95
AG8480 PRO3	V6-V7	32	65.31	4	8.16
Weeds		20	7.14	17	6.07
BM953 PRO4	V6-V7	41	83.67	1	2.04
Weeds		7	12.07	9	15.52
AG7098 TRE	V7-V8	10	45.45	6	27.27
Weeds		3	10.34	4	13.79
AG8480 PRO3	V7-V8	17	62.96	2	7.41
Weeds		10	43.48	4	17.39
BM953 PRO4	V7-V8	23	76.67	5	16.67
Weeds		2	8.33	6	25.00

Table 3. Weeds infesting the maize crop area with the AG7098TRE, BM953 PRO4 and AG8480 PRO3 hybrids and the BR 451 cultivar (Embrapa Milho e Sorgo, Sete Lagoas, Minas Gerais state, Brazil).

Family	Species	Common name
Poaceae	*Cenchrus echinatus*	Southern sandbur
	Digitaria horizontalis	Crabgrass
	Digitaria insularis	Sourgrass
	Eleusine indica	Goosegrass
	Panicum maximum	Guinea grass
Asteraceae	*Ageranthum conyzoides*	Billy-goat weed
	Bidens pilosa	Hairy beggarticks
	Conyza spp.	Horseweed
	Galinsoga parviflora	Chickweed
	Acanthospermum hispidum	Bristly starbur
	Parthenium hysterophorus	Parthenium weed
Commelinaceae	*Commelina* spp.	Tropical spiderwort
Amaranthaceae	*Amaranthus* spp.	Pigweed
	Alternanthera tenella	Joyweed
Convolvulaceae	*Ipomoea* spp.	Morning glory
Euphorbiaceae	*Euphorbia heterophylla*	Wild poinsettia
	Chamaesyce hirta	Garden spurg
Portulacaceae	*Portulaca oleracea*	*Common purslane*
Rubiaceae	*Richardia brasiliensis*	*Brazilian clover*
Solanaceae	*Nicandra physaloides*	Apple of Peru

Table 4. Phytosociological parameters of four main weeds with high relative frequency (Fr), relative density (Dr), relative dominance (DOr) and relative importance index (Ir) found in the experimental area (Embrapa Milho e Sorgo, Sete Lagoas, Minas Gerais state, Brazil).

Species	Family	Dr (%)	Fr (%)	DOr (%)	Ir (%)
Amaranthus spp.	Amaranthaceae	23.6	18.3	25.6	22.9
Cenchrus echinatus	Poaceae	21.7	13.6	17.8	17.2
Panicum maximum	Poaceae	10.4	10.2	14.8	11.8
Parthenium hysterophorus	Asteraceae	15.1	14.9	10.0	13.3
Others		29.2	43.0	31.8	34.8

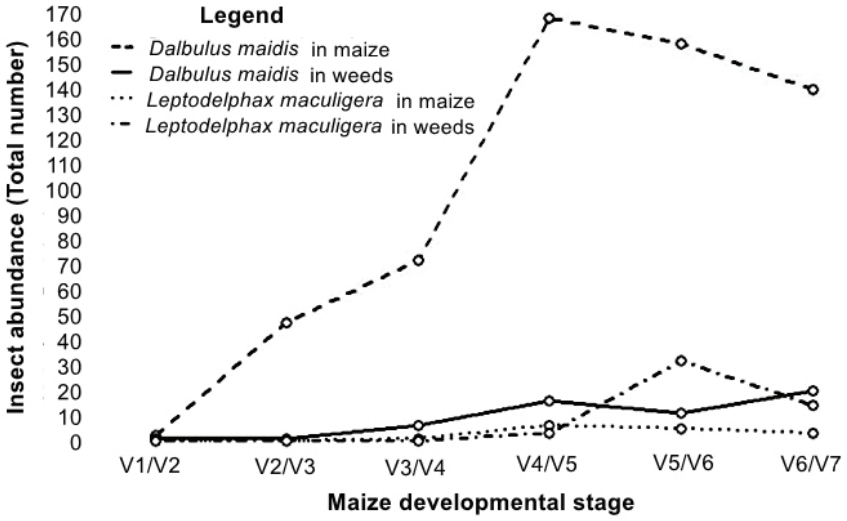

Figure 5. Population fluctuation of *Dalbulus maidis* and *Leptodelphax maculigera* collected weekly in the BR 451 maize cultivar and in weeds in the crop (Embrapa Milho e Sorgo, Sete Lagoas, Minas Gerais state, Brazil).

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