ECOLOGICAL OBSERVATIONS ON SPITTLEBUGS WITH EMPHASIS ON THEIR OCCURRENCE IN RICE[1]

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ABSTRACT - A survey for spittlebugs in rice fields of the State of Mato Grosso do Sul showed presence of as many as 36 adults/10 sweeps of a sweep net. Spittlebug densities were also monitored in pastures and the adjoining rice fields. The observations in the rice were made from germination till flowering. The insects flew to rice despite the abundance of food and very low density (about 4 adults/10 sweeps) in pastures. The adults tended to invade rice in large numbers when the plants were about 20 cm or taller. At densities ⩽ 10 adults/10 sweeps, the counts tended to follow the negative binomial distribution and at higher densities the Poisson distribution. Spittlebugs preferred the rice field with taller rice plants rather than the adjoining rice field with shorter plants. In a screenhouse, the insects preferred pasture plants over rice and corn of the same height. Eggs of these insects were found in the rice fields. However, the nymphs were detected on extremely rare occasions.

Index terms: *Zulia entreriana, Deois flavopicta,* cercopidae, pasture, *Brachiaria decumbens.*

OBSERVAÇÕES ECOLÓGICAS DAS CIGARRINHAS-DAS-PASTAGENS COM ÊNFASE NAS SUAS OCORRÊNCIAS NA CULTURA DE ARROZ

RESUMO - O levantamento das cigarrinhas-das-pastagens, nas culturas de arroz no Estado de Mato Grosso do Sul, mostrou a presença de até 36 adultos/10 golpes de rede entomológica em algumas lavouras. As densidades destes insetos também foram determinadas nos pastos e em lavouras de arroz margeando os pastos. No arroz, as observações foram feitas desde a germinação até a floração das plantas. Os insetos voaram para o arroz, a despeito da baixa densidade (cerca de 4 adultos/10 golpes) e da abundância de alimentos nos pastos. Os adultos mostraram uma tendência de invadir as lavouras de arroz em maior número quando as plantas tinham cerca de 20 cm ou mais de altura. A densidade de insetos mostrou uma tendência de distribuição matemática do tipo binomial negativa quando esta era ⩽ 10 adultos/10 golpes e, do tipo Poisson para densidades maiores. As cigarrinhas preferiram a lavoura de arroz com plantas de maior altura à lavoura com plantas de menor altura, quando estas estavam lado a lado. Na casa telada, os insetos preferiram as plantas de pasto ao arroz ou milho da mesma altura. Foram encontrados ovos de cigarrinhas em lavouras de arroz. Entretanto, as ninfas foram encontradas em ocasiões muito raras.

Termos para indexação: *Zulia entreriana, Deois flavopicta,* cercopidae, pasto, *Brachiaria decumbens.*

INTRODUCTION

In November of 1983, we received inquiries from rice growers and extension people, from several places in Brazil, about spittlebug problems in rice. Furthermore, a survey carried out by the extension service of the State of Mato Grosso do Sul reported loss of 23,000 ha of rice due to spittlebugs in the 1983-84 growing season.

Very little is known about spittlebugs in rice. Ferreira & Guazzelli (1982) reported on the chemical control and on the light trap catches of the spittlebug, *Deois flavopicta* Stal. in the experimental area. Barbosa et al. (1983) evaluated the damage caused by different densities of *D. flavopicta* in rice plants of different ages. Based on these informations and our data on spittlebugs in pasture and rice, guidelines to control these insects were presented (Nilakhe et al. 1984b).

In this paper we report on 1) survey of spittlebug populations in rice fields of the State of Mato Grosso do Sul; 2) population fluctuation in rice beginning from germination till flowering, and in the adjoining pastures; 3) type of mathematical distribution within rice; 4) screenhouse and field observations about the preference of spittlebugs for rice plants of different heights, and preference for pasture, corn and rice plants of the same height in the screenhouse, and 5) observations on occurrence of eggs and nymphs of spittlebugs in rice fields.

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MATERIALS AND METHODS

Spittlebug survey

In November of 1983, 20 rice fields distributed in municipalities of Anaurilândia, Bataguassu, Nova Andradina, Rio Brilhante, Xavantina and the region of Dourados in the State of Mato Grosso do Sul were sampled for spittlebugs. Fifteen of the 20 fields bordered pasture. Of the five fields that did not, two were of irrigated rice. For each field, ten samples each of ten sweeps of a 40 cm diameter sweep net were taken at random in an area of about 1/2 ha. When a pasture bordered the rice field, the 1/2 ha areas chosen for the sampling lied in the immediate vicinity. It was not possible to record the cultivar of each rice field. However, the majority of rice in the areas sampled was planted with cultivars IAC 25, IAC 47, IAC 164 and IAC 165. The details about sweeping were the same as of Nilakhe et al. (1984c). Adult spittlebugs caught in sweep net were separated by species and counted in the field itself. To obtain a mean height, 25 plants were measured. The pasture was rated for the spittlebug damage on a scale of 0 to 10, where, 0 = absence of damage, 1 = 10% leaf area with damage symptoms, up to 10 = 100% dry leaf area and leaves apparently dead.

Seasonal abundance in pastures and adjoining rice fields

Details of the four pastures and the adjoining rice fields located within 25 km from Dourados sampled about twice a week are given below: Cristalina farm - Fitteen ha was planted with rice cv. IAC 164 on Nov. 4, 1983. The sampling began on Nov. 11 and terminated upon flowering of rice. The adjoining pasture of about the same area as rice was of *Brachiaria ruziziensis* German & Evrard, kept at 45 cm height. Sampling with a sweep net was done as described in the above section. The population in rice was also monitored using 20 sticky traps. The trap was made of plywood 50 cm x 30 cm painted green, and was held 50 cm aboveground by affixing it to a wooden strip. The sticky substance "Verniz pega-poeira" manufactured by Glasurit do Brasil Ltda., São Paulo, SP, was applied on both sides of the trap and was reapplied as necessary. Four traps were placed 40 m from the dividing line of pasture and rice. The distance between the traps was 40 m, also. Likewise, four traps were set each at the distance of 80, 120 and 160 and 200 m. A sample of ten sweeps of a sweep net was also taken in the vicinity of the trap.

Cerro Porã farm - About 100 ha were planted with rice cv. IAC 164 in the first week of Nov. of 83. The adjoining pasture of same area as rice belonged to species *Brachiaria decumbens* Stapf. and was kept at 25 cm height. The sampling details were the same as for the Cristalina farm.

Santa Ana farm - A 50 ha *B. decumbens* plot bordered 1/2 ha plot of rice cv. IAC 25 - this was designated as the Location 1. About 250 m from Location 1, the same pasture plot bordered 12 ha of rice cv. IAC 47, and about 50 ha of another grass species *Panicum maximum* Jacq., cv. Colonião; this was designated as the Location 2. No sticky traps were used, but ten samples of a sweep net were obtained as described in the section above. *B. decumbens* pasture was maintained at 20 cm height and *P. maximum* at 30 cm.

A fifth field was monitored, at Anaurilândia, only for two weeks, to see if and when spittlebugs move to the 2 ha rice (cultivar unknown). The adjoining pasture was a 20 ha plot of *Brachiaria humidicola* (Rendel) Schwnickerdt, maintained at 25 cm of height. All pastures, except at the Cristalina farm, were under cattle grazing.

Within field mathematical distribution of spittlebugs

Entire areas of 11 rice fields were sampled by dividing the fields in plots of 40 m x 30 m. Clearly, some border plots had smaller dimensions. In each plot a sweep sample of ten sweeps of a sweep net was taken at random. The indices of aggregation (k) and dispersion (ID) were calculated for each field, and the counts were evaluated for conformity to the Poisson and the negative binomial distribution. The details were given by Nilakhe (1982).

Preference for plants of different heights

Adjoining rice fields with different plant heights at four locations were sampled to study the preference of spittlebugs for rice plants of different heights. The sampling procedure was the same as for rice and the adjoining pasture mentioned in the first section.

In the screenhouse, a potted rice plant each of 18, 35 and 55 cm high of of cv. IAC 164 was placed in a 1 m^3 saran screen cage and 30 adults of *D. flavopicta* were released inside each of the similarly prepared 6 cages. The number of spittlebugs present on each plant were counted four times a day at 2 hour intervals, until a total of 12 observations were obtained. After each observation, the dead insects were replaced with live ones.

The preference of spittlebugs for rice (cv. IAC 164), corn (cv. Decalb 511) and pasture (*B. decumbens*) of about 35 cm height was tested in the similar manner as mentioned in the preceding paragraph. Because spittlebugs are a problem also in corn (Santos et al. 1982), it was included in the test.

Eggs and nymphs in rice fields

To determine whether spittlebugs oviposit in rice fields or not, soil samples along with 8 cm aboveground portion of rice plants from four fields were obtained and processed for examination for eggs, as described by Nilakhe et al. 1984a, 1984d. From each field, twelve 10 cm sections of rice row were chosen at random. The soil up to 3 cm depth and 5 cm from each side of the row was included in the sample. The samples were obtained in November 83 and sweeping for adults at the time of soil sampling showed mean number of adults/10 sweeps ranging from 8 to 19.

At least forty rice rows of 1 m in 25 fields were examined for the presence of spittlebug nymphs from Nov. 83 to Feb. 84.

RESULTS AND DISCUSSION

Spittlebug survey

Roughly 80% of all the spittlebug adults caught in this survey belonged to species *D. flavopicta* and the remainder to *Zulia entreriana* Berg. On extremely rare occasions adults of *Mahanarva fimbriolata* Stal were encountered. Also, the proportion of the species in a given rice field remained the same as in adjoining pasture. Table 1 shows that when the rice field bordered the pasture, the number of spittlebugs found in rice fields varied from 2.7% (field 15) to 75.4% (field 13) of those found in the respective pastures. Also, the percentage found in rice was in no way related to the kind of the adjoining pasture, pasture height, or even the amount of spittlebugs damage. For example, fields 9 and 12 had the damage rating of 9, which probably indicated insufficient optimum food and thus enough reason for the insects to search another food source. However, the number of adults found in the rice was not particularly high. When the number of adults in pastures was > 37/10 sweeps, the percentage of adults found in rice was > 36% only in those rice fields in which the plant height was ≥ 30 cm (fields 11, 13 and 14). On the other hand, when the plant height was ≤ 20 cm (fields 10, 12 and 15), the percentage was < 17%.

In the three rice fields that did not border pasture, the mean number of adults ± SE were 3.0 ± 0.62, 5.2 ± 1.00, and 11.3 ± 1.48. Of the two irrigated rice fields, no spittlebugs were found in one field and the other had 0.1 ± 0.1. With regards to spittlebug damage in rice, plants in fields 10, 11 and 12 were totally dry and apparently dead. It is likely that there were more spittlebugs in these fields before the sampling. We did not give any damage rating for rice, but the dama-

TABLE 1. Mean number of spittlebug adults caught in a sweep net in pasture and the bordering rice field, Mato Grosso do Sul, November, 1984[1].

Field no.	Pasture				Rice	
	Type[2]	$\bar{x}$ height (cm)	Damage rating[3]	$\bar{x}$ no. of adults ± SE	$\bar{x}$ no. of adults ± SE	$\bar{x}$ height (cm)
1	colonião	10	1	3.6 ± 0.68	0.3 ± 0.15	30
2	humidicola	16	4	9.4 ± 0.85	5.4 ± 0.93	38
3	decumbens	14	3	12.9 ± 3.39	4.2 ± 0.18	33
4	decumbens	20	4	13.3 ± 2.85	2.8 ± 0.59	65
5	humidicola	21	-	13.4 ± 2.09	2.8 ± 0.70	53
6	decumbens	21	6	21.1 ± 2.78	3.6 ± 0.81	39
7	decumbens	21	-	21.1 ± 2.78	2.5 ± 0.64	40
8	colonião	30	7	26.7 ± 2.32	7.8 ± 1.18	45
9	ruziziensis	37	9	33.5 ± 2.23	5.1 ± 0.94	46
10	decumbens	34	5	37.8 ± 3.60	6.4 ± 0.58	20
11	decumbens	34	5	37.8 ± 3.60	19.0 ± 1.14	31
12	decumbens	25	9	40.3 ± 2.57	4.4 ± 1.00	17
13	decumbens	26	5	47.2 ± 3.40	35.6 ± 3.15	30
14	decumbens	15	8	55.5 ± 3.38	19.9 ± 1.76	43
15	humidicola	23	3	58.2 ± 4.15	1.6 ± 0.43	10

[1] Mean height is based on 25 plants. Mean number of adults is based on 10 samples of 10 sweeps each.

[2] Colonião = *Panicum maximum* cv. Colonião; humidicola = *Brachiaria humidicola*, decumbens = *Brachiaria decumbens*, ruziziensis = *Brachiaria ruziziensis*.

[3] A scale of 0 to 10 was used, where 0 = absence of damage, 1 = 10% leaf area with damage symptoms, up to 10 = 100% dry leaf area, and leaves apparently dead.

ge was evident only in one more field (field 13). The sampling efficiency, as measured by values of the relative variation (RV) (RV = SE x 100 ÷ $\bar{x}$) was better for pastures than for rice fields. For pastures, in only two of the 15 cases (fields 3 and 4) the RV exceeded 20%, whereas for rice fields, in nine of the 19 cases (fields 1, 2, 4, 5, 6, 7, 12, 15 and 1 field of irrigated rice).

Seasonal abundance in pastures and adjoining rice fields

Tables 2 to 5 show that considerably high numbers of adults were found in pastures compared to rice. Of all the adults obtained in sweeping at Cristalina farm, 94% were in pasture and 6% in rice. The respective percentages for Cerro Porã farm were 92.6 and 7.4; for Location 1, Santa Ana farm 91.1 and 8.9; for Location 2, Santa Ana farm 94.9 and 5.1 (considering pasture of *B. decumbens* only), and were 92 and 8 for Anaurilândia farm. Only in two cases, the percentage of adults found in rice exceeded 30 to that found in pasture (Feb. 3 and Feb. 16, location 2, Santa Ana farm); this occurred despite of heavy populations in the pasture (> 50 adults/10 sweeps) on several occasions.

In general, distinct population peaks were observed in pasture during Nov. and Jan. To a lesser extent, peak populations in rice fields occurred in Nov. and Jan. also.

Although a greater number of spittlebug adults were found in the *B. decumbens* pasture than in rice at Location 2 in Santa Ana farm, the numbers found in the bordering rice and the pasture of *P. maximum* cv. Colonião were similar (overall mean of 29.3 for *B. decumbens*, 3.8 for rice, and 2.9 for the Colonião). The Colonião pasture was in the state of degradation compared to *B. decumbens;* nevertheless, spittlebugs showed preference for the latter. When only Colonião borders rice, it is likely that most of the adults will be found in the pasture.

The sticky traps were set in the rice fields at

TABLE 2. Population fluctuation of spittlebugs in pasture of *Brachiaria ruziziensis* and the adjoining rice field, Cristalina farm. Dourados, MS, 1983-84.

Sampilng date	No. of spittlebugs in		
	Pasture	Rice[2]	
	No./10 sweeps[1] of a sweep net ±SE	No./10 sweeps of a sweep net ±SE	No./sticky trap ±SE[3]
Nov. 11	34.5 ± 4.75	0.15 ± 0.08	1.10 ± 0.23
Nov. 18	29.2 ± 2.97	0.90 ± 0.41	1.60 ± 0.33
Nov. 25	22.7 ± 1.54	2.50 ± 0.50	6.30 ± 0.89
Nov. 29	17.5 ± 1.75	2.17 ± 0.47	1.05 ± 0.32
Dec. 02	4.0 ± 0.82	0.25 ± 0.13	0.08 ± 0.08
Dec. 05	1.1 ± 0.38	0	0
Dec. 09	2.0 ± 0.33	0.33 ± 0.18	0
Dec. 13	1.1 ± 0.35	0.25 ± 0.13	0.08 ± 0.08
Jan. 06	4.6 ± 1.44	0.17 ± 0.17	0.33 ± 0.15
Jan. 12	9.2 ± 1.45	0.89 ± 0.26	-
Jan. 17	27.2 ± 3.56	2.30 ± 0.54	-

[1] Mean based on 10 samples

[2] Mean based on 20 samples. On Nov. 11 the rice plants had mean height of 10 cm. On Jan. 17, flowers had begun to emerge.

[3] The trap was made of 50 cm x 30 cm plywood and held 50 cm aboveground by affixing it to a wooden strip. The sticky substance "Verniz pega - poeira" was applied on both sides of the board.

TABLE 3. Population fluctuation of spittlebugs in pasture of *Brachiaria decumbens* and the adjoining rice field, Cerro Porã farm, Dourados, MS, 1983-84.

Sampling date	No. of spittlebugs in		
	Pasture	Rice[2]	
	No./10 sweeps[1] of a sweep net ± SE	No./10 sweeps of a sweep net ± SE	No./sticky trap ± SE[3]
Nov. 14	10.1 ± 0.90	0.05 ± 0.05	0.15 ± 0.08
Nov. 21	6.5 ± 1.08	1.05 ± 0.33	0.10 ± 0.07
Nov. 25	9.2 ± 0.92	0.65 ± 0.25	0
Nov. 29	22.1 ± 2.41	1.30 ± 0.29	0.10 ± 0.07
Dec. 02	4.4 ± 0.56	0.70 ± 0.25	0
Dec. 07	12.8 ± 1.37	2.40 ± 0.70	0
Dec. 09	15.6 ± 2.38	0.95 ± 0.22	0
Dec. 13	5.3 ± 1.17	0.45 ± 0.15	0
Dec. 16	6.5 ± 0.76	0.05 ± 0.05	0.10 ± 0.07
Dec. 21	7.2 ± 1.55	0.55 ± 0.15	0
Jan. 06	2.8 ± 0.55	0	0.10 ± 0.07
Jan. 12	1.3 ± 0.34	0.30 ± 0.15	-
Jan. 18	3.7 ± 0.96	0.20 ± 0.13	-

[1] Mean based on 10 samples

[2] Mean based on 20 samples. Rice was planted during the first week of Nov.

[3] The trap was made of 50 cm x 30 cm plywood and held 50 cm aboveground by affixing it to a wooden strip. The sticky substance "Verniz pega - poeira" was applied on both sides of the board.

Cerro Porã and Cristalina farms with the objective that more detailed population fluctuations would be revealed. However, the number caught in sticky traps and the sweepings were similar indicating that no extra advantage was obtained with use of the traps.

Despite of heavy populations in the bordering pastures, very few adults were found in the rice fields when the plant height was about ≤ 20 cm (Tables 1 to 5). This is good because for the same level of the bugs, the younger plants manifest far more damage than the older plants (Barbosa et al. 1983).

In the survey reported in the previous section, one rice field had as many as 36 adults/10 sweeps, when the adjoining pasture had only 47 adults (Table 1). Therefore, we expected to find heavy populations in rice fields (Tables 2 to 4). However, the maximum number of adults found was 11, despite the presence of 86 adults in the adjoining pasture (Table 4). Thus, if and when the spittlebugs will enter rice fields is unpredictable. We assumed that the majority of spittlebugs entering rice are from the adjoining pasture. It is likely that the adults from nearby pastures also enter rice.

Within field mathematical distribution of spittlebugs

In the 11 fields where the entire field areas were divided in plots of 40 m x 30 m, the values of variance (s^2) were always greater than the respective means (Table 6). Also, in general, the counts tended to fit the negative binomial model at the lower insect densities and Poisson at higher densities. Especially at densities > 10 adults/10 sweeps, every plot tended to have some adults. Thus, at least in fields of up to 15 ha, control measures such as insecticide application would probably be necessary in the entire area.

Preference for plants of different heights

Table 7 shows that spittlebugs preferred rice field with taller rice plants rather than the adjoin-

TABLE 4. Mean number of spittlebugs in samples of 10 sweeps of a sweep net ± SE, in adjoining pasture and rice fields, Santa Ana farm, Dourados, MS, 1984[1].

Sampling date	Location 1		Location 2		
	Decumbens	Rice	Decumbens	Colonião	Rice
Jan. 17	66.2 ± 6.40	1.5 ± 0.43		4.2 ± 1.34	0.2 ± 0.13
Jan. 23	80.5 ± 5.80	5.7 ± 0.51	85.8 ± 4.90	7.9 ± 0.92	10.7 ± 1.22
Jan. 26	88.8 ± 8.02	7.9 ± 1.82	95.8 ± 7.92	19.0 ± 1.44	10.4 ± 1.38
Jan. 31	19.1 ± 3.53	0.5 ± 0.27	23.3 ± 3.12	3.4 ± 0.95	3.2 ± 0.96
Feb. 03	11.1 ± 1.17	0.9 ± 0.28	26.9 ± 1.45	5.5 ± 0.31	10.3 ± 1.43
Feb. 09	6.0 ± 0.96	0.2 ± 0.13	6.5 ± 1,34	1.8 ± 0.53	1.5 ± 0.22
Feb. 16	4.2 ± 0.61	0.2 ± 0.13	10.4 ± 1.82	1.7 ± 0.50	3.2 ± 0.61
Feb. 23	6.4 ± 1.49	0	35.3 ± 5.75	0.6 ± 0.22	3.6 ± 0.73
Feb. 27	3.4 ± 1.04	0	45.5 ± 5.72	1.5 ± 0.37	7.6 ± 0.58
Mar. 02	3.7 ± 0.73	0	19.8 ± 3.14	0.8 ± 0.25	3.5 ± 0.50
Mar. 08	17.3 ± 0.75	0.4 ± 0.16	30.7 ± 1.78	2.9 ± 0.46	2.9 ± 0.77
Mar. 13	19.2 ± 1.62	0.3 ± 0.21	36.3 ± 2.93	1.5 ± 0.48	2.5 ± 0.43
Mar. 15	-	-	28.1 ± 2.09	0.7 ± 0.21	3.5 ± 0.97
Mar. 29	-	-	25.3 ± 3.09	1.5 ± 0.27	0.8 ± 0.36
Apr. 03	-	-	29.6 ± 2.11	1.3 ± 0.34	1.1 ± 0.38
Apr. 09	-	-	11.9 ± 1.33	0.5 ± 0.22	0.1 ± 0.10
Apr. 11	-	-	8.4 ± 1.27	0.4 ± 0.22	1.1 ± 0.31
Apr. 18	-	-	8.6 ± 1.09	0.5 ± 0.17	0.1 ± 0.10

[1] The pasture of *Brachiaria decumbens* was one continuous field. The distance between "decumbens" at the two locations was about 250 m. On Jan. 17, the rice plants at the Location 1 had mean height of 35 cm and at Location 2. 15 cm. Sampling was terminated when the rice panicles were visible entirely. Each mean is based on 10 samples.

TABLE 5. Population of spittlebugs in pasture of *Brachiaria humidicola* and the adjoining rice field, Anaurilândia, MS, 1983.

Sampling date	No. spittblebugs/10 sweeps of a sweep net ± SE in[1]	
	Pasture	Rice
Nov. 17	56.2 ± 4.12	1.3 ± 0.50
Nov. 21	18.5 ± 2.13	3.9 ± 0.80
Nov. 24	7.4 ± 0.92	1.8 ± 0.70
Nov. 29	5.3 ± 1.05	0.7 ± 0.28
Dec. 01	3.2 ± 0.46	0.2 ± 0.13

[1] Mean based on ten samples. On Nov. 17 rice plants had mean height of 10 cm.

ing field with shorter plants. In the screenhouse, the adults preferred taller plants also. The number of adults found on plants of 18 cm height was 0.87 ± SE of 0.19, 1.12 ± 0.41 on 35 cm plants and 4.50 ± 0.64 on 55 cm plants.

The data indicated about the possibility of use of "trap crop". A few rows of the rice encircling the entire field could be planted two to three weeks before the entire planting. Adults would prefer the taller plants, and thus these encircling rows only may be subjected to control method such as use of insecticide. The use of trap crop merits field evaluation.

The adults showed preference for pasture in comparison with rice and corn plants. The number of adults found on pasture, rice and corn were 3.0 ± 0.49, 0.93 ± 0.26 and 0.78 ± 0.22, respectively. Because spittlebug adults are capable of flights of about 1/2 km or more the use of nongraminaceous crops such as cotton or soybean as a barrier between pasture and corn or pasture and rice would probably be impracticable.

Eggs and nymphs in rice fields

The number of eggs found in the four fields sampled were 0.75 ± 0.45, 1.08 ± 0.43, 2.08 ± 1.06

TABLE 6. Mean number of spittlebug adults in samples of ten sweeps of a sweep net in entire rice fields and mathematical distribution, characteristics of the counts, Mato Grosso do Sul, 1983-84.

Sampling date	Height of rice plants (cm)	No. of 40 m x 30 m plots sampled	$\bar{x}$ no. of adults/ 10 sweeps ± SE	s^2	Index of aggregation (k)[1]	Index of dispersion (ID)[2]	Distribution fits[3]	
							Poisson	Negative binomial
Nov. 09	39	68	1.9 ± 0.22	2.9	3.3	105		V
Jan. 27	-	80	1.9 ± 0.21	6.9	0.7	288		V
Nov. 09	39	15	2.5 ± 0.64	5.3	2.2	30		V
Nov. 09	65	80	3.4 ± 0.38	5.0	7.8	114	V	V
Nov. 24	52	104	3.7 ± 0.22	5.1	9.2	144	V	V
Nov. 09	38	44	4.8 ± 0.72	9.3	5.2	84	V	
Nov. 24	46	16	5.2 ± 0.65	6.8	16.4	20	V	
Nov. 23	52	119	8.9 ± 0.54	35.2	3.0	465		V
Jan. 23	27	10	10.7 ± 1.42	16.4	20.0	15	V	
Nov. 18	41	10	19.9 ± 1.83	30.8	36.5	14	V	
Nov. 18	30	10	35.6 ± 3.21	99.6	19.8	25	V	

[1] $k = \frac{\bar{x}^2}{s^2 - \bar{x}}$

[2] $ID = \frac{s^2 (n-1)}{\bar{x}}$

[3] In deciding the distribution fit, both the k and ID values were considered.

TABLE 7. Spittlebug preference for the adjoining rice fields with different plant heights, Dourados, MS, 1983.

Location	$\bar{x}$ plant height (cm)	No. of adults/10 sweeps of a sweep net ± SE[1]	$\bar{x}$ plant height (cm)	No. of adults/10 sweeps of a sweep net ± SE[1]
1	20	6.4 ± 0.58	30	19.0 ± 1.14
2	19	0.5 ± 0.21	34	5.0 ± 1.57
3	26	0.5 ± 0.26	43	10.5 ± 2.33
4	26	0.5 ± 0.21	45	13.5 ± 1.88

[1] Mean based on 10 samples.

and 19.08 ± 4.56 per 10 cm of rice row. Of the 25 rice fields examined for the nymphs, only one field had nymphs on rice plants. Although nymphs were found in some rice fields, they were on the weed grasses. Despite of the presence of eggs in the rice fields, the absence of nymphs was surprising. Even the four fields sampled for eggs did not have any nymphs. Thus, generally, the spittlebugs are created in pastures and the insects fly to rice fields. Therefore, to reduce or eliminate the spittlebug problem in rice, they should be controlled in pastures.

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