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Entomology

Entomology research during 1981 continued to pursue the following main objectives:

a) To systematically evaluate the germplasm bank for plant materials tolerant or resistant to insect pests;

b) to study insect taxonomy, biology and population dynamics of the most important pests, and

c) to evaluate germplasm included in regional trials for insect damage in various ecosystems.

Basically, the Section continued studies on the stemborer, still considered the most important pest of the genus *Stylosanthes*; on spittlebug, the most important pest of several grasses; it completed studies on population fluctuations of the false army worm and yellow aphid on grasses. It also initiated studies on the components of natural biological control of spittlebug and false army worm, especially in the Carimagua environment.

Pests of Legumes

Stemborer

Field evaluations have shown that most accessions of *Stylosanthes guianensis*, and some of *Stylosanthes capitata*, are badly affected by the stemborer *Caloptilia* sp. This pest causes yield reductions and makes the stems breakable under grazing, greatly affecting persistance of the legumes.

The legume *Stylosanthes* is still considered promisory by the Tropical Pastures Program. Thus, studies on the stemborer were continued to better understand resistance or tolerance observed in this genus to the stemborer attack. On the basis of previous studies, research was conducted this year to understand field resistance observed and to complete information concerning antibiosis reported in *S. capitata* species. Results have shown clearly that the antibiosis effect of *S. capitata* is affecting more the biology of the progeny coming from females reared on *S. capitata* substrate than progeny coming from males reared on *S. guianensis* substrate (Tables 1 and 1A).

Stem hardness, a characteristic of several *Stylosanthes* species, is considered an important resistance factor, which restricts the ability of the larvae to penetrate and bore the stem. A penetrometer was used to measure the degree of stem hardness, and this was correlated to percentage of stemborer infestation. Considering different ecotypes of *S. guianensis* and *S. capitata*, it could be shown that harder ones - those with more sclerenchyma -- present less stemborer damage. In

Table 1. Effect of food substrate on the biology of the stemborer *Caloptilia* sp.

Female from accessions	Male from accessions	Substrate	No. eggs	No. larvae	No. pupae	No. adults	Longevity (mean days)
S. guianensis CIAT 136	*S. capitata* CIAT 1019	*S. guianensis* CIAT 136	41	29	28	26	6.3
S. capitata CIAT 1019	*S. guianensis* CIAT 136	*S. guianensis* CIAT 136	25	18	17	16	5.0

Table 1A. Effect of food substrate on the biology of the stemborer *Caloptilia* sp.

S. guianensis CIAT 136	*S. guianensis* CIAT 136	*S. guianensis* CIAT 136	53	52	49	48	6.9
S. capitata CIAT 1019	*S. capitata* CIAT 1019	*S. capitata* CIAT 1019	16	8	7	2	4.3

contrast, softer ones -- those with less sclerenchyma layers -- suffer more stemborer damage, with a r^2 = .83 (Figure 1). These results are consistent with last year's results. This year, two-year data were completed from a series of experiments on the effect of management on stemborer incidence. Records have shown that the association *A. gayanus*-*S. capitata* is superior to *B. decumbens*-*S. capitata*. The parameters considered showed higher reduction in number of larvae per plant, percentage of infestation and length of tunnels (Table 2). Grazing reduced incidence of stemborer damage, suggesting good reduction in stemborer populations under field conditions in Carimagua (Table 3).

Budworm

Special emphasis was given to studies on oviposition preference of the budworm *Stegasta bosquella* (Chambers), considering *Stylosanthes* spp. and *Zornia* spp., the two genera most affected by this insect. These studies showed that the females oviposit according to the number of inflorescences available. Consequently, higher oviposition occurs in the outer parts of the branches which is where inflorescences are mainly found. Another study to determine the larval damage of *S. bosquella* in *S. capitata* showed that the estimated damage caused by an infestation of one larva/inflorescence was related to the seed production capability of the ecotype. In *Z. latifolia* this relation was not so evident probably because the seed production capability of the ecotypes under study is similar (Figures 2 and 3).

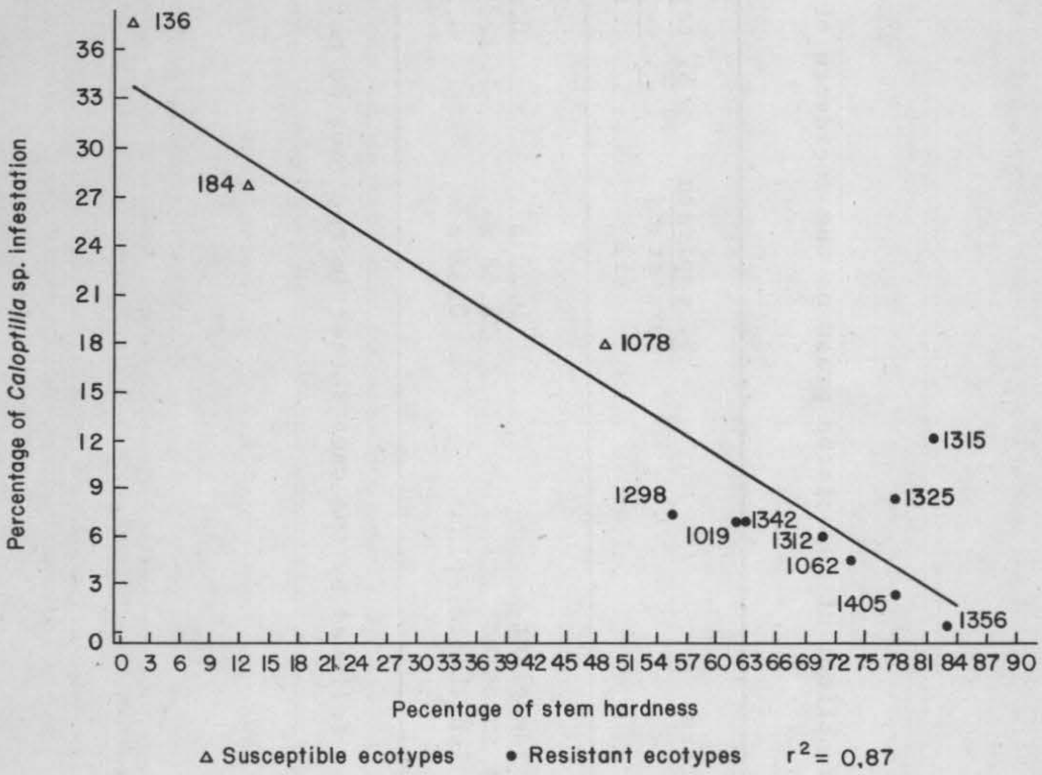

Figure 1. Relationship between percentage of stem hardness and percentage of stemborer infestation in *Stylosanthes* spp.

Table 2. Effect of associated grass on the incidence of stemborer *Caloptilia* sp. on *Stylosanthes capitata*.

Parameters	*S. capitata* pure stand (1)	*S. capitata* + *B. decumbens* (2)	*S. capitata* + *A. gayanus* (3)	% reduction 1-2	1-3
No. larvae/plant	0.20 a[1]	0.17 ab	0.14 b	15.0	30.0
% plant infested	28.68 a	22.51 b	21.57 b	21.3	24.8
Tunnel length (cm)/plant	0.32 a	0.29 ab	0.27 b	9.4	15.6

[1] Means followed by the same letter in the rows do not differ significantly at P = 0.05 level (Duncan).

Table 3. Effect of grazing on the incidence of stemborer Caloptilia sp. on Stylosanthes capitata.

Parameters	Ungrazed	Grazed	% reduction
No. larvae/plant	0.20 a[1]	0.14 b	30.0
% of infestation	25.64 a	22.87 b	10.8
Tunnel length (cm)/plant	0.33 a	0.25 b	24.2

[1] Means of the row followed by the same letter do not different significantly at P = 0.05 level (Duncan)

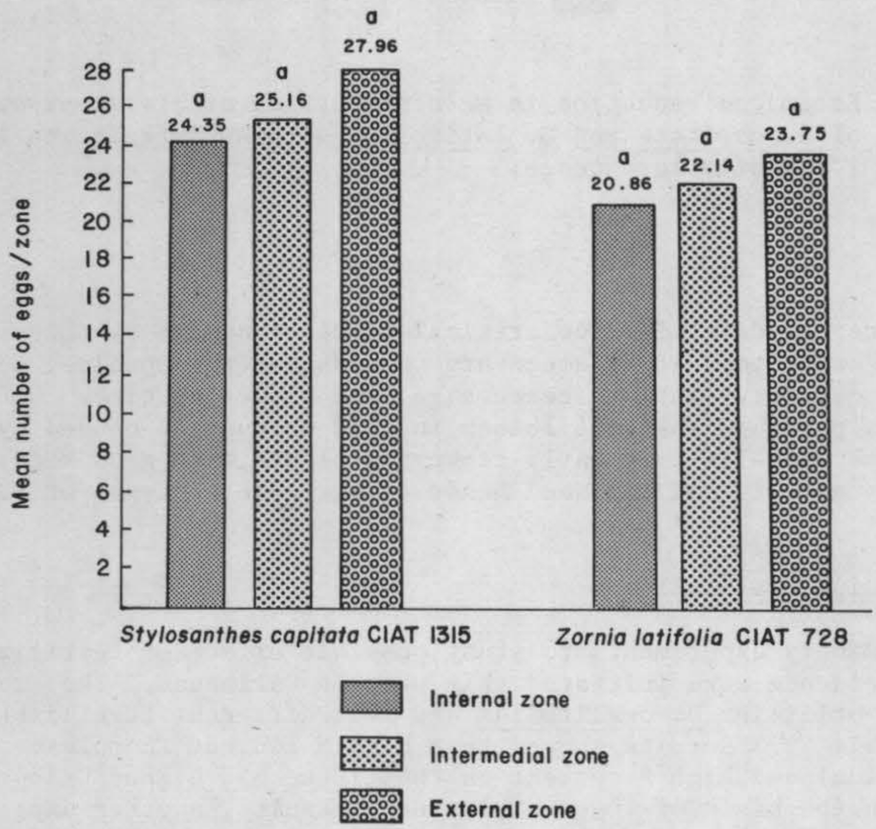

Figure 2. Oviposition preference of Stegasta bosquella (Chambers) on different conventional zones of branches of Stylosanthes capitata and Zornia latifolia plants.

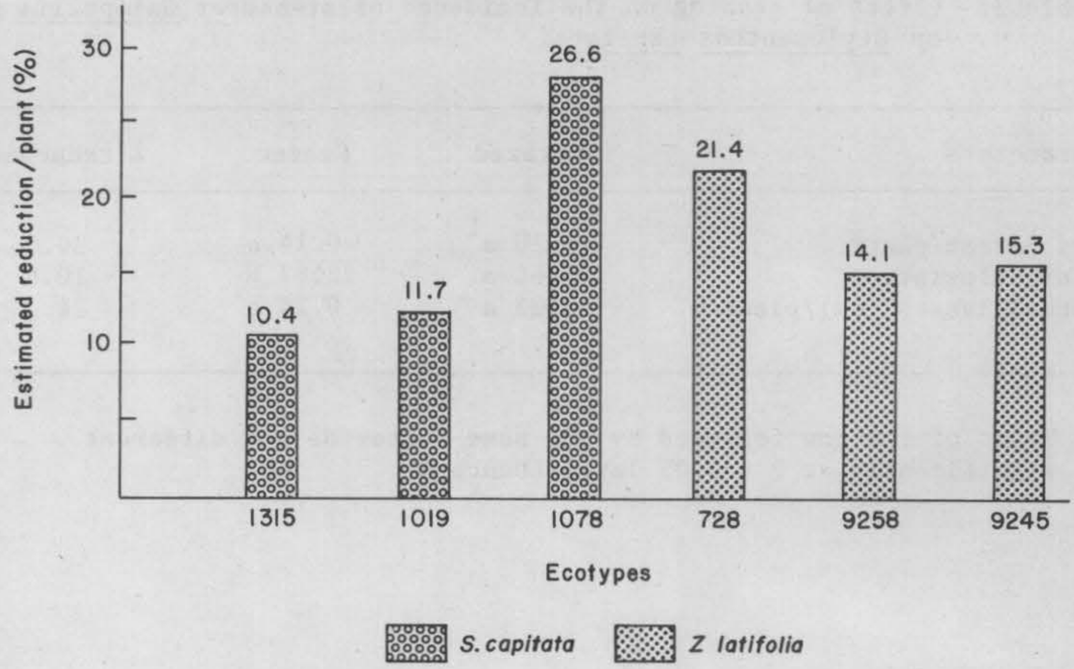

Figure 3. Estimated reduction in seed production of different ecotypes of S. capitata and Z. latifolia, with an infestation level of 1 larva/inflorescence.

In order to determine the critical level of damage of this insect in a given ecosystem, it is necessary to consider the species, seed production capacity, inflorescence size, and flowering time. On such basis it is possible that the losses in seed production caused by S. bosquella may be slight in early flowering plants with good seed production capacity and big seed heads (e.g., some ecotypes of S. capitata).

Desmodium ovalifolium

Preliminary experiments to study possible effect of fertilization on pest incidence were initiated this year in Carimagua. The experiment was set up utilizing D. ovalifolium and four different fertilization levels (Table 4). Results showed that high N content (complete fertilization) and high P content in the tissue had higher Crisomelidae damage. On the basis of these preliminary results, another experiment with promising plant material was set up in order to better understand the relationship between fertilization and disease and pest incidence.

Table 4. Differences in N and P content in foliage of D. ovalifolium with four fertilization levels and different degrees of Crisomelidae damage.

Nitrogen

Fertilization level	No damage	Damage Slight	Moderate	Severe
1	1.79 a[1]	1.74 a	1.75 a	1.80 a
2	1.74 a	1.71 a	1.67 a	1.77 a
3	1.71 b	1.74 b	1.71 b	1.82 a
4	2.18 b	2.13 b	2.05 b	2.28 a

Phosphorus

Fertilization level	No damage	Slight	Moderate	Severe
1	0.125 a	0.121 a	0.125 a	0.127 a
2	0.149 a	0.146 b	0.147 b	0.156 a
3	0.141 b	0.145 b	0.144 b	0.157 a
4	0.149 b	0.144 b	0.142 b	0.152 a

[1] Means followed by the same letter in the rows do not differ significantly (DMS; P = 0.05)

Pests of Grasses

Spittlebug (Zulia colombiana - Aeneolamia reducta)

During 1981, the attempt to characterize the damage of spittlebug at different stages of its life cycle was intensified. Research was conducted in Carimagua and Quilichao under controlled conditions. The experiments attempted to study the feeding preference of spittlebug nymphs in four grasses, and to characterize the damage of nymphs, adults and adults plus nymphs in three grasses: B. humidicola, B. decumbens and A. gayanus.

Results showed that adult damage is always more severe than nymph damage even when its mean adult population is less than the nymph population (Figure 4). B. decumbens showed the highest yield losses as well as numbers of dead plants. B. humidicola and A. gayanus presented lower yield losses. Recuperation (regrowth) in B. decumbens was slow (more than 90 days) while in B. humidicola it was fast due to its natural condition. In reference to A. gayanus, yield was affected although the spittlebug population was not high under this controlled situation (Figure 4). A general conclusion of this study is that B. decumbens is the most affected grass, being considered highly susceptible to spittlebug. B. humidicola is tolerant, being able to support high insect populations during long periods. Because of its ability to produce new shoots rapidly, this grass is able to recover from spittlebug attack.

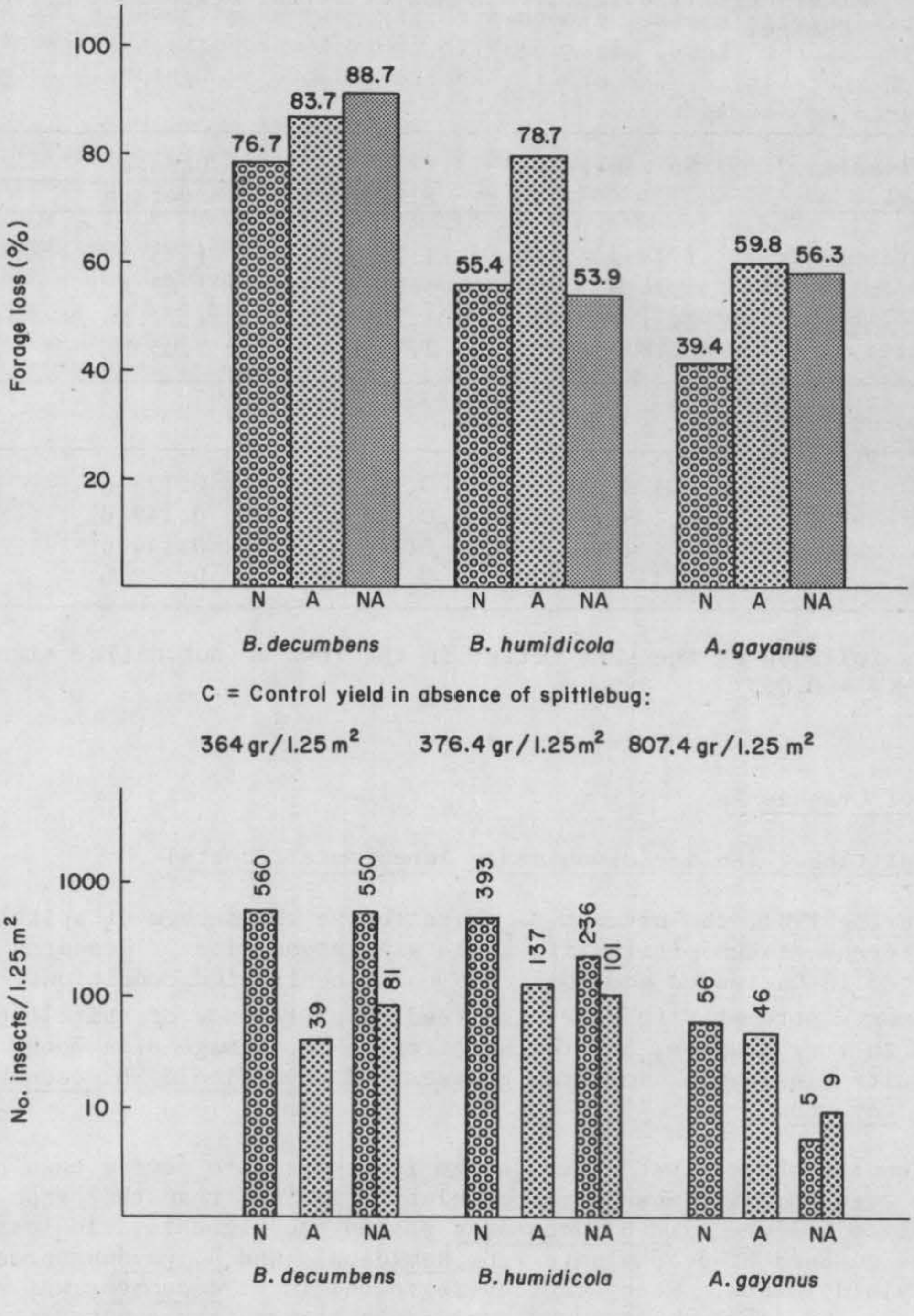

Figure 4. Forage losses of three grasses (above) caused by high infestation levels of Nymphs (N), Adults (A) and Nymphs and Adults (NA) of spittlebug Zulia colombiana, under controlled conditions. Mean number of insects found per treatment (below).

In contrast, A. gayanus is presently considered a bad host to the spittlebug. This is possibly due to its growth habit which is defined as erect, forming compact clumps with its many stems, and/or the hairy condition of the stems, especially in their lower part. As a result of these characteristics and others, the resistance mechanism in A. gayanus is defined as antixenosis.

Feeding preference studies of spittlebug nymphs have shown B. humidicola as the most preferred and A. gayanus the least preferred (Figure 5). These results are in agreement with results of field evaluations (insect infestation) of several grasses from the germplasm bank. During this year preliminary studies were carried out with four grasses, B. decumbens, B. humidicola, B. ruziziensis and A. gayanus. The internal structure of stems and their degree of hardness was studied in an attempt to find an explanation for the degree of susceptibility, resistance and/or tolerance to spittlebug damage.

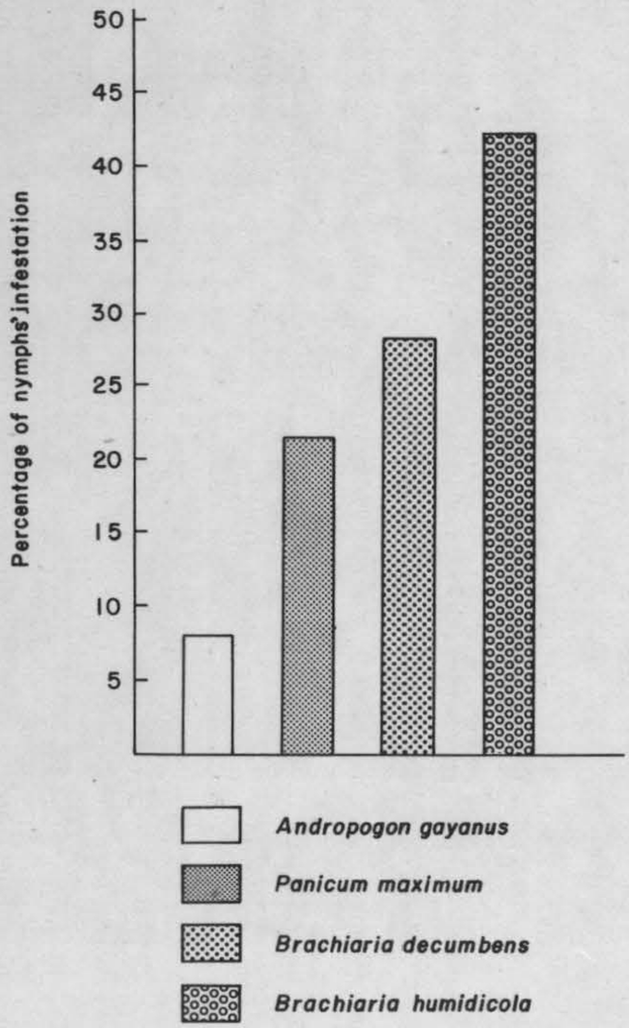

Figure 5. Feeding preference of nymphs of spittlebug Zulia colombiana in four different grasses.

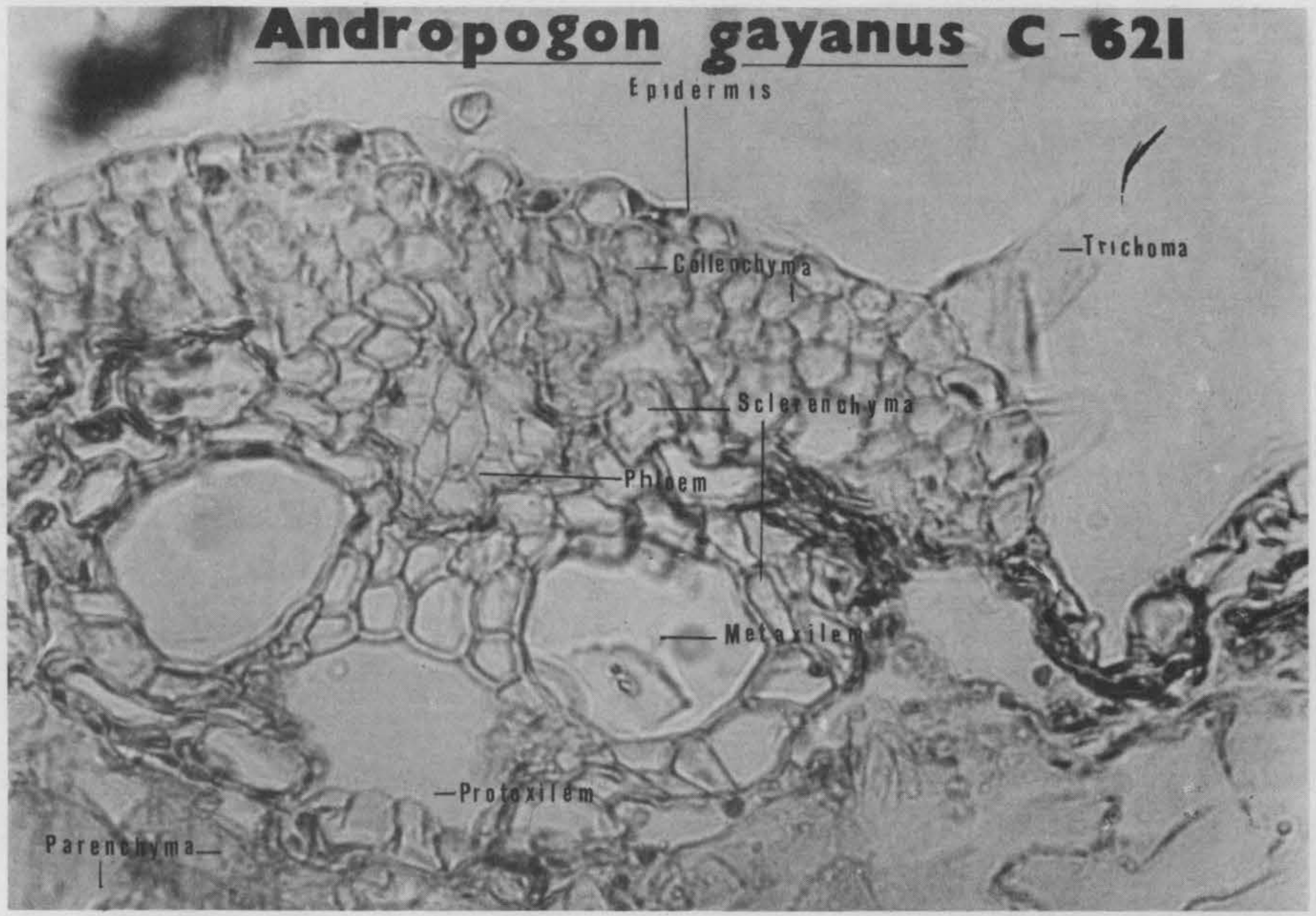

Figure 6. Transverse section of the stem of A. gayanus at 10 weeks of age.

The thickness of the sclerenchymatous tissue was measured. It is composed by lignified cells which make the stems harder and also give good protection to the vascular bundle. Results showed (Figure 6) that A. gayanus has those characteristics in contrast to the Brachiaria species studied. In addition, A. gayanus presents several leaf sheaths around its erect stems that make it difficult for young nymphs to feed on them.

Field surveying of grasses across Colombia has continued in order to understand one of the most important natural biocontrol agents of the spittlebug (Table 5). In collaboration with the Plant Pathology Section, pathogenicity of eight native strains of Metarhizium spp. have been tested using nymphs and adults of Zulia colombiana. Preliminary results indicate that under controlled conditions it is possible to obtain 100% control of nymphs and adults. The importance of this finding is that it may be possible to help natural environment by spraying useful entomogenous fungi to reduce spittlebug populations.

Table 5. Pathogenicity of different isolates of Metar hizium spp. on nymphs and adults of Zulia colombiana.

Isolate	Origin	Host	Pathogenicity	
			Nymphs	Adults
B 1	Belize	Aeneolamia spp. - adult	50	100
E 59	Brazil	Deois spp. - adult	50	83
CAR 1	Colombia	Aeneolamia reducta - adult	-	100
CAR 2	Colombia	Soil - Carimagua	16	-
CAR 3	Colombia	Aeneolamia reducta - nymph	33	83
CAR 4	Colombia	Aeneolamia reducta - nymph	83	33
CAR 5	Colombia	Aeneolamia reducta - nymph	33	50
CAR 7	Colombia	Mocis latipes - larva	100*	100*
QUIL 8	Colombia	Zulia colombiana - adult	33	16

* Native strain highly pathogenic to different stages of spittlebug

Life cycle studies of the spittlebug Zulia colombiana have been completed (Figure 7), and studies continue of a nematode which affects nymphs and adults.

Yellow aphid

Studies on population dynamics of this insect continued. Figure 8 shows population fluctuations in A. gayanus in Carimagua. Aphid population increases rapidly with the first showers, reaching peak numbers when the heaviest rainfall occurs (May, June, July). At the end of the wet season, the population begins to decrease reaching the lowest numbers during the dry season. It was found that a high stocking rate

(4.4 animals/ha) during June, July and August gave good control of aphids in comparison with the lower stocking rate (2.2 animals/ha) (Figure 9).

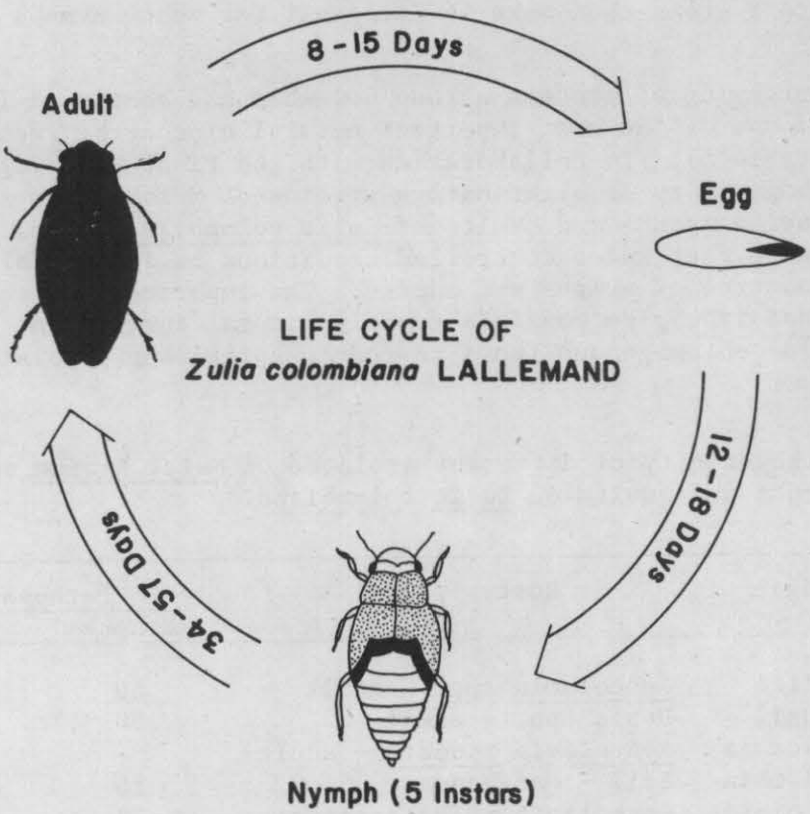

Figure 7. Life cycle of Zulia colombiana Lallemand.

Also the effect of burning of A. gayanus during the dry season (January) on aphid population was studied. This practice kept the A. gayanus paddock practically free of aphid infestation during the year, in comparison with other practices studied (Figure 10). However, burning should be considered carefully when the grass is associated with a legume.

Germplasm Evaluation

Evaluation of entries in Categories I, II and III, as well as in regional trials, continued during the year. As in the past, emphasis was placed on the most important insect groups already defined as a) chewing and b) sucking insects. As a result of the systematic evaluation of germplasm, the most important groups affecting plant material in different ecosystems have been defined (Table 6). Based on insect-plant interaction during the wet season, and in order to better approach the evaluation system, different evaluation schedules of legume

Table 6. Importance of different groups of insects* in relation to damage caused on legumes and grasses in various ecosystems.

Ecosystem	Stylosanthes spp.	Zornia spp.	Centrosema spp.	Desmodium spp.	Pueraria spp.	Andropogon spp.	Brachiaria spp.
Brazil (CPAC)	SI +++	SI +	SI +				SI +++
Well-drained isothermic	CI +++	CI +++	CI ++	CI ++	CI +++		
savanna-Cerrado	SB +						
	BW +	BW +					
Carimagua	SI +++	SI +++	SI +++				SI +++
Well-drained	CI +	CI +	CI ++	CI ++	CI +++	CI +	FBC ++
isohyperthermic	SB +	LM +				A +	
savanna-Llanos	BW +	BW +					
Venezuela	SI +++	SI +++					SI +++
(El Tigre)	CI ++	CI ++	CI +++				
Well-drained	SB +	SM +++					
isohyperthermic	BW +						
savanna-Llanos							
Peru (Pucallpa)	SI +++	SI +++					SI +++
Seasonal semi-evergreen forest	CI +++		CI +++	CI +++	CI +++		FBC +

* SI = sucking insects; CI = chewing insects; SB = stemborer; BW = budworm; FBC - flea bettle (Rasper); LM = leaf miner; A = aphids; SM = spider mites

germplasm were defined: An intensive one at the end of the wet season; two during the dry season, one when the soil is still moist, and the other in the middle of the dry season. This is based on the necessity to have a better understanding of plant performance when plants go into the dry period stress, during which, according to the strategy of the Program, the animal is supposed to utilize the legume as the main source of protein. In this way the Section expects to be able to better appreciate in the future the losses caused by insect damage during this critical period of the year.

Preliminary estimations were done of losses caused by chewing insects (Crisomelidae) in five forage legumes, S. capitata, Z. latifolia, Centrosema pubescens, Desmodium ovalifolium and Pueraria phaseoloides (Table 7). Results showed that the estimated losses for each level of damage in the different legumes under evaluation were very variable among plant species and with respect to leaf-stem ratio and the time when the estimation was made. Further studies will be done to improve this new methodology.

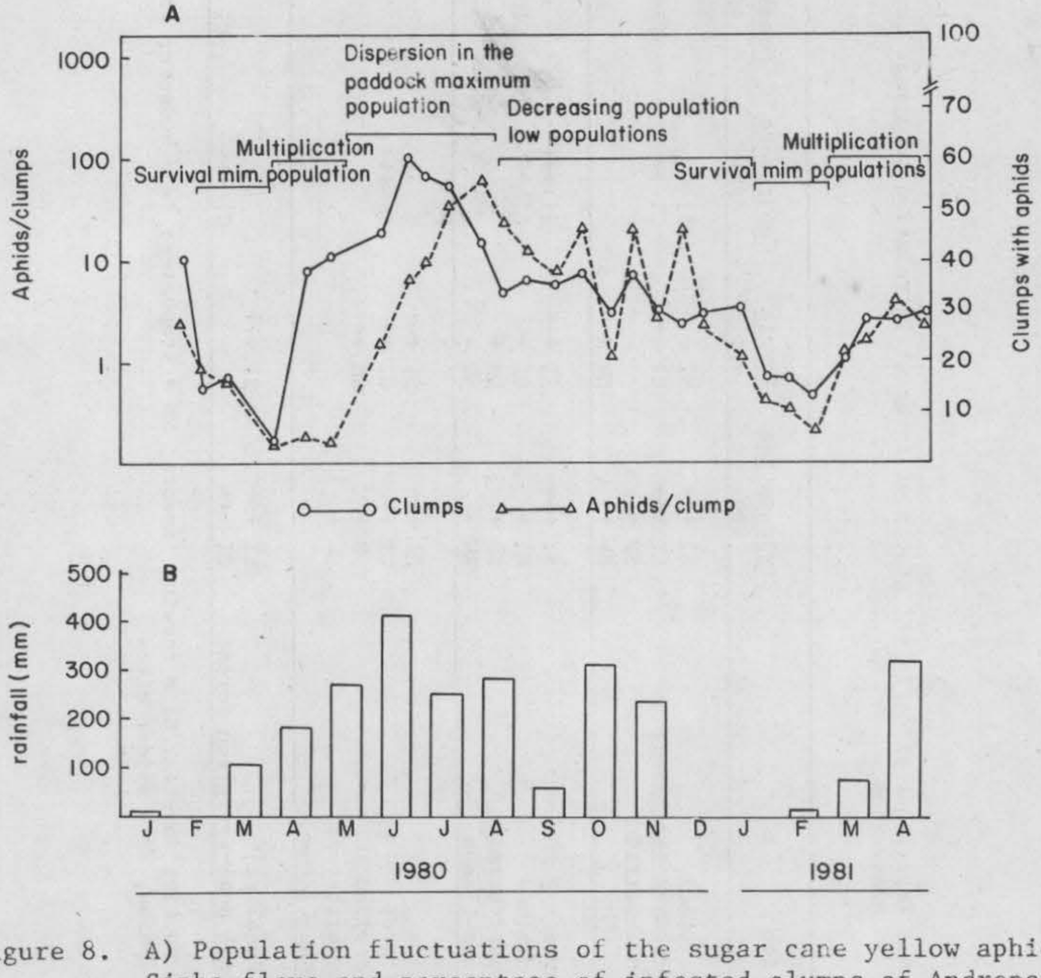

Figure 8. A) Population fluctuations of the sugar cane yellow aphid *Sipha flava* and percentage of infested clumps of *Andropogon gayanus*, Carimagua 1980-1981.
B) Rainfall (mm) during the same period.

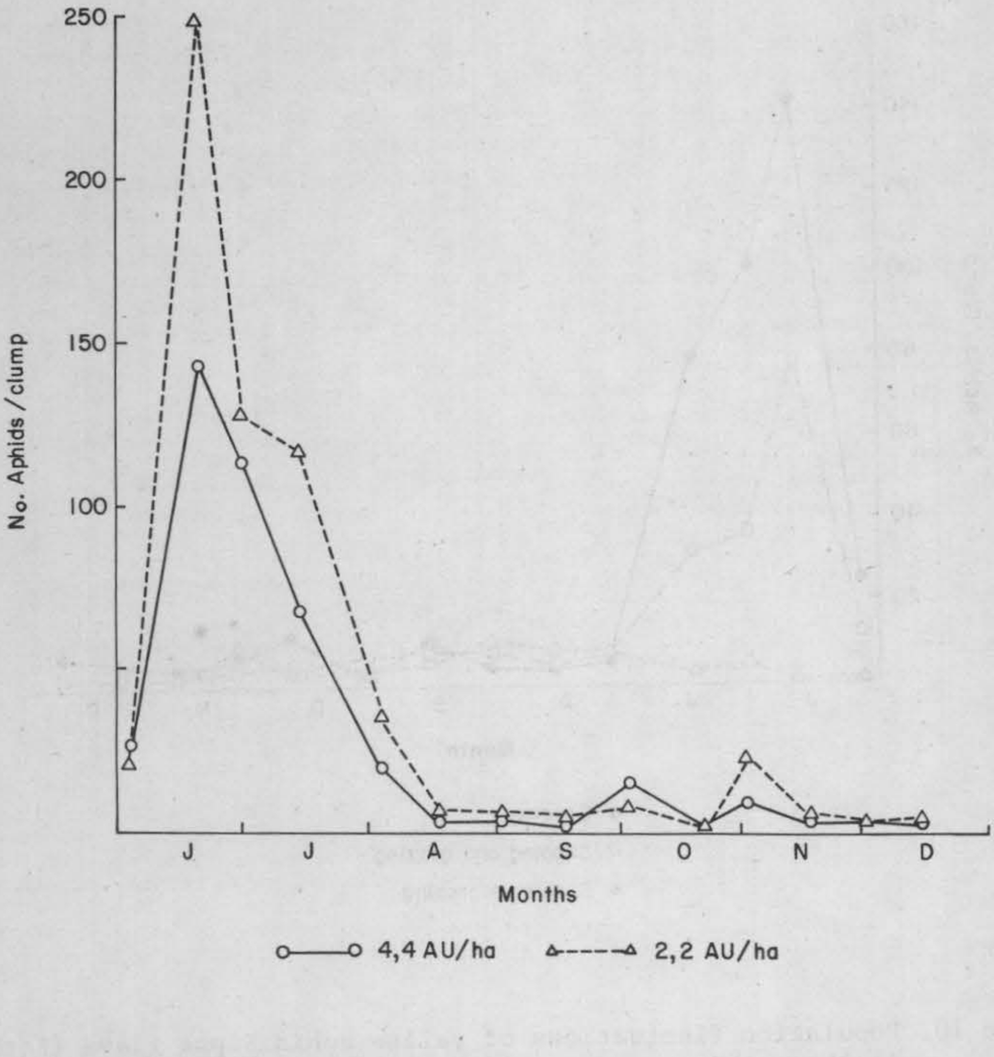

Figure 9. Population fluctuations of yellow aphid <u>Sipha flava</u> (Forbes) in two <u>A</u>. <u>gayanus</u> paddocks, submitted to two different stocking rates.

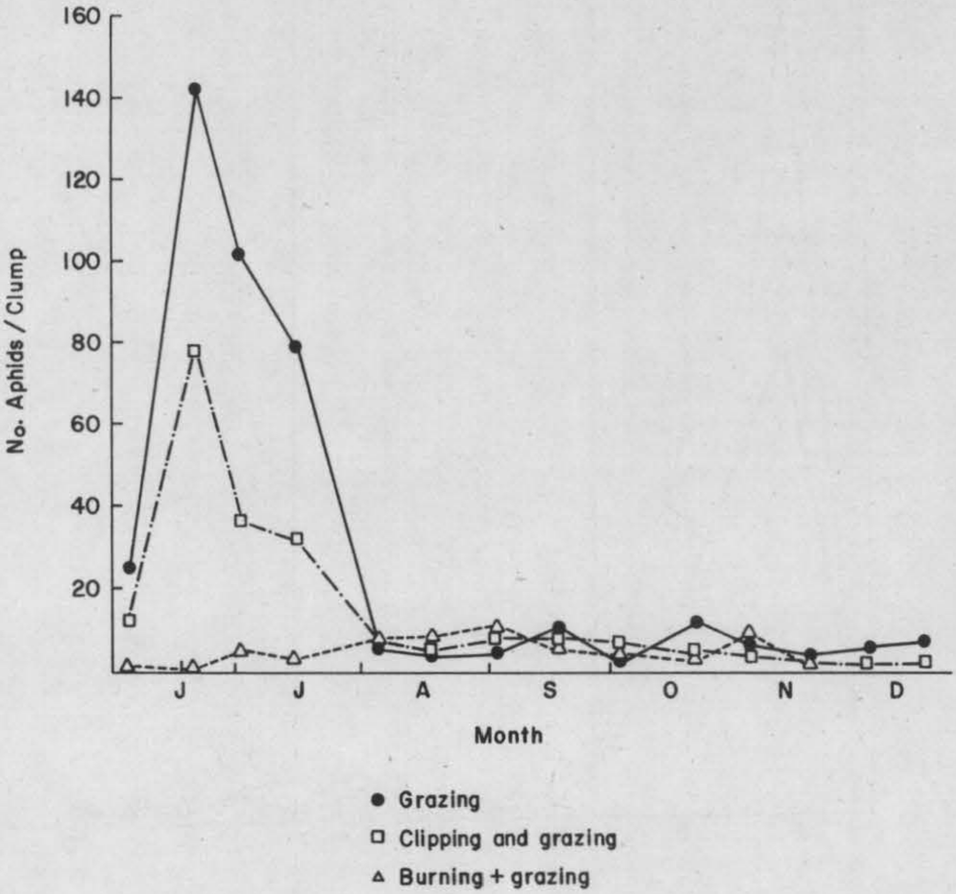

Figure 10. Population fluctuations of yellow aphid Sipha flava (Forbes) in three Andropogon gayanus paddocks under different managements.

Table 7. Damage categories used in evaluating chewing insect damage (Crisomelidae) and estimating final yield reduction of five forage legumes.

Degree of damage	1 - No damage		2 - Slight		3 - Moderate		4 - Severe	
% foliar area damaged	0.0		>0-10		>10-20		>20	
final yield reduction	(kg DM/ha)	(%)	(kg DM/ha)	(%)	(kg DM/ha)	(%)	(kg DM/ha)	(%)
S. capitata	0.0	0.0	>0- 85.4	>0-3.3	> 85.4-170.9	>3.3- 6.6	>170.9	> 6.6
Z. latifolia	0.0	0.0	>0- 51.1	>0-3.1	> 51.1-102.2	>3.1- 6.2	>102.2	> 6.2
D. ovalifolium	0.0	0.0	>0-159.8	>0-5.3	>159.8-319.7	>5.3-10.6	>319.7	>10.6
C. pubescens	0.0	0.0	>0-135.4	>0-6.4	>135.4-270.9	>6.4-12.8	>270.9	>12.8
P. phaseoloides	0.0	0.0	>0-199.8	>0-7.9	>199.8-399.7	>7.9-15.8	>399.7	>15.8