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A FIELD SURVEY OF PESTS OF MALANGA, XANTHOSOMA CARACU KOCH AND BOUCHE, IN SOUTH FLORIDA[1]

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Abstract. **In the fall of 1983, 5 fields were surveyed for pests of malanga,** Xanthosoma caracu **Koch and Bouche. The survey was conducted on the 2 common soil types, Rockdale series and Perrine marl. Insects found most often and in highest numbers were whiteflies,** Aleuroglandulus malangae **Russell, and a wooly-bear type caterpillar,** Diacrisia virginica **(F.). The most abundant plant pathogenic nematodes were reniform,** Rotylenchulus reniformis **Lindford and Oliveira, 1940; ring,** Criconemella onoensis **(Luc, 1959) Luc and Raski, 1981; and spiral,** Helicotylenchus pseudorobustus **(Steiner, 1914) Golden, 1956. The most prevalent diseases were bacterial leaf spot,** Xanthomonas campestris **pv** dieffenbachiae **(McColloch and Pirone) (Dye); dasheen mosaic virus, and anthracnose,** Colletotrichum **spp. Common weeds noted were spiny pigweed,** Amaranthus spinosus **L.; common purslane,** Portulaca oleracea **L.; yellow nutsedge,** Cyperus esculentus **L.; and** Parthenium hystrophorus **L.**

Malanga, *Xanthosoma caracu* Koch and Bouché (Araceae), is one of several tropical "root and tuber" crops that has increased steadily in relative economic importance in Dade County, Florida as a result of large influxes of Latin American immigrants. In a recent season, 680 ha (1700 acres) were planted in Dade County, with farm-gate cash receipts of $9.8 million, fifth among all vegetable crops grown, and first among the root and tuber crops, including Irish potatoes (2).

Although *Xanthosoma* culture is relatively new to Florida, it has long been a staple food crop in many parts of the humid tropics. Reports of several diseases (1, 3, 6, 9, 13, 14, 21, 26), insects (3, 10, 13, 22, 24, 27), and nematodes (8, 21, 29) have been made from around the world. Several pests have been recorded in Florida (4, 5, 19, 20, 23, 28, 30), but no systematic study has been made of the incidence and relative abundance of disease, insect, and nematode pests in commercial fields over time.

This study was undertaken to identify disease, insect, and nematode pests affecting malanga in Florida; to determine the relative abundance of these pests as a function of time; and to note relationships among populations of different pests and relationships among pest populations and soil type. These data could provide a basis for an integrated pest management (IPM) program on the crop.

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Material and Methods

Surveys were conducted bimonthly in 5 commercial fields in southwest Dade County from mid-September to mid-November, 1983. Field size, crop planting dates, and soil types are listed in Table 1. Fields were divided into 1-ha units, with an average of 20 plants/ha rated for disease incidence and symptom severity, using the Horsfall-Barratt grading system (12). Each hectare was traversed along a 'Z' pattern, and every n^{th} plant graded. Senescing leaves were not rated. Within each ha unit, upper and lower leaf surfaces of one plant were examined for insects. Lepidopterous larvae and adults of other orders were counted. Preliminary tests with sticky traps and beat cloths (7) were not useful in sampling insects on malanga.

Table 1. Field size, soil types and planting dates of 5 commercial malanga fields surveyed in Dade County, Florida. Fall 1983.

Field no.	Field size (ha)	Soil type	Planting date 1983
I	8	Perrine marl	August
II	40	Perrine marl	February
III	37	Rockdale	February
IV	8	Rockdale	February
V	8	Rockdale	March

Both soil and root systems were assayed for nematodes. Soil samples came from 1) a Perrine marl, 2) a Perrine marl shallow phase, 3) a Rockdale fine sandy loam phase-limestone complex (11) and 4) a Rockdale gravelly silt loam-limestone complex (personal communication, Carol Wettstein, USSCS). One soil sample was composed of 40 cores per ha (17). Cores consisted of soil taken with a hand trowel to a depth of 17.5 cm (minus the top 2.5 cm) from as close to the malanga roots as possible. Endoparasitic nematodes were assayed once during the survey from 2 whole root systems randomly selected from each of the 5 fields.

In the laboratory, root samples were processed for nematodes by maceration of 1.3 cm root segments for 10 sec in a Waring blender, followed by aeration and incubation in 200 ml water for 7 days. In preparation for microscope examination of nematodes, soil samples were sifted to insure mixing and removal of rocks and debris, suspended in water for decanting and sieving, resuspended in sugar (453 g/liter) and centrifuged (16).

Serious weed problems developed in 2 of the fields. Qualitative measurements of the prevalent weeds were made.

Results and Discussion

Diseases. Bacterial leaf spot [*Xanthomonas campestris* pv *dieffenbachiae*] (6, 23) was the most common, occurring on nearly 100% of the malanga plants surveyed. Horsfall-Barratt ratings ranged from 1 to 4, indicating a maximum of 12% of the plant tissue was damaged on any plant (Table 2).

Anthracnose, *Colletotrichum* spp., was found on a maximum of 50% of the malanga plants (Table 2). Damage was light, with the mean Horsfall-Barratt rating ranging from 1.0 to 1.8 and individual plants ranging from 1 to 4 or 0% to 12% damage to any one plant. This is the first report of *Colletotrichum* spp. on *Xanthosoma* in Florida.

Two distinct sets of virus symptoms were found on malanga. Some closely resembled those of dasheen mosaic

Table 2. Diseases found in 5 commercial malanga fields in Dade County, Florida, Fall 1983.

Field no. (soil type)	Date	Bacterial leaf spot		Dasheen mosaic		Unusual virus-like symptoms		Anthracnose	
		I[z]	S[y]	I	S	I	S	I	S
I (Marl)	Oct 4	100	4.0	14	1.4	6	1.2	10	1.3
	Oct 13	100	4.0	47	2.2	26	1.6	12	1.5
	Oct 25	99	3.0	14	1.3	12	1.4	39	1.4
	Nov 8	99	4.1	7	1.2	4	1.2	17	1.4
	Mean	100	3.8	20	1.5	12	1.3	19	1.4
II (Marl)	Oct 10	100	3.5	70	2.4	12	1.6	0	1.0
	Oct 21	68	2.3	42	1.7	2	1.1	5	1.1
	Nov 1	76	2.8	39	1.5	4	1.1	11	1.1
	Nov 14	100	3.9	28	1.6	21	1.8	15	1.1
	Mean	86	3.1	45	1.8	10	1.4	8	1.1
III (Rockdale)	Oct 7	100	3.8	48	3.1	1	1.1	8	1.2
	Oct 14	99	3.9	34	1.9	8	1.2	21	1.5
	Oct 31	100	3.6	14	1.3	6	1.2	16	1.6
	Nov 15	100	4.2	22	1.4	17	1.5	28	1.6
	Mean	99	3.9	30	2.0	8	1.3	18	1.4
IV (Rockdale)	Oct 4	100	3.6	15	2.2	0	1.0	6	1.1
	Oct 11	99	3.7	99	4.5	3	1.1	18	1.4
	Oct 24	100	3.3	8	1.1	0	1.0	31	1.5
	Nov 4	100	3.7	5	1.1	3	1.1	8	1.1
	Nov 18	100	4.2	5	1.1	15	1.4	19	1.4
	Mean	100	3.7	27	2.0	4	1.1	11	1.3
V (Rockdale)	Sep 15	100	3.9	—[x]	—	—	—	25	1.5
	Sep 30	100	3.3	8	1.1	—	—	6	1.1
	Oct 11	100	3.9	98	3.9	4	1.1	12	1.2
	Oct 21	100	3.0	7	1.0	2	1.2	24	1.6
	Nov 11	100	4.2	10	1.2	5	1.3	30	1.8
	Mean	100	3.7	31	2.4	4	1.2	19	1.4

[z]I = incidence (%) = (no. plants with at least one lesion/total no. of plants survey) x 100.
[y]S= severity based on Horsfall-Barratt rating system; each rating is a mean of 20 plants.
[x]Data not taken.

virus (DMV). In other cases virus-like symptoms were observed that were distinctly different from those commonly associated with DMV. Identification of the unusual virus-like pathogen will require further laboratory tests. Buddenhagen et al. reported a range of virus-like symptoms on *Colocasia* spp. and *Xanthosoma* spp., some of which closely resemble these unusual symptoms found in Florida. The unusual virus-like symptoms were found on 0% to 25% of the malanga plants surveyed (Table 2), with a few plants rated a 9 on the Horsfall-Barratt scale. DMV (Fig. 1) was present in all fields, with substantial numbers of plants infected (Table 2). The range of damage on individual plants was from 1 to 6, although no field averaged more than a 4.5 rating on the Horsfall-Barratt scale.

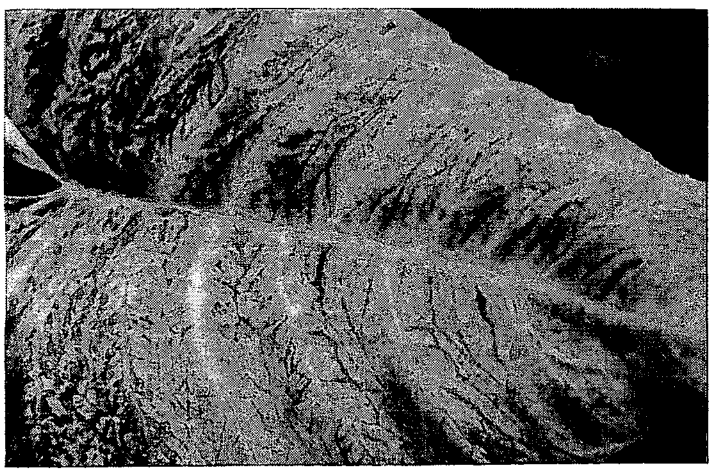

Fig. 1. Symptoms of dasheen mosaic infection, Field II, November, 1983.

Plant growth was apparently not impaired by bacterial leaf spot, anthracnose, or DMV, although bacterial leaf spot was most frequently observed. In some plants with the unusual virus-like symptoms, high injury levels were noted, suggesting that this could be a serious problem.

Nematodes. Many genera of nematodes were found associated with malanga, although only 3 are known plant parasites. These were: *Rotylenchulus reniformis, Criconemella* spp. and *Helicotylenchus* spp. *Aphelenchus* spp. and *Tylenchus* spp. were also found with some frequency. Differences in parasite population counts between the two soil types were highly significant ($P \leq 0.001$), according to an analysis of variance for Fields I through IV (Table 3). For these tylenchid nematodes, a means separation test indicated that populations from Fields I and II were similar, but significantly different from those in Fields III and IV. *Criconemella* spp. preferred Perrine marl; *R. reniformis* and *Helicotylenchus* spp. preferred Rockdale series soils. One *Criconemella* species found in the Perrine marl was identified to be *Criconemella onoensis. Helicotylenchus* species found in the survey included *H. pseudorobustus* and *H. dihystera* (Cobb, 1893) Sher, 1961. This is the first report of *C. onoensis* and *H. pseudorobustus* on *X. caracu* in Florida. Other nematode genera found in the malanga fields were: *Pungentus, Eudorylaimus, Alaimus, Aphelenchoides, Actinolaimus, Bunonema, Boleodorus, Cervidellus, Acrobeloides, Diphtherophora, Rhabditis,* as well as various *Cephalobidae.* These decomposer organisms were not counted, although the latter 3 were very common. No galls nor endoparasitic nematodes were observed.

Populations of *R. reniformis* can increase appreciably from relatively small initial populations on aroids. High populations of *R. reniformis* reduced yields of cormels of malanga in Dade County when the initial population was

Table 3. Selected nematode genera associated with commercial malanga fields in Dade County, Fall, 1983.

Field no.	Soil type	Nematodes/100 cm³ soil				
		Aphelenchus	*Tylenchus*	*Rotylenchulus*	*Helicotylenchus*	*Criconemella*
I	Perrine marl	4	58	6	14	162
II	Perrine marl	4	54	0	4	151
III	Rockdale	20	50	168	78	0
IV	Rockdale	12	36	41	62	0
V	Rockdale	0	0	8	8	0

56 per 100 cm³ soil (19). To anticipate damage to marketable cormels, it may be worthwhile for the grower to sample for *R. reniformis* before planting, especially if the malanga is planted on Rockdale soils. *Criconemella* spp. and *Helicotylenchus* spp. can at times damage host crops when populations are high (15, 18). Specific damage by these nematodes on aroids has not as yet been observed, and therefore economic injury levels are expected to be very high. Sound decision-making for managing harmful nematode populations will be enhanced once thresholds have been determined.

Insects. Of the insects recorded, only one was found with any regularity; this was the whitefly, *Aleuroglandulus malangae*. Adult infestations of this insect were found on 95% of the plants in all fields. Counts generally increased during the course of the survey. (Fig. 2). Direct damage, however, was not readily apparent, although whiteflies have the capability of vectoring certain types of virus (25).

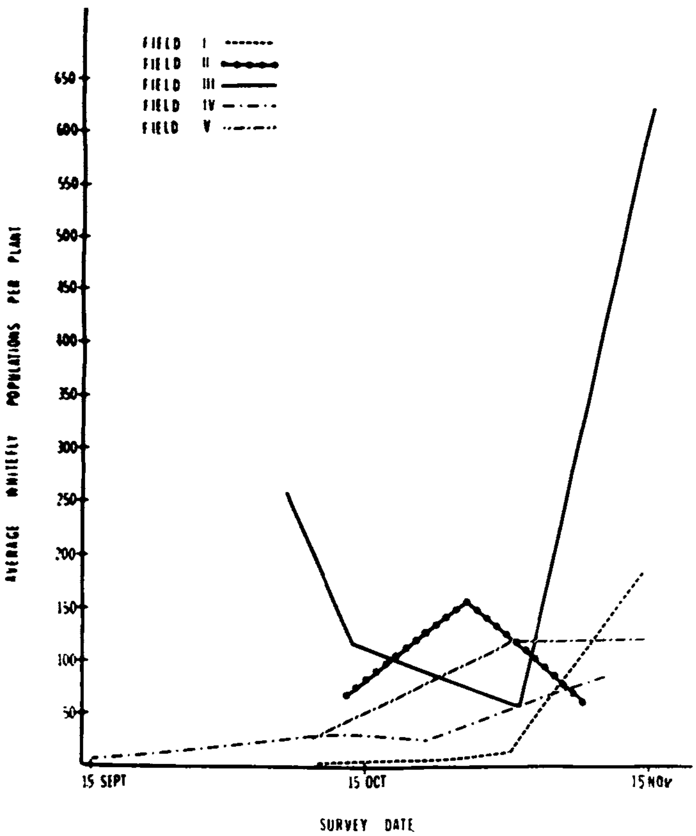

Fig. 2. Mean whitefly counts for 5 fields, 4 survey dates, Fall 1983.

An incidental pest of note is the larval form of *Diacrisia virginica*, a wooly-bear caterpillar. The first instars hatch on the underside of leaves and begin feeding. The early instars, however, are not able to chew through the entire leaf. Thus a tell-tale ultra-thin layer of transparent veined leaf tissue indicated feeding by early instar larvae. Later instars were found in 2 predominant colors—white or brown—and devoured entire leaves except the largest veins. The adult of *D. virginica*, a tiger moth, is almost pure white with a few black spots.

Only in Field II was *D. virginica* a serious pest, averaging 6.25 caterpillars per plant with larvae present on over 50% of the plants infested. Because of the severity of this infestation, measures were taken to control the outbreak, after which no significant counts of *D. virginica* were recorded in that field. In Fields I, III, and IV, minor infestations of this wooly-bear were observed; no supplemental control measures were initiated in these fields during the course of this survey. This is the first report of *D. virginica* as a pest of malanga in Florida. *Spodoptera eridania* (Cramer), another polyphagous caterpillar was also found, but the frequency and abundance of this species were very low.

Weeds. Weeds found in malanga fields were considered pests when they were observed to be either outcompeting malanga plants for sun and root space, or strangling and using the malanga for support. Vines of the *Ipomoea* spp. were climbers, whereas *Amaranthus* spp. *Parthenium* spp., *Portulaca oleraceae* L. and *Cyperus esculentus* L. were contiguous competitors. Weed populations were remarkably low in Field I, in which mechanical cultivation between rows was an effective weed control since a cultivator could easily pass between the relatively small malanga plants. Once the malanga reached a height of about 1.25 m (as was the case in the other 4 fields), the leafy canopy was broad enough to shade out almost all weeds. Only in certain small localized areas did the weeds out-compete the malanga.

In summary, the pests did not seem to pose a serious threat to this economically important crop. However, seed-pieces of plants exhibiting severe virus-like symptoms should probably not be used for a new crop. The insect that can sporadically pose a threat to this vegetable is the wooly-bear caterpillar.

These surveys have established the identity and relative abundance of malanga pests and can serve as the basis for the development of an integrated pest management program on this crop.

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SOIL FUMIGANTS FOR CONTROL OF NEMATODES, FUSARIUM WILT, AND FUSARIUM CROWN ROT ON TOMATO[1]

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Abstract. **Methyl isothiocyanate 20%/chlorinated C_3 hydrocarbons, including dichloropropenes, dichloropropane and related chlorinated hydrocarbons 80% (MS/DD) (Vorlex) at 30 gal/acre, methyl isothiocyanate 17%/chlorinated C_3 hydrocarbons, including dichloropropenes, dichloropropanes and related chlorinated hydrocarbons 68%/chloropicrin 15% (MS/DD/C) (Vorlex 201) at 20 or 25 gal/acre, methyl bromide 67%/chloropicrin 32% (MB/C33) (Terr-o-gas) at 350 lb./acre, and methyl bromide 99.5%/chloropicrin 0.5% (MB/C 0.5) (Brom-o-gas) at 400 lb./acre were evaluated in the fall 1983 and MS/DD at 25 or 35 gal/acre, MS/DD/C or methyl isothiocyanate 40% (MS) (Trapex 40) at 25 gal/acre, and (MB/C 0.5) at 400 lb./acre were evaluated in the spring 1984 for crop yield response and control of nematodes, Fusarium wilt** (Fusarium oxysporum **Schlecht. f. sp.** lycopersici **(Sacc.) Snyder & Hansen race 3) or Fusarium crown rot** (Fusarium oxysporum **Schlecht. f. sp.** radicis-lycopersici **Jarvis & Shoemaker) of tomato. All treatments increased tomato fruit yield and reduced populations of the sting** (Belonolaimus longicaudatus **Rau), stunt** (Tylenchorhynchus **spp.), and awl** (Dolichodorus heterocephalus **Cobb) nematodes. Root-knot** [Meloidogyne incognita **(Kofoid & White) Chitwood**] **nematodes were suppressed by all treatments. All treatments reduced Fusarium wilt race 3 and Fusarium crown rot. A greater number of plants showed symptoms of wilt at pH 5.5-6.0 than at pH 7.0-7.5; soil pH had no effect on incidence of crown rot.**

Soil fumigation is a common practice in sandy soils repeatedly planted to tomato in Florida. Methyl bromide/chloropicrin mixtures are most frequently used (8) in soil pest management programs which include full-bed mulch (6), adjustment of soil reaction (3, 5), and use of host resistance (9) to protect crops from Fusarium wilt race 2, Verticillium wilt (*Verticillium albo-atrum* Reinke & Berth), nematodes, and weed infestations.

The advent of Fusarium wilt race 3, the increase in importance of Fusarium crown rot in commercial tomato fields, and the critical review being given methyl bromide as an agricultural pesticide by the Environmental Protection Agency emphasized the need for re-evaluation of available broad-spectrum soil fumigants. Previous research (3, 4, 6, 7, 9) demonstrated the efficacy of certain fumigants for control of Fusarium wilt race 2, Verticillium wilt and nematodes. Five available materials were selected from this inventory of chemicals for evaluation of their efficacy against

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Trade names are included for the benefit of the reader and do not infer any endorsement or recommendation by the author.