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Survival and injuries of *Deois flavopicta* (Stal., 1854) in pastures under seed treatment with insecticides and dry mass yield

Sobrevivência e injúrias ocasionadas por **Deois flavopicta** *(Stal, 1854) em pastagens submetidas a tratamento de sementes com inseticidas e produtividade de massa seca*

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ABSTRACT: The present study evaluated the survival and injuries of *Deois flavopicta* (Hemiptera: Cercopidae) in pastures of *Urochloa* (Syn. *Brachiaria*) *decumbens* and *U. brizantha*, submitted to seed treatment with fipronil (Amulet®) and thiamethoxam (Cruiser 350 FS®), and dry mass yield. The experiment, carried out at the APTA Experimental Unity, São José do Rio Preto, SP, Brazil, was designed in randomly blocks, with six treatments (factorial 2x3) and four replications. Sowing was manual, with 12.0 kg ha^{-1} seeds. Twenty adults were released on the plot, in a 40x40x70 cm cage, forty-nine days after sowing. The insects were sampled every two days during twelve days, without replacement of dead insects. Injuries caused by the spittlebug were evaluated by a rating scale and by productivity (dry mass yield). Data were analyzed by F-test and means compared by Tukey's test ($p \leq 0.05$). The survival of adults was higher in the *U. decumbens* pasture than in the *U. brizantha* pasture. Results show that seed treatment with thiamethoxam reduced the survival of *D. flavopicta* in pasture formation, but did not influence the injuries caused by insect and the dry mass yield of forage species.

KEYWORDS: Spittlebug; *Urochloa decumbens*; *Urochloa brizantha*; integrated pest management.

RESUMO: Objetivou-se avaliar a sobrevivência e injúrias causadas por *Deois flavopicta* (Hemiptera: Cercopidae) em pastagens de *Urochloa* (Syn. *Brachiaria*) *decumbens* e *U. brizantha*, submetidas a tratamento de sementes com fipronil (Amulet®) e tiametoxam (Cruiser 350 FS®), bem como à produtividade de massa seca. A pesquisa foi desenvolvida na Unidade de Pesquisa e Desenvolvimento de São José do Rio Preto/Agência Paulista de Tecnologia dos Agronegócios, sob o delineamento de blocos ao acaso, com seis tratamentos (fatorial 2x3) e quatro repetições. A semeadura foi realizada manualmente, distribuindo 12,0 kg ha^{-1} de sementes. Para infestação, foram liberados 20 adultos, em gaiolas de 0,40x0,40x0,70 m, aos 49 dias após a semeadura, e a contagem dos insetos nas gaiolas foi conduzida a cada dois dias, por um período de 12 dias, sem a substituição dos insetos mortos. Em avaliação visual foram atribuídas notas de injúrias causadas pela cigarrinha-das-pastagens às gramíneas. Para produtividade, foi efetuada avaliação de massa seca. Os dados obtidos foram submetidos à análise de variância pelo teste F e comparação de média pelo teste de Tukey ($p \leq 0,05$). A sobrevivência de *D. flavopicta* foi maior em pastagem de *U. decumbens* do que em *U. brizantha*. O tratamento de sementes com tiametoxam reduziu a porcentagem de cigarrinhas sobreviventes em pastagens em formação, embora não tenha influenciado nas injúrias causadas pelo inseto-praga e na produtividade de massa seca das forrageiras.

PALAVRAS-CHAVE: cigarrinha-das-pastagens; *Urochloa decumbens*; *Urochloa brizantha*; manejo integrado de pragas.

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INTRODUCTION

Extensive culture of *Urochloa* (syn. *Brachiaria*) caused outbreaks of spittlebug populations (Hemiptera: Cercopidae), the main pests in the pastures of tropical America (COSENZA, 1981; VALÉRIO; NAKANO, 1988; SUJII et al., 2001). According to AUAD et al. (2009), signalgrass (*U. decumbens*) is more prone to attacks by the spittlebug when compared to other Brachiaria species. In addition to the genus *Mahanarva*, the species *Deois flavopicta*, *Deois schach*, *Deois incompleta* and *Notozulia entreriana* are extremely common in the South-Central region of Brazil among the spittlebugs that attack pastures (SILVEIRA NETO et al., 1992; RESENDE et al., 2013). Further, the species *D. flavopicta* was reported in signalgrass in the northwestern region of the state of São Paulo, Brazil (PEREIRA et al., 2011). Female spittlebugs usually lay their eggs on the ground or in vegetal remains. After eclosion, nymphs fix themselves at the base of the signalgrass and maintain themselves protected by characteristic foam (PEREIRA; PEREIRA, 1985; VALÉRIO, 2009).

Spittlebug nymphs suck the sap of the root and stalk on the soil's surface. Adults feed on the aerial section of the grass and inject it with toxins, giving it a yellowish color and causing it to wither. They also reduce crude protein, fat and essential minerals. Dry matter increases and the grass becomes less tasty. Consequently, the animal feed is reduced, decreasing the milk and beef production (HEWITT, 1988; VALÉRIO; NAKANO, 1988). In other words, decrease of pest population is a must. Liabilities are estimated in hundreds of millions of dollars a year. In the case of the Brazilian savannah, with an area planted with signalgrass reaching 15 million hectares, losses may range between 99 and 819 millions of dollars a year (MACEDO, 2005; HOLMANN; PECK, 2002; VALÉRIO, 2012).

Management and control methods for spittlebug in pastures include biological control by the fungus *Metarhizium anisopliae*, a substance with insecticides and resistant varieties (VALÉRIO; KOLLER, 1993; PEREIRA et al., 2008). However, high costs impair control measures, as well as lack of information and scarcity of specific insecticides against the spittlebug, scanty tolerant or resistant foragers, difficulties in acquisition and inconsistent results of biological control (TOWNSEND et al., 2001). Insecticides are frequently and mistakenly applied after the yellowing of pastures, as the symptom appears approximately three weeks after the spittlebug attack (SOUZA et al., 2008).

Seed treatment by insecticides, fungicides and nematicides for protection against pest-insects and phytopathogens is highly relevant for the development of robust and healthy plants (PARISI; MEDINA, 2014). One of the most important characteristics in the treatment of seeds by insecticides is the systemic effect on the plant, enhanced by low vapor pressure and solubility in water of the main active substances. In fact, the ingredient releases itself slowly and is absorbed by the roots. The plant is thus protected against ground and aerial insects (SILVA, 1998).

Current analysis evaluates the dry mass yield and the survival and injuries caused by adult spittlebugs *D. flavopicta* in growing *U. decumbens* and *U. brizantha* pastures, submitted to seed treatments with insecticides fipronil (Amulet®) and thiamethoxam (Cruiser 350 FS®).

MATERIALS AND METHODS

The experiment

The assay was developed at the Research and Development Unit of São José do Rio Preto (49º23'W; 20º48'S; altitude 468 m)/ Agência Paulista de Tecnologia dos Agronegócios (APTA), between November, 2015 and January, 2016, within the context of the spittlebug *D. flavopicta* infesting pastures in the northwestern region of the state of São Paulo, Brazil (PEREIRA et al., 2011). Experimental design comprised randomized blocks with six treatments (2x3) and four replications. Each parcel was made up of eight sowing rows, spaced 0.20 m and 4 m in length, totaling 6.40 m^2. Treatments consisted of two species of signalgrass (*U. decumbens* and *U. brizantha*), with seeds treated with insecticides fipronil (Amulet®), at 40 mL p.c. ha^{-1}; thiamethoxam (Cruiser 350 FS®), at 300 mL p.c. 100 kg^{-1} seeds; control (without any treatment). Soil correction and preparation were undertaken in an area with remnant pasture for the establishment of the field assay.

Application of the products

Duly registered for signalgrass seed treatment, the products were applied to the seeds immediately before sowing, with broth volume proportional to 500 mL 100 kg^{-1} seeds, following technical recommendations (ANDREI, 2013). The seeds were placed in plastic bags, which were filled with air and sealed. These were the recipients in which pesticide and seeds were shaken and homogenized. After drying, seeds were sown manually with a distribution of 12.0 kg ha^{-1} seeds (78% of the crop value) of the two species of the *Urochloa* grass. Moreover, the establishment of the field assay was carried out taking into account favorable soil-climate conditions for the implantation of pastures.

Infestation of adult *D. flavopicta*

Spittlebug adults (*D. flavopicta*) were collected in remnant pastures for the standardization and uniformity of infestation in the experimental units. Insects were then selected in the laboratory and 20 specimens were inoculated per parcel (in a

0.40x0.40x0.70 m cage), after 49 post-sowing days (Fig. 1). Population level and infestation period followed recommendations by VALÉRIO; NAKANO (1988) and RESENDE et al. (2013).

Evaluation and data analysis

The emergency of plants (stand) was evaluated at each parcel, recording the number of plants present in 0.5 m^2, at 15 and 30 days after sowing (DAS).

Survival of *D. flavopicta* was calculated by counting the insects in the cages every two days after infestation, during 12 days, without replacing the dead ones. Rates were converted into percentages of surviving spittlebugs, at each evaluation, proportional to the initial population.

Figure 1. Infestation by *D. flavopicta* in the experimental units.

Injuries (yellowing) caused by spittlebug adults to signalgrass were assessed visually by four independent evaluators who gave marks (adapted by DAVIS; WILLIAMS, 1989) according to yellowing-withering percentages: 1–0 at 20%; 2–20% at 40%; 3–40% at 60%; 4–60% at 80% and 5–80% at 100%, with 0=totally healthy plants; 100%=totally withered plants. Yield was calculated by signalgrass cutting and weighing of green mass. Later, vegetal biomass was conditioned in a forced-air buffer at 60°C to constant weight. Dry matter was then weighed. Evaluation occurred 70 days after sowing and data were converted into kg m^{-2}. Data underwent analysis of variance by F-test and means were compared by Tukey's test ($p \leq 0.05$).

RESULTS AND DISCUSSION

Analysis of variance showed that there was no significant interaction among the signalgrass species and insecticide-treated seeds on the survival of *D. flavopicta* in all evaluations (Table 1).

D. flavopicta population did not differentiate significantly the forage species at 2, 4, 6 and 8 days after infestation (DAI). However, overtime (on the 10th and 12th DAI) a greater percentage of spittlebugs survived in *U. decumbens* than in *U. brizantha.* The latter is resistant to spittlebugs, as reported by COSENZA (1981) and AUAD et al. (2009). The treatment of signalgrass seeds by insecticides fipronil and thiamethoxam failed to decrease *D. flavopicta* population at the 2nd and 4th DAI, when compared to grass without seed treatment (control). Therefore, on the 6th DAI, the systemic

Table 1. Percentage of survivals of *D. flavopicta* in cages on *U. decumbens* and *U. brizantha*, submitted to seed treatment with insecticides. São José do Rio Preto SP Brazil, 2015/16.

Treatment	Days after infestation					
	2	4	6	8	10	12
U. decumbens	58.33 a[1/]	51.67 a	42.50 a	37.92 a	37.08 a	35.00 a
U. brizantha	62.08 a	47.08 a	41.25 a	36.25 a	28.75b	25.42b
F (E)	0.24	0.80	0.11	0.18	6.33	7.88
P (E)	0.6306	0.3859	0.7414	0.6749	0.0238	0.0133
control	68.75 a	55.63 a	49.38 a	40.63 a	36.88 a	34.38 a
fipronil	61.25 a	50.00 a	45.63 a	43.13 a	40.63 a	37.50 a
tiametoxam	50.63 a	42.50 a	30.63b	27.50b	21.25b	18.75b
F (TS)	1.89	2.20	9.49	6.19	12.83	11.54
P (TS)	0.1846	0.1458	0.0022	0.0110	0.0006	0.0009
F (E x TS)	0.51	1.63	1.05	0.35	0.11	0.10
P (E x TS)	0.6113	0.2291	0.3729	0.7073	0.8959	0.9016
CV (%)	31.08	25.46	21.75	25.74	24.65	27.68

E: species of signalgrass. TS: treatment of seeds. [1/] Means followed by the same letter in the column do not differ by Tukey's test ($p > 0.05$).

insecticide thiamethoxam significantly reduced the percentage of the surviving insects when compared to foragers without any chemical protection of the seeds. It also reduced those submitted to seed treatment with fipronil. Impact of thiamethoxam on cercopid adults remained during the other evaluations at 8th, 10th and 12th DAI. The above may be related to the systemic activity of thiamethoxam with great efficaciousness in the control of sucker insects (GAZZONI, 2008). The study reveals that the treatment of signalgrass seeds with thiamethoxam (Cruiser 350 FS®), specifically employed for the control of termites in pastures (ANDREI, 2013), may be an asset in the population decrease of the spittlebug *D. flavopicta* in young pastures.

The number of *U. decumbens* and *U. brizantha* stands did not differ significantly among the different grass species and between the areas submitted or not to seed treatment with thiamethoxam and fipronil. In fact, the products (applied according to manufacturer's instructions) did not reveal any phytotoxicity to seeds and, consequently, to plant emergence (Table 2).

Injuries attributed to the forager attacked by spittlebug adults in the susceptible grass (*U. decumbens*) were comparatively greater than those in the resistant one, regardless of the treatment of seeds by insecticides (Fig. 2). The above corroborates the resistance of *U. brizantha* to spittlebugs (VALÉRIO et al., 1997).

Fipronil and thiamethoxam, applied in the treatment of signalgrass seeds, failed to reduce significantly injuries by *D. flavopicta*, even though there was a higher yellowing rate in pasture without any chemical protection to seeds. Since there was a decrease in survival rates in grasses from seeds treated with thiamethoxam, it may be surmised that

Table 2. Number of plant stands; injuries caused by *D. flavopicta* adults; dry matter yield of *U. decumbens* and *U. brizantha*, submitted to seed treatments with insecticides. São José do Rio Preto SP Brazil, 2015/16.

Treatment	Stand - Plants.m^{-2}		Injuries[2/]	Dry matter kg.m^{-2}
	12 DAS	27 DAS		
U. decumbens	147.67 a[1/]	139.67 a	2.98 a	0.533 a
U. brizantha	128.00 a	117.17 a	1.50b	0.582 a
F (E)	4.22	2.92	20.78	0.60
P (E)	0.0577	0.1080	0.0004	0.4513
control	140.00 a	140.00 a	2.56 a	0.509 a
fipronil	126.50 a	116.00 a	2.09 a	0.616 a
tiametoxam	147.00 a	129.25 a	2.06 a	0.548 a
F (TS)	1.58	1.11	0.99	0.99
P (TS)	0.2382	0.3545	0.3934	0.3933
F (E x TS)	1.17	1.05	1.49	0.15
P (E x TS)	0.3372	0.3737	0.2573	0.8651
CV (%)	17.01	25.11	35.49	27.73

E: species of signalgrass. TS: Treatment of seeds. DAS: Days after sowing. [1/]Means followed by the same letter in the column do not differ by Tukey's test ($p>0.05$).[2/]Injuries: 1: 0 to 20%; 2: 20 to 40%; 3: 40 to 60%; 4: 60 to 80%; 5: 80 to 100%; 0 = healthy plants; 100% = withered plants.

B

Figure 2. Injuries caused by *D. flavopicta* adults in *U. decumbens* (a) and *U. brizantha* (b).

similarity in injuries perceived among the experimental units was probably due to high infestation rates (20 adults 0.16 m^{-2}) of the spittlebugs in the cages and to the fact that defensive activities on the spittlebug occurred only after six days of infestation. During evaluation of the pest-insect, yellowing of the grass was perceived on the 2nd and 4th day after infestation. This fact differs from the report by SOUZA et al. (2008), who revealed that symptoms appeared about three weeks after the attack by the spittlebug.

Dry matter yield was significantly similar among species *U. decumbens* and *U. brizantha*, and between the areas submitted or not to seed treatment by insecticides. However, the yield of the resistant signalgrass was 9.15% times higher than that of the susceptible one. According to MARTUSCELLO et al. (2009), this fact may be related to the multi-stalk development of *U. brizantha*, which, aside from being a resistant variety to pest-insects, has high stalk production when compared to the growth of *U. decumbens.*

CONCLUSION

The treatment of signalgrass seeds with insecticide thiamethoxam may be an asset in decreasing the population of *D. flavopicta* in young pasture. However, it does not affect injuries caused by the pest insect and dry matter yield.

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