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FINAL REPORT

PROJECT TITLE: MANAGEMENT OF THE INSECT VECTOR OF LETHAL YELLOWING DISEASE OF PALMS BY MANAGEMENT OF GROUND COVER IN PALM PLANTATIONS

COOPERATING INSTITUTIONS:

1) THE COCONUT INDUSTRY BOARD
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Work in Jamaica and Florida involved:

1) Screening of grasses and legumes to determine which are hosts of *Myndus crudus*.

2) Ground cover control to assess effect on development of *Myndus crudus*.

ABSTRACT

Reports that *Stenotaphrum secundatum* (St. Augustine grass) supports the development of *Myndus crudus*, have been confirmed by field plot work in Jamaica in a trial to increase *M. crudus* population. Three grasses Rhodes (*Chloris gayana*), palisade (*Brachiaria brizantha*) and limpo *Hermarthria sp.* have proven to be poor hosts of *M. crudus*. Indications are that control of ground cover by chemical means reduces *M. crudus* population.

In Florida and Jamaica the initial emphasis of the project was on developing an efficient method of screening grasses as potential breeding hosts of Mydnus crudus. Myndus crudus adults oviposit on grasses and the nymphs develop in the root zones. When the adults emerge they fly to palms. In Florida methods attempted during approximately the first year of the project included setting pots on the ground in coconut plantings highly infested with M. crudus, setting the potted grasses off the ground on benches next to infested palms, and setting the potted grasses in large walk-in cages into which M. crudus were introduced. Grasses were placed in the shade and exposed to sunlight and placed under various fertilization, watering, and clipping regimes. None of these methods was successful, i.e., colonization of the grasses by M. crudus was too sporadic for meaningful comparisons. However, colonization was more extensive among potted grasses in the walk-in cage than those exposed in the field, evidently because this limited the plants that could be selected by ovipositing females. Additional problems were that the space requirements of the potted grasses were high, and to make counts of M. crudus nymphs in the root zones of the grasses it was necessary to lift the grass and rootball out of each container, thus disturbing the habitat. By addressing these problems, an efficient method of screening grass species and varieties as potential breeding hosts of M. crudus was developed.

This technique was as follows: Grasses were grown in soil in relatively small (7cm x 12cm) transparent polystyrene containers with drainage holes. To maintain a dark environment for the nymphs, a black polyethylene sleeve was fitted over each container and removed only when the root zone was examined. Grasses were tested by arranging them in randomized blocks in a 1.2 x 1.2 x 2.4 meter cage with screen sides that prevented passage of M. crudus. Usually four species or varieties of grass were tested at a time. 'Floratam' St. Augustine grass (Stenotaphrum secundatum) was included as a standard in each test because it is a known breeding host of M. crudus and is the most common turfgrass in southern Florida. Adult M. crudus were collected from palm foliage in collecting bottles and introduced into cages. About 200 of these planthoppers were released into a cage per week for 1 or 2 months until early instar M. crudus nymphs were visible through the container sides in the root zones of all 'Floratam' St. Augustine grass samples. The development of the nymphs was monitored by frequent examinations through the transparent sides of the containers. Twenty days later, at which time most of the nymphs were in late instars, the soil of each container was emptied into a basin of water and the numbers of M. crudus nymphs that floated to the surface determined.

Grasses included in initial screening tests, which were completed in 1987, are shown in Table 1. Test results are shown in Table 2. It is significant that two grasses that have been recommended as groundcovers for coconut plantations in the South Pacific, viz, St. Augustine grass and buffel grass (Cenchrus cilaris), (Smith & Whiteman 1983, 1985) were shown by these tests to be highly suitable hosts of M. crudus.

Although M. crudus is not known to occur in that area, the use of hosts of this insect in coconut plantations would provide conditions conducive to an LY epidemic should infected vectors be introduced.

In Jamaica, grasses, Table 1A, were propagated vegetatively in black polystyrene pots and set out on stands in the open. It was observed, however, that M. crudus was almost nonexistent at the Kingston test site. As a consequence, colonization of the pots by M. crudus was not occurring.

In order to increase the population of the insect at the test site, an area of approximately 7,000 sq. ft. was planted with Stenotaphrum secundatum (St. Augustine grass). Water and fertilizer were applied regularly to speed establishment. The grass was well established in approximately nine months. Sticky traps set on palms in and adjacent to the St. Augustine grass plot which were not showing catches previously started showing catches. Over a period of ten months 121 insects were trapped on five traps set on coconut palms within the grass plot and one insect on a palm outside the plot. In addition, 277 live insects were caught on other palms mainly in the grass plot over a nine month period.

These results confirmed the observation that Stenotaphrum secundatum (St. Augustine grass) fosters the development of Mydnus crudus.

Of the grasses listed in Table 1A, six, indicated by asterisks, were planted in 7.00 cm diameter transparent polystyrene cups for screening in a test cage. The 277 insects mentioned above were put in the test cage over a period of 21 months. The insects, however, did not survive for very long due apparently to very high daytime temperatures of over 100°F. As a consequence, the insects did not oviposit in the containers.

Three types of grasses that proved to be poor hosts of M. crudus in Florida were selected from the initial screening tests for further testing in the field. Two of these, viz, Rhodes grass (Chloris gayana) and palisade grass (Brachiaria brizantha) are recommended for coconut-cattle farms in the tropics (Anon. 1982, Payne 1985). The third, limpo grass PI No. 364871 (Hemarthria altissima) was selected as potentially useful for this purpose. 'Floratam' St. Augustine grass was included in the field tests. In Autumn 1987, the grasses were established in each of four complete randomized blocks in a 0.6 ha field planted to coconut palms and several other species of palms. The plots were watered and fertilized frequently with a 6-6-6 granular formulation to encourage the grasses to spread. By spring 1988, the grasses had spread and formed a dense turf and were trimmed to circular $2m^2$ plots.

An emergence trap was designed for sampling M. crudus adults from grasses. It consisted of a 1.6 m dia x 1.6 m tall cone made of screening material that prevented passage of M. crudus. When the circular cone opening was placed over a 2 m^2 plot, insects that attempted to fly were deflected into the top of the cone and eventually through a funnel into a 11 x 20 cm canister. The canister and cone were suspended from a pyramidal wooden frame.

The first field test was conducted from 7 June to 14 July, 1988. Emergence traps were placed over the four plots (species) of grass in a block for a period of one week, after which the number of M. crudus adults in each canister were determined and the traps moved to four plots of the next block. This was repeated weekly until the four blocks had been sampled.

A second similar field test was conducted from 1 to 29 September, 1988. In each block, M. crudus adults captured in the emergence trap canisters were counted after one day and after one week. This was done under the assumption that the first day's catch may have consisted at least partly of insects that were temporary visitors in the grass plots. M. crudus adults captured during the next six days were assumed to be adults that had developed as nymphs in the plots.

Field test results are shown in Table 3. In the June-July field test, the mean number of M. crudus adults caught per week in the emergence traps placed over 'Floratam' St. Augustine grass was five or more times greater than the mean number of adults caught in traps placed over palisade grass, limpograss No. 364871, and Rhodes grass ($P < 0.01$). In the September field test, the mean number of M. crudus adults per week in traps over 'Floratam' St. Augustine grass was lower than in the June-July test, and differences in mean number of adults caught in traps over the four grasses were less pronounced. Nevertheless, the mean number of adults caught in traps over 'Floratam' St. Augustine grass was three times higher than in traps over both palisade and Rhodes grass ($P < 0.07$). The difference between the means of adults caught in St. Augustine grass and limpograss No. 364871 was not significant at this level. About one or two M. crudus adults were caught in each emergence trap during the first day of sampling in each plot. It can be assumed that those caught during the rest of the week developed as nymphs prior to placement of the traps, emerging from the soil as adults in those plots during the week.

Three plots each of the following grasses and legume - Panicum maximum (guinea grass), Panicum muticum (para grass), Stenotaphrum secundatum (St. Augustine grass) and Pueria Pueraria sp. (Kudzu) were established at Waterloo Road, Kingston, for evaluation as alternate hosts of Myndus crudus.

Cone shaped emergence traps, three feet high and with a base diameter of 6 ft, were placed over the grass plots to trap insects as they emerge from the plots. This test is not complete and will be continued at the Coconut Industry Board.

Ground cover manipulation studies were undertaken at two sites in Jamaica, Caenwood and Fair Prospect in Portland. The two areas of approximately five acres each where lethal yellowing disease killed susceptible palms were replanted with several highly resistant and less resistant cultivars. Ground cover was treated with weed killer (sprayed) or left to grow undisturbed excepting for an occasional slashing with a machette (unsprayed). Counts of M. crudus trapped on ten stickly traps set in each of the four sections are shown in Table 4. Although the number of insects trapped was low for most

months shown, whether the count was low or high, in all cases, except one, more M. crudus was caught on palms growing in the unsprayed sections of the plots.

Myndus crudus catches in coconut palm plantation with different ground cover

At Bengal Estate in Trelawny, five traps each were set in coconut palms with ground cover of para, napier and guinea grasses. After two weeks of exposure, all the traps on palms growing in para grass ground cover had Myndus crudus totalling 21 insects whilst the traps on palms in napier and guinea grass ground cover had no Myndus crudus.

Pending further research, grasses identified as poor hosts of M. crudus in this study and which are suitable for use in coconut plantations in the tropics could be recommended for LY disease control or prevention. Testing of such grasses for effects on populations of M. crudus in palm plantations in Jamaica and ultimately for effects on the rate of spread of LY disease in these plantations was originally planned as the final phase of this project. However, because of the 1988 hurricane and other conditions, this phase of the project was initiated in Florida during the latter months of 1988 with pilot test of one replication. St. Augustine grass was removed from an area of 1500 m^2 in a coconut planting at Ft. Lauderdale by application of glyphosate. Sticky traps were attached to fronds of five coconut palms inside this area and of 5 coconut palms in the adjacent area where St. Augustine grass had not been removed. The numbers of M. crudus caught on sticky traps were monitored weekly for 2 months. There was no significant difference in the numbers of M. crudus in the area devoid of grass compared to the area with St. Augustine grass. Probably M. crudus adults flew to the palms in the area devoid of grass from the adjacent areas with St. Augustine grass. Based on these results, a study is being initiated in Florida in experimental palm plantings isolated from each other by several hundred meters. The experiments are designed to provide information on the flight range of M. crudus and to test the feasibility of ground-cover management as a method of managing M. crudus and ultimately the spread of LY. This work will continue as a Florida Agriculture Experiment Station project.

During the period of the joint project between the Jamaica Coconut Industry Board and the University of Florida, F. W. Howard made visits of several days to a week to Jamaica one or two times per year. During these visits, progress in Jamaica and Florida were reviewed and work plans revised. The visits enabled Howard to become familiar with the Jamaica coconut industry and the research facilities of the Coconut Industry Board, thus ensuring a more realistic approach to the research being conducted in Florida. In addition, research techniques developed during the course of this work in Florida were conveyed to the researchers in Jamaica. Since there is currently no entomologist assigned to the Coconut Industry Board, some entomological work was conducted during these visits, the most important being the discovery of a strong relationship between

a cixiid planthopper, Nymphocixia caribbea, and coconut palms in one area of the north coast of Jamaica. Because of its close taxonomic relationship to M. crudus, this insect is of interest as a potential vector of LY. However, its distribution is quite limited, and if it is a vector its importance is minor compared to M. crudus.

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SCIENTIFIC COMMUNICATIONS OF RESULTS OF THIS PROJECT

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Table 1. Grass species and cultivars tested in Florida as breeding hosts of *Myndus crudus*

Common name and accession number	Scientific name	Source[1]
a carpet grass, PI No. 404285	*Axonopus* sp.	FLREC
palisade grass PI No. 226049	*Brachiaria brizantha* Hochst. ex A. Rich.)	RPIS
buffel grass PI No. 185561	*Cenchrus ciliaris* L.	RPIS
Rhodes grass	*Chloris gayana* Kunthe	FLREC
'Puerto Rico' star grass	*Cynodon nlemfluensis* Vander *nlemfluensis*	ARECO
'Floralta' limpo grass	*Hemarthria altissima* (Poir.) Stapf & C.E.Hubb	ARECO
'Bigalta' limpo grass	" "	"
limpo grass PI 364871	" "	"
Para grass	*Panicum purpurescens* Raddi	FLREC
'Argentine' Bahia grass	*Paspalum notatum* Flugge	"
Dwarf napier grass (Tifton N 75)	*Pennisetum purpureum* Schumacher	DOA
sugar cane selection No. 70-1527	*Saccharum officinarum* L.	CP
St. Augustine grass FX 332	*Stenotaphrum secundatum* (Walt.)Kuntze	FLREC
'Floratam' St. Augustine grass	" "	FLREC
zoysia grass	*Zoisia sp.*	FLREC

[1]Univ. of Florida sources: FLREC=Ft. Lauderdale Res. & Educ. Cent., ARECO=Agric. Res.& Educ. Cent., Ona. DOA=Depart. of Agronomy. U.S. Depart. of Agric. sources: RPIS=Regional Plant Introduct. Stat., Experiment, Georgia. CP=Sugarcane Field Stat., Canal Point, Florida.

Table 1A. Grass species and cultivars tested in Jamaica as breeding hosts of *Myndus crudus*

COMMON NAME	SCIENTIFIC NAME
Carpet grass	*Axonopus compressus*
Bahama grass	**Cynodon dactylon*
African star grass	**Cynodon plectostachyus*
Pangola grass	*Digitaria decumbens*
Crab grass	**Digitaria sanguinalis*
Guinea grass	*Panicum maximum*
Para grass	*Panicum muticum*
Tickle grass	*Panicum trichoides*
Cutting sedge	*Scleria pterota*
St. Augustine grass	**Stenotaphrum secundatum*
Seymour grass	*Andropogon pertusus*
Sour grass	**Trichachne insularis*
Water grass	**Commelina diffusa*

Table 2. Mean numbers of *M. crudus* nymphs observed per container on different types of grass grown in containers and exposed to adult populations.

Grass	Mean nymphs/sample	Standard Deviation
Test 1		
'Argentine' Bahia grass	37.3a[1]	20.1
'Floratam' St. Augustine grass	27.0b	16.1
Zoysia grass	18.4c	15.2
'Floralta' limpo grass	8.9d	5.9
Axonopus sp.	8.7d	8.3
Test 2		
Puerto Rico star grass	15.4a	10.5
'Floratam' St. Augustine grass	14.4a	12.4
Para grass	11.6ab	9.8
Rhodes grass	6.1bc	4.4
Limpo grass PI No. 364871	5.3c	7.1
Test 3		
St. Augustine grass FX 332	15.0a	9.8
'Floratam' St. Augustine grass	11.5ab	9.8
buffel grass	10.6ab	8.0
'Bigalta' limpo grass	7.1bc	5.8
palisade grass	5.1c	5.6

Table 2 (Cont.)

Test 4

'Floratam' St. Augustine grass	43.8a	23.6
dwarf napier grass	11.3b	21.3
sugar cane	4.5b	3.0

[1] Means in the column not followed by the same letter are significantly different [P < 0.01, Waller-Duncan Bayesian *k*-ratio *t*-test) (SAS Institute 1985)].

Table 3. Mean numbers of *M. crudus* adults captured in emergence traps placed for 1 week periods over 2 m^2 field plots of four different types of grass at Ft. Lauderdale, Florida in

Grass	June - July Field Test		September Field Test	
	Mean *M. crudus*	Standard Deviation	Mean *M. crudus*	Standard Deviation
'Floratam' St. Augustine grass	35.0a[1]	17.2	10.8a[1]	6.9
Palisade grass	7.0b	7.6	4.0ab	3.5
Limpo grass PI No. 364871	5.8b	4.4	3.5b	2.3
Rhodes grass	3.5b	4.4	3.5b	1.3

[1] Means in the column followed by the same letter are not significantly different [$P < 0.01$ in the June-July Field Test and $P < 0.7$ in the September Field Test, Waller-Duncan Bayesian *k*-ratio *t*-test, SAS Institute, 1985)]

Table 4. Counts of *M. crudus* trapped over 13 months at two sites in Jamaica

Site No. 1 - Caenwood, Portland

	July	Aug.	Sept.	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May	June	July
Unsprayed	21	6	6	7	2	0	1	3	2	1	-	6
Sprayed	0	1	0	0	0	0	0	0	0	0	-	3

Site No. 2 - Fair Prospect, Portland

	July	Aug.	Sept.	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May	June	July
Unsprayed	-	12	3	5	11	0	1	1	19	0	10	12
Sprayed	0	1	0	0	0	0	0	0	12	2	1	8