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## OBSERVATIONS ON SOME INSECTS ASSOCIATED WITH SUGARCANE IN PUERTO RICO

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In connection with investigations carried on by the Bureau of Entomology and Plant Quarantine in Puerto Rico with special funds from August 1935 to June 1936 to obtain information on insects which transmit sugarcane diseases, surveys were made to secure data on the status and distribution of the insects in and around sugarcane fields, with special reference to those forms which feed on the juices of plants. The work was headquartered at the Federal Experiment Station at Mayagüez, which cooperated by supplying laboratory and other facilities and giving helpful suggestions and advice. This paper reports results of these surveys.

The sugarcane insects of Puerto Rico were listed by D. L. Van Dine (10) in 1913, with a review of earlier work. This list was supplemented by later observations on cane insects made by Jones (4, 5), Smyth (9), Wolcott (12), and Seín (7). Wolcott has published a general list of Puerto Rican insects (15) and a textbook including chapters on cane insects of the West Indies (14). The cane insects of Santo Domingo have been listed by Wolcott (13) and those of Cuba by Van Dine (11). Insects in relation to cane mosaic in Puerto Rico have been discussed by several writers, especially Smyth (8). Chardon and Veve (1), and Seín (6).

In the present survey the greatest attention was paid to those sucking insects which might conceivably transmit mosaic disease. Three species were noted as occurring regularly on cane, viz, the yellow cane aphid, *Sipha flava* Forbes; the mealybugs, mostly *Trionymus sacchari* Ckll.; and the fulgorid *Saccharosydne saccharivora* Westw. Three additional aphids were carefully observed because these were occasionally found on cane or because they were suspected of transmitting mosaic disease. These were *Aphis maidis* Fitch, *Hysteroneura setariae* Thos., and *Carolinaia cyperi* Ainslie. Other

insects were observed incidentally, and observations were made on grasses which harbor some of these insects.

A few ecological details may be recorded for the benefit of those not familiar with Puerto Rico. The climate is tropical. The rainy season sets in late in the spring in most sections, reaches its height late in the summer or early in the fall, and declines late in the fall. The winter and early spring months comprise the dry season. This year (1935-1936) the drought was unusually pronounced, and the rainy season began suddenly at Mayagüez about May 1 with heavy and frequent rains. The north coast shows a moderate rainfall, 50 to 60 inches a year in many places. The interior mountains and the east, west, and northeast coasts have a high rainfall, 80 inches or more. The south coast has a comparatively low rainfall, 40 inches or less, and here cane is produced under irrigation. Nearly all the sugarcane is grown on the coastal plain or in valleys reaching toward the interior, practically none occurring in the central mountains. Some of the areas of most intensive cane culture are located in the southern irrigated part. The cane is harvested from January to May.

Two systematic extensive surveys of the cane-growing areas of the island were made, one in the fall of 1935, the other in the spring of 1936, the localities examined being indicated on the map (fig. 1). Other field observations were made occasionally, and an intensive survey was conducted at the experiment station at Mayagüez each month that other work permitted.

#### THE INTENSIVE SURVEY

The intensive survey at the experiment station included examination of cane varieties, grasses, and sedge. Six cane varieties, of some commercial importance, were growing in large replicated plats, and these were observed regularly; these were POJ 2878, M 28, M 63, FC 916, PR 803, and PR 807. Some small areas of old and new varieties were also available. Various grasses, *Panicum barbinode*, *Syntherisma*, *Capriola*, *Echinochloa colonum*, *Eleusine indica*, *Andropogon virgatus* (tent. det.), and *Cyperus rotundus* (a sedge), were common not only at Mayagüez but all over the island; while some other grasses occur but are less common. Corn is found growing at the experiment station at most times of the year. Over most of the island it is grown in small fields in either spring or fall. A small plot of sorghum grew at the experiment station, but this species is rare on the island.

The most noteworthy results of this survey are shown in table I.

TABLE I. RESULTS OF INTENSIVE SURVEY OF SUGARCANE INSECTS AT THE EXPERIMENT STATION AT MAYAGUEZ, P. R. 1935-36

Insect	Plant	Percentage infested in month of--								
		August	Nov.	Dec.	Jan.	Feb.	March	April	May	June
<i>Aphis maidis</i> .....	Corn, tasseled.....	some.....	26	26	14	15	20	8	40	.....
	Sorghum.....	some.....	82	54	58	26	48	16	52	66
	<i>Panicum barbinode</i> , field.....	few.....	1-	3	1-	0	1	0	1	.....
	<i>Panicum barbinode</i> , moist ditch.....	.....	.....	.....	.....	8	8	6	2	.....
	<i>Echinochloa colonum</i> .....	.....	3	4	0	0	0	0	8	.....
<i>Hysteronneura setariae</i> .....	Sugarcane.....	very few..	0	0	0	0	0	0	1-	0
	<i>Eleusine indica</i> .....	few.....	4	7	12	8	8	19	3	0
	<i>Panicum barbinode</i> .....	.....	0	1	6	1	8	1	5	.....
	<i>Syntherisma</i> .....	.....	0	6	4	11	2	3	0	.....
	<i>Echinochloa colonum</i> .....	.....	2	8	4	8	2	0	0	.....
<i>Sipha flava</i> .....	Sugarcane.....	0	0	0	0	1-	0	1-	0	.....
	Sugarcane.....	many.....	8	6	14	15	34	65	57	11
	<i>Chaetochloa setosa</i> .....	.....	18	10	10	4	16	22	12	.....
	<i>Syntherisma</i> .....	.....	1	0	1	1	4	2	5	.....
<i>Carolinaia cyperi</i> .....	<i>Cyperus rotundus</i> .....	.....	25	10	28	21	1	1-	0	0
	Sugarcane.....	.....	1	1-	1-	2	1-	1-	1-	0
<i>Saccharosydne</i> .....	Sugarcane.....	few.....	.....	.....	.....	.....	.....	.....	.....	.....
Mealybugs.....	Sugarcane.....	some.....	10	27	35	43	some....	some....	12	.....
	Sorghum.....	.....	42	74	70	(cut) ...	some....	40	36	.....

(In most cases the stalk or stem was the unit counted; in the cases of *Eleusine* and *Cyperus* the whole plant was the unit taken. Most of the percentages for sugarcane represent several hundred units; from 50 to 100 samples of other plants were examined.)



The results of the survey on a number of cane varieties were recorded separately, but these details are omitted for the sake of brevity. Only a few varietal differences were encountered. The cane variety POJ 2878 had heavier mealybug infestations than other varieties, PR 803 showed somewhat greater populations of *Sipha flava* than others, and the unimportant variety M 505 was outstandingly susceptible to *Sipha flava*.

Mosaic disease was not an important factor around Mayagüez, since nearly all cane grown there was of highly resistant varieties. The few small areas of susceptible varieties seen were considerably infected, and mosaic-like symptoms were noted on crabgrass and sorghum. Sugarcane borers (*Diatraea* sp.) were present at all times, but only in moderate numbers; the variety PR 807 was most consistently infested.

Mealybugs (*Trionymus sacchari*) seemed rather scarce on young cane, and were difficult to find without uprooting the plants. On older cane they were more numerous and located higher on the plants, under the sheaths. Dead mealybugs covered with fungus were sometimes seen, especially in rainy weather. *T. sacchari* was also found on sorghum. Another mealybug, *Pseudococcus brevipes* Ckll., was seen occasionally on crowns of *Panicum barbinode*, *Eleusine indica* and *Cyperus*, and once on corn. Root insects were not included in the survey.

In addition to these records, *Aphis maidis* was seen occasionally on untasseled corn, a few times on *Coix lachryma-jobi*, *Pennisetum purpureum*, and *Gynerium sagittatum*, and once on *Chaetochloa setosa* and *Cyperus*. Only migrants of this aphid were seen on cane in the field, though at one time a colony occurred in a cage. The species was usually found on heads or terminals of plants, but sometimes on the leaves. It was found in greater numbers in cages or sheltered places than in the open. When numerous, *A. maidis* was attacked by parasites and predators. Parasites reared included *Lysiphlebus testaceipes* Cress., *Pachyneuron siphonophorae* Ashm., and *Tetrastichus marylandensis* Gir. Predators included coccinellids and syrphids.

*Hysteroneura setariae* was found in small numbers a few times on *Paspalum conjugatum*, *P. paniculatum* (tent. det.), *Capriola dactylon*, *Panicum reptans* (tent. det.), *Andropogon virgatus* (tent. det.), *Sporobolus virginicus* (tent. det.), and *Gynerium sagittatum*. It was nearly always found on the heads of grasses, although sometimes stems or leaves were colonized, especially on *Eleu-*

*sine*. Colonies occurred on cane (on the auricle) in southern Puerto Rico, but not at Mayagüez. When abundant, this aphid was attacked by parasites, predators, and under damp conditions by a fungus (*Acrostalagmus aphidum* Oud.) Parasites reared included *Lysiphlebus testaceipes*, *Pachyneuron siphonophorae*, and *Aphidensyrthus aphidivorus* Mayr.

*Sipha flava* occurred on the leaves of its food plants, a reddish discoloration being associated with its feeding. Besides the plants noted in table I it was found a few times on *Panicum barbinode*, *P. maximum*, *Eleusine indica*, *Echinochloa colonum*, *Paspalum conjugatum*, and *P. paniculatum* (tent. det.), and one migrant was observed on corn. The species occurred on grasses in small numbers, but sometimes became numerous and injurious on sugarcane, 400 individuals once having been found on a single leaf. It was attacked by predators and a fungus (*Acrostalagmus*), but parasites were not seen in this work. Predators observed were a few syrphids and some coccinellids, including *Cycloneda Sanguinea* L. and a small black species.

*Carolinaia cyperi* was seen only on *Cyperus*, usually in small numbers, and no insect enemies were observed. *Saccharosydne saccharivora* was usually seen only on cane, but was once swept from grass, mostly *Panicum barbinode*.

Numerous other insects were encountered. Several aphid migrants, not yet determined, occurred on cane in May; some seemed to be from nearby citrus. Leafhoppers and fulgorids were frequently found on cane and grasses, but seemed in most cases to be transients. *Cicadella similis* Walker on *Panicum barbinode* and other grasses, *Delphacodes* sp. on *Echinochloa colonum*, *Peregrinus maidis* Ashm. on corn, and *Phaciocephalus cubanus* Myers on cane were especially noted. *Nesostelus incisus* Mats. was swept from grass, mostly *P. barbinode*; *Typhlocybella minima* Bak. and *Empoasca* sp. were swept from *Bradburya*; and *Empoasca* from indigo. Chinch bugs (*Blissus leucopterus* var. *insularis* Barber) occurred on grasses a few times. Ants, principally the fire ant, attended aphids, and were especially active around mealybugs. Snout beetles, caterpillars, scales, psocids, thrips, mites, and other organisms were noted in small numbers. *Chirotrips mexicanus* Crawf. was repeatedly noted in heads of *Eleusine indica*.

Aphids were determined by P. W. Mason, mealybugs by Harold Morrison, aphid parasites by A. B. Gahan, leafhoppers and fulgorids by P. W. Oman and H. L. Dozier, thrips by J. C. Crawford, and the fungus by Vera K. Charles.



## THE EXTENSIVE SURVEY

The first extensive survey was conducted in September and October 1935, late in the rainy season. The cane at this time was of medium to large growth. A field was selected at random in each of the 34 localities marked on the map (fig. 1). In each field 100 stalks were examined in 5 samples of 20 each, well distributed through the field. The results appear in Table II.

Insects were found much as recorded for the intensive survey. The borer *Diatraea saccharalis* F. was widespread and often injurious; it seemed somewhat more numerous in the south than elsewhere. *Hysteronura setariae* occurred on *Eleusine* near Aguadilla, Río Grande, Naguabo, Fajardo, Patillas, and on *Gynerium* at Guánica. *Aphis maidis* occurred in small numbers on *Panicum barbinode* near Isabela, Guayama, Naguabo, Fajardo; on *Gynerium* at Guánica; on corn near Loíza, Fajardo, Hatillo, Arecibo, Naguabo, Dorado, Isabela, and Juana Díaz; and on *Pennisetum* (elephant grass) near San Germán. *Sipha flava* was recorded once on corn, once on crabgrass, and once on an unknown grass.

The second extensive survey was conducted in March and April 1936, toward the end of an unusually severe dry season. Some fields were still unharvested, with stalks of large growth and dry lower leaves (classes as "large" in Table III). Some were fall-planted, of medium growth (rather large when irrigated, as in the south). Some were of new ratoon growth and rather small. Sampling was conducted as in the fall survey and approximately the same localities were selected, except that the one in San Sebastián and one in Cabo Rojo were omitted. The results appear in Table III.

Other insects were noted much as in the fall survey and the intensive survey. *Diatraea saccharalis* was widespread and somewhat injurious in places. It was more abundant in southern Puerto Rico and less abundant on the west coast than elsewhere. Little difference in its numbers could be noted between varieties or seasons. Chinch bugs were found once on a single stalk of cane at Humacao.

Aphids found on nearby plants included *Aphis maidis* on corn at San Germán and on *Panicum barbinode* at Guánica, Caguas, and Guayama. *Hysteronura setariae* occurred on *Eleusine* at Carolina, Yabucoa, Guayama, Santa Isabel, and San Lorenzo; and on *P. barbinode* at Rincón, Arecibo, and Yabucoa. *Carolinaia* occurred on *Cyperus rotundus* near Arecibo, Dorado, Ponce, Peñuelas, Yauco, and San Lorenzo.

TABLE II. RESULTS OF EXTENSIVE FALL SURVEY OF SUGARCANE INSECTS IN PUERTO RICO, 1935

Section	Locality	Variety of cane	Percentage of stalks with—						Aphids on nearby plants
			Mealybug	<i>Saccharosydne saccharivora</i>	<i>Sipha flava</i>	<i>Hysteronera setariae</i>	<i>Aphis maidis</i>	Mosaic	
West coast.....	Cabo Rojo (1)....	POJ 2878.....	64	10	2	0	0	0	See table I <i>Hysteronera setariae</i>
	Cabo Rojo (2)....	M 28.....	24	13	36	0	0	0	
	Cabo Rojo (3)....		41	1	1	0	0	0	
	Mayagüez.....	POJ 2878.....	21	11	8	0	0	0	
	Rincón.....	POJ 2878.....	17	11	25	0	0	0	
	Aguadilla.....	POJ 2878.....	74	6	11	0	0	0	
North coast.....	Isabela.....	M 28.....	19	5	11	0	0	0	<i>Aphis maidis</i>
	Hatillo.....	POJ 2878.....	47	5	4	0	0	0	<i>Aphis maidis</i>
	Arecibo.....	POJ 2878.....	32	16	0	0	0	1	<i>Aphis maidis</i>
	Manatí.....	POJ 2878.....	57	12	17	0	0	0	<i>Aphis rumicis</i>
	Dorado.....	PO. 2878.....	39	3	1	0	0	1	<i>Aphis maidis</i>
	Carolina.....	SC & BH.....	20	23	8	0	0	6	
	Río Grande.....	SC 12-4.....	46	1	25	0	0	0	<i>Hysteronera setariae</i>
East coast.....	Fajardo.....	BH 10-12.....	40	5	17	0	0	0	<i>Hysteronera set.</i>
	Naguabo.....	BH 10-12.....	29	3	9	0	0	21	<i>Do. Aphis maidis</i>
	Humacao.....	BH 10-12.....	24	13	28	0	0	0	
	Yabucoa.....	BH 10-12.....	4	7	11	0	0	1	
South coast.....	Guánica.....	BH 10-12.....	15	4	16	6	0	0	<i>Hysteronera setariae,</i>
	Peñuelas.....	BH 10-12.....	20	5	4	0	0	0	<i>Sipha flava,</i>
	Ponce.....	BH 10-12.....	6	1	34	4	0	1	<i>Aphis maidis</i>
	Santa Isabel.....	BH 10-12.....	54	11	3	0	0	3	
	Guayama.....	BH 10-12.....	17	4	0	6	0	0	<i>Aphis maidis</i>
	Patillas.....	BH 10-12.....	32	4	18	0	0	0	<i>Hysteronera setariae</i>
Interior valleys.....	San Sebastián....	POJ 2878.....	47	12	2	0	0	0	<i>Aphis maidis</i> <i>Aphis maidis, Sipha</i> <i>Aphis maidis flava</i>
	Añasco.....	PO. 2878.....	24	1	5	0	0	0	
	Quebradillas....	POJ 2878.....	45	17	9	0	0	1	
	Barceloneta.....	POJ 2878.....	18	4	19	0	0	1	
	Caguas.....	SC 12-4.....	55	9	9	0	0	37	
	San Lorenzo.....	SC 12-4.....	59	12	4	1	0	37	
	Lolza.....	BH 10-12.....	15	2	15	0	0	6	
	Juana Díaz.....	BH 10-12.....	37	5	38	0	1	0	
	San Germán.....	POJ 2878.....	43	14	23	0	0	0	
	Yauco.....	BH 10-12.....	60	0	7	0	0	1	
	Lajas.....	BH 10-12.....	66	1	0	0	0	0	

TABLE III. RESULTS OF EXTENSIVE SPRING SURVEY OF SUGARCANE INSECTS IN PUERTO RICO, 1936

Section	Locality	Variety of cane	Growth	Percentage of stalks with—						Aphids on nearby plants
				Mealybug	<i>Saccharosydne saccharivora</i>	<i>Sipha flava</i>	<i>Hysteronera setariae</i>	<i>Aphis maidis</i>	Mosaic	
West coast.....	Cabo Rojo (1)...	POJ 2878.....	Small.....	0	0	31	0	0	0	See table I <i>Hysteronera setariae</i>
	Cabo Rojo (2)....	POJ 2878.....	Small.....	16	3	29	0	0	0	
	Mayagüez.....	POJ 2878.....	Medium.....	22	8	64	0	0	0	
	Rincón.....	M 28.....	Medium.....	25	2	37	0	0	0	
	Aguadilla.....	M 28.....	Medium.....	5	5	5	0	0	0	
North coast.....	Isabela.....	M 28.....	Small.....	0	2	4	0	0	0	<i>Hysteronera setariae</i> , <i>Carolinaia</i> <i>Carolinaia</i> <i>Hysteronera setariae</i>
	Hatillo.....	M 28.....	Small.....	6	1	2	0	0	0	
	Arecibo.....	BH 10-12.....	Medium.....	16	2	33	0	0	6	
	Manatí.....	M 28.....	Small.....	1	56	42	0	0	0	
	Dorado.....	M 28.....	Medium.....	15	3	5	0	0	1	
	Carolina.....	SC 12-4.....	Large.....	41	0	11	0	0	4	
	Río Grande.....	POJ 2878.....	Large.....	91	0	8	0	0	0	
East coast.....	Fajardo.....	BH 10-12.....	Medium.....	11	1	1	0	0	0	<i>Hysteronera setariae</i>
	Naguabo.....	BH 10-12.....	Small.....	6	1	12	0	0	0	
	Humacao.....	BH 10-12.....	Medium.....	31	2	18	0	0	0	
	Yabucoa.....	BH 10-12.....	Medium.....	8	0	0	0	0	0	
South coast.....	Guánica.....	BH 10-12.....	Medium.....	32	1	0	0	0	0	<i>Aphis maidis</i> <i>Carolinaia</i> <i>Carolinaia</i> <i>Hysteronera setariae</i> <i>Hysteronera setariae</i> , <i>Aphis maidis</i>
	Peñuelas.....	BH 10-12.....	Medium.....	2	2	37	3	0	30	
	Ponce.....	BH 10-12.....	Medium.....	7	4	22	0	0	0	
	Santa Isabel.....	BH 10-12.....	Medium.....	4	1	8	0	0	0	
	Guayama.....	BH 10-12.....	Medium.....	0	1	40	0	0	0	
	Patillas.....	BH 10-12.....	Medium.....	39	4	17	0	0	3	
	Interior valleys....	Añasco.....	POJ 2878.....	Large.....	70	2	8	0	0	
Quebradillas.....		M 28.....	Large.....	65	5	19	0	0	0	
Barceloneta.....		FC 916.....	Medium.....	14	21	19	0	0	0	
Caguas.....		POJ 2878.....	Small.....	0	1	22	0	0	0	
Loíza.....		BH 10-12.....	Medium.....	4	1	5	0	0	20	
San Lorenzo.....		POJ 2878.....	Large.....	73	1	4	0	0	0	
Juana Díaz.....		POJ 2878.....	Large.....	93	1	4	0	0	0	
San Germán.....		SC 12-4.....	Large.....	33	1	4	0	0	28	
Yauco.....		Co 281.....	Small.....	15	0	0	0	0	0	
Lajas.....		"Jap".....	Small.....	1	0	0	0	0	0	



## DISCUSSION

Mealybugs, often in large numbers, were found wherever search was made on cane. Wet weather appears to be unfavorable to them. The mealybugs are hard to find on young, small cane, but they seem to be come very abundant on cane that is old and has nearly stopped growing. Hence they are numerous in unharvested fields in the dry season. They were somewhat more numerous on POJ 2878 than on other varieties. While these insects do not receive much consideration, they may cause more injury than is generally suspected. Their work is not conspicuous.

*Sipha flava* was also widespread, and in the spring was somewhat more numerous in western Puerto Rico than in other parts of the island. It became more abundant in dry weather, but wet weather was not unfavorable enough to keep it from maintaining numerous small colonies. It became locally injurious near Cabo Rojo following a short dry spell in August 1935 and was somewhat injurious over wide areas in the spring of 1936. It seemed to favor certain varieties, but little preference was shown among the more important ones. It appears to be among the minor problems of cane growing.

*Saccharosydne saccharivora* was widely present, but nearly always in small numbers. In the fall it was less abundant in the dry south-coast country than elsewhere, and in the spring it was generally less abundant than in the fall. Thus on the whole it seems that dry conditions were not favorable; but in the one field, where it was very abundant, dry conditions prevailed (Table III, Manatí). It did not appear to do much injury.

*Aphis maidis* was more abundant in the rainy than in the dry season. This may be ascribed to the better condition of the food plants. It was seldom found on cane. It was present on some grasses in widely scattered localities, but only in small numbers. Sorghum is a favorable but rare host. The only host that supported large populations over any considerable area was tasseled corn. According to observations of Mr. B. A. App and the writer, *Aphis maidis* occurred on corn all over the island, but corn was not abundant in the areas of the south and east coasts, where cane is grown as the almost exclusive crop. Corn was found growing close to cane most often in areas of diversified farming.

*Hysteroneura setariae* occurred in small to moderate numbers on grasses all over Puerto Rico, and in limited numbers on cane (BH 10-12) along the south coast. It was rarely seen on cane elsewhere

The colonies on cane were on the auricles, as has been observed in Louisiana. It was not seen on BH 10-12 in sections other than the south coast, and was once observed in the southern region in a field of SC 12-4. Hence the difference in distribution seems to be regional rather than varietal and may be ascribed to low rainfall and the favorable growth of irrigated cane. The species was much more abundant in dry than in rainy weather.

*Carolinaia cyperi* was found in a number of places in small or moderate numbers, and was seen only on the common sedge, *Cyperus rotundus*. It was more abundant in dry than in rainy weather, except when its food plant was injured by drought. It persisted at some points in the dry region in May, after rains had set in at Mayagüez and it could no longer be found there.

Tables II and III show the susceptibility of the cane varieties SC 12-4 and BH 10-12 to mosaic, and its almost complete absence in other important varieties. The resistant varieties have almost entirely replaced the susceptible ones in the west, and have largely replaced them on the north coast and in interior valleys. In the south and east BH 10-12 is still widely planted. Jensen (3) finds that the spread of mosaic disease is rapid in the west, north, and interior and slower in the south. He observes that it is more rapid near hills and pastures and less rapid near the sea and in areas solidly planted to cane. In the areas of rapid spread, fields of susceptible varieties are often heavily infected, though control by roguing sometimes gives fair results. In areas of slow spread control by roguing is usually successful, though infected fields occur.

The areas of slow or rapid spread must be marked by scarcity or abundance of vectors, respectively. Mealybugs are numerous in both areas, and hence do not seem likely to be a vector; the same is true, to an extent, of *Saccharosydne saccharivora*. The yellow aphid *Sipha flava* also occurs throughout the island and experiments in transmission with this aphid under this project have been negative. In the same experiments *Hysteroneura setariae* and *Carolinaia cyperi* have shown ability to transmit mosaic. It is doubtful whether they are of much importance in field transmission, because they are at least as numerous in areas of slow spread as in areas of rapid spread. *Aphis maidis* seems more likely to be important in field transmission, because of the evidences mentioned of its greater abundance in the areas of rapid mosaic spread in the west, north, and interior than in the areas of slow spread. Another possibility in field transmission is that aphids having no association with grasses might trans-

mit mosaic by temporary feeding on cane in the course of migration. A situation of this sort was found in connection with a disease of onion (Drake, Harris, and Tate (2)). Such aphids have been taken on cane at Mayagüez, and in one case positive transmission was secured with a species not normally found on grasses. Rapid mosaic spread shows a strong association with diversified plant growth, which is probably accompanied by an abundance of vectors.

#### SUMMARY

Survey work in 1935-36 on sugarcane insects of Puerto Rico, especially those which may transmit mosaic disease, is described. Previous work is cited; climate, geography, and methods are outlined briefly.

*Aphis maidis* was found to be rather abundant on tasseled corn, sparingly present on several grasses, and scarce on cane. *Hysteronera setariae* was moderately abundant on some grasses, occasional on cane along the south coast, and rare on cane elsewhere. *Sipha flava* was widespread on cane, sometimes injurious, and small numbers occurred on grasses. *Carolinaia cyperi* was found in moderate numbers on a sedge. *A. maidis* was most numerous in the rainy season, the other three in the dry season. Mealybugs were numerous, especially on mature cane. *Saccharosydne saccharivora* was widespread but seldom numerous on cane. Some minor insect notes are recorded.

*Aphis maidis* seems likely to be important in mosaic dissemination, because more abundant in areas of rapid than of slow spread. *Hysteronera* and *Carolinaia* seem less likely to be important, and the other insects named seem unlikely to be implicated at all. Some aphids not breeding on grasses may be important.



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