VII^th Symposium of the International Society for Tropical Root Crops,
Gosier (Guadeloupe), 1-6 July 1985, Ed. INRA, Paris, 1988.

FIELD DISEASES OF TROPICAL YAMS (DIOSCOREA SPP.) AND THEIR CONTROL IN PUERTO RICO

(Maladies des ignames tropicales (Dioscorea spp.) rencontrées au champ et leur contrôle à Puerto-Rico)

Julia MIGNUCCI, R. TORRES-LOPEZ, P.R. HEPPERLY and D. RAMOS-BUSIGO
Dept. of Crop Protection, Agricultural Expt. Sta.,
College of Agric. Sci., Univ. of Puerto Rico,
Mayaguez Campus
Mayaguez, P.R. 00708

SUMMARY

For the last 5 years, we have studied yam diseases and their control in Puerto Rico. Damaging diseases occurring on yams from planting to harvest include : seed-tuber rot (*Penicillium* spp., *Fusarium oxysporum* and *F. solani*), root rot (*F. oxysporum* and *Pythium* sp.), stem basal canker (*F. oxysporum*), vascular wilt (*F. oxysporum*), virus (shoe string and mosaic viruses), anthracnose (*Colletotrichum gloeosporioides*), leaf spots (*Curvularia eragrostidis, C. geniculata*, and *Cercospora* sp.), scorch (unknown etiology), rectangular leaf spot (*Aphelenchoides ritzemabosi*) and stem blight (*Botryodiplodia theobromae*). *Penicillium* spp., *Fusarium* spp., *Curvularia* spp., *Pythium* sp., *C. gloeosporioides* were all found tuberborne inhabiting either the cortex or deeper internal tissues. For controlling these diseases we tested a range of practices and their integration. These include : chemical control, use of varietal resistance, and cultural practices. We will describe the symptomatology, etiology, epidemiology, and control of these yam diseases.

RESUME

Pendant les 5 dernières années, nous avons étudié les maladies de l'igname et leur contrôle à Puerto-Rico. Les maladies dommageables, de la plantation à la récolte comprennent : la pourriture des tubercules-semences (Penicillium spp., Fusarium oxysporum et F. solani), la pourriture racinaire (F. oxysporum et Pythium sp.), le chancre de la base des tiges (F. oxysporum), le flétrissement vasculaire (F. oxysporum), des viroses (virus des feuilles filiformes et de la mosaïque), l'anthracnose (Colletotrichum gloeosporioides), des taches foliaires (Curvularia eragrostidis, C. geniculata et Cercospora sp.), l'écorchure (étiologie inconnue), les taches foliaires rectangulaires (Aphelenchoides sp.) et la flétrissure des tiges (Botryodiplodia theobromae). Les Penicillium, Fusarium, Curvularia, Pythium sp. et C. gloeosporioides sont tous rencon-

trés dans le tubercule, soit au niveau du cortex, soit dans les tissus internes plus profonds. Afin de contrôler ces maladies, nous avons testé une gamme de pratiques ainsi que leur intégration. Celles-ci comprennent : la lutte chimique, l'utilisation de la résistance variétale et les pratiques culturales. Nous décrirons la symptômatologie, l'étiologie, l'épidémiologie et le contrôle de ces maladies de l'igname.

INTRODUCTION

In Puerto Rico an other countries yam field diseases have recently been recognized as important contributors to production losses (MIGNUCCI, et al., 1981a, 1981b, 1982, 1985 RAMOS and MIGNUCCI, 1985). Traditionally, viral diseases of foliage have be considered most limiting to *Dioscorea rotundata* cultivars while anthracnose was viewed as the major constraint for *D. alata* commercial production (MIGNUCCI, et al. 1981b ; 1981c ; 1982, 1984, 1985). In Puerto Rico, we have encountered other field diseases of yams of which little information is available (MIGNUCCI et al., 1985). We have been interested in identifying these diseases, calculating the losses associated with them and determining their distribution in the island's yam production zone. Efforts were focused also toward describing disease symptoms, pathogen identification, host susceptibility and developing control methods via an integrated approach. Research results on these areas will be summarized here.

Yam diseases can be classified into two groups. The first group covers those diseases that affect the tubers and that occur from harvest or during storage and shortly after emergence (MIGNUCCI et al., 1983, 1984a, 1984b). The second group, i.e., those occurring from emergence to senescence of field plants, will be described here.

MATERIALS AND METHODS

Disease and Pest Survey : At the end of 1980 and throughout 1981 growing seasons, a disease and pest survey was conducted throughout the yam growing zone of Puerto Rico. The survey covered 48 farms of 10 municipalities. Each farm was visited 3-4 times during the 12-month growing cycle to assess diseases and pests at various stages of crop development and during yam storage. The survey included an interview with the farmers using a questionaire to record agronomic practices and farmers views. Samples of plant parts were taken to the laboratory to isolate, identify, and culture organisms associated with damage and losses. Photographic records were taken of plants, agronomic practices, symptoms, etc.

Monitoring diseases and pests : A disease and pest nursery was yearly planted since 1980 to 1983 at the Alzamora fields in Mayaguez. The yam collections planted every year

at the Tropical Agriculture Research Station in addition to farmer's fields were visited regularly to determine the occurence and development of yam diseases and pests. Samples of disease tissues were obtained, organisms associated with disease symptoms were identified, and described, field distribution and severity recorded, and photographic records were also obtained.

Chemical control of anthracnose : At Corozal Experiment Station, field experiments using *D. alata* varieties (Florido and Forastero) were established to screen fungicides (Benomyl, Captafol and Thiabendazole), determine the appropriate dosages (0.5 and 1.0 A.I./acre) and the frequency of foliar sprays (every 3 and 4 weeks) for control of yam anthracnose during 1980, 1981 and 1982 growing season. Disease ratings per plot were done on a monthly basis from June to September each year. A randomized complete block design with four replications for each treatment were used. Seed-pieces were placed on 8 cm deep and 20 cm apart within 50 cm high banks which were separated by 167 cm. Each experimental plot contained four banks of 5 m long each. Fungicides were applied with a 20 l Hardi Backpack at 30 psi. Disease ratings were done from June to September to estimate foliage necrosis caused by *Colletotrichum gloeosporioides*. Yam tubers were harvested during late January to early February and yield components were determined.

Resistance to anthracnose : *D. alata* varieties (Florido, Forastero, Gemelos, Binugas, Kinampay, Moresby, Purmay, and Gunung) and *D. rotundata* varieties (Guinea Blanco and Guinea Negro) were planted using 4/plots/variety at Mayaguez and Corozal. Experimental design and plots size were as described in the previous section of this report.

RESULTS AND DISCUSSION

Virus symptoms were found on 35 per cent of *D. rotundata* farms. Shoe string virus on *D. alata* cultivars was identified for the first time in Puerto Rico. Anthracnose, caused by *Colletotrichum gloeosporioides* is the most important foliar disease on *D. alata* yams on the Island. Symptoms ranging form 20 per cent to total destruction were found in all plantings of *D. alata* cv. Florido visited. Other unknown diseases of yams were encountered. One is a foliar disease of *D. rotundata* presenting black to brown spots caused by *Curvularia* spp. This disease was found on 40 per cent of the farms ranging from 70 to 90 per cent severity. Another disease is recognized by tubers dissected by deep and sharp cracks. It was found on 18 per cent of the farms affecting 30 to 90 per cent of the tubers. Scorch, a disease of unknown etiology, previously reported in Nigeria, was found to occur on *D. alata* in Puerto Rico.

Foliar spots caused by *Curvularia geniculata, C. eragrostidis* and *C.* sp. were identified on *Dioscorea rotundata* and *D. alata* yams for the first time in Puerto Rico. Pathogenicity tests revealed these fungi as the causal organisms of leaf lesions. Of the three species, *C. eragrostidis* caused more lesions than *C. geniculata* or *C.* sp. on inoculated leaves. Rounds to oval spots with irregular margins (3 x 3 mm) were caused by *C. geniculata* and *C. eragrostidis* while *C.* sp. caused blotches (42 x 27 mm) usually at the leaf margin. *C. geniculata* spores were falcate with five cells measuring 18 x 8 μ (min.), 27 x 14 μ (max), and 25.3 x 11.1 μ (mean) ; *C. eragrostidis* were oval with four cells and measured 18 x 11 μ (min), 27 x 20 μ (max) and 26.1 x 15.4 μ (mean) ; *C.* sp. spores were oval to round with four cells measuring 20 x 9 μ (min.), 24 x 11 μ (max) and 21.9 x 9.8 μ (mean). Cultivars of *D. rotundata* (Guinea Blanco and Guinea Negro) and of *D. alata* (Florido, Binugas, Forastero and Purmay) were found susceptible while Gemelos, Gunung, Kinampay and Moresby were resistant to the disease. *Curvularia* sp. were found tuber borne, both on the cortex and internal tissues of tubers. Thiabendazole used as pre-storage and as pre-plant treatments do not affect *Curvularia* spp. recovery. More than half of the plants were attacked by *Curvularia* spp. and in some plots severity was up to 30 per cent on Guinea Blanco at 240 days after planting.

A basal canker of *D. rotundata* was observed for the first time during 1982. The causal fungus has been identified as *F. oxysporum* but seems to be a different race from the one that causes vascular wilt of yams. Pathogenicity tests resulted in the reproduction of symptoms on inoculated plants in the field but not in the shadehouse. Little information is available on root rot, basal canker and vascular wilt of yams. Recently, we determined that *Pythium* sp. and *Fusarium oxysporum* are the causal agents of yams root rot in Puerto Rico and that both fungi act synergistically. Guinea Blanco is susceptible, Florido is intermediate and Guinea Negro is the most resistant to root rot. Besides being a component of the root rot complex, *F. oxysporum* also causes vascular wilt and basal stem canker. The isolates causing these diseases can be differentiated by pigmentation (which is a stable characteristic) and other colony characteristics on potato-dextrose agar. The root rot isolate of *F. oxysporum* produces abundant, elevated, cottony mycelium and an intensive violet pigmentation. The vascular wilt isolate produces a compact colony with sparse aerial mycelium and a light pink pigmentation. In field inoculations, the damage caused by the three different isolates appears to be related to isolate source. The vascular isolate causes greatest damage in the stem vascular system, the root rot isolate in the roots, and the basal isolate in the vine base. This suggests that these isolated of *F. oxysporum* may be distinct strains which differ in colony vigor, pigmentation and tissue preference. The three isolates of *F. oxysporum* caused a 32-44 per cent reduction in yield of yams. *Pythium* sp. caused 46 per cent yield loss on "Habanero" yams.

A newly recognized foliage disease of yams caused by foliar nematodes was found on wild *D. alata* plants in Camuy, Puerto Rico (MIGNUCCI J.S., P.R. HEPPERLY and J. ROMAN, Unpublished, 1985). Pathogenicity tests revealed the isolated nematodes as the causal agent. *Aphelenchoides ritzemabosi* was identified as the causal nematode but the specimens have some similarities to *A. besseyi*. A report from the West Indies (KERMARREC and ANAIS, 1974) reports *A. besseyi* on *D. trifida* foliage but fails to indicate if it was associated with disease symptoms or it's pathogenicity. To our knowledge, our is the first demonstration of a foliar nematode pathogenic to yam foliage.

Chemical Control of anthracnose : This disease has reduced the production of Florido yams in Puerto Rico and has caused a shift to increased production of *D. rotundata* cultivars. Fungicide sprays reduced anthracnose severity by 98 per cent under the best treatments. It was estimated that 79 per cent total yield, 91 per cent marketable yield, 89 per cent marketable tubers, 58 per cent plants, 58 per cent yield/plant were lost to anthracnose on Florido check plots when compared to the best fungicide control during 1980-81. Benomyl foliar sprays at four week interval were found as effective as those applied every three weeks. Control by benomyl at rates of 0.5 and 1.0 lb. A.I./acre every three weeks were superior to any regime of chlorothalonil and captafol.

Resistance to anthracnose : Six varieties (Guinea Negro, Binugas, Guinea Blanco, Gunung, Kinampay and Purmay) were identified as resistant to anthracnose while Gemelos, Florido and Moresby are highly susceptible (Table 1). Forastero has shown variable reactions in different years and localities. Forastero plots sometimes give resistant reaction even when surrounded by heavily infected plants of susceptible cultivars. Based on their yield components and resistance to anthracnose, Binugas and Kinampay could replace Florido where the disease is prevalent.

Diagnosis and integrated control programs : We present here a condensed description of the encountered field diseases of yams and outline the components in the control program based on our observations and research results obtained up to date. We hope that this will help in diagnose, monitor, and control these diseases in other yam producing countries.

Root rot : Plants with root rot show a wilted and flacid foliage that usually turns yellow. The roots become soft with brown lesions and a deteriorated cortex that easily sloughs off. Some plants have no roots or a reduced root system. Root rot in yams is caused by *F. oxysporum* and *Pythium* sp. Both species are tuber borne. Similar root rots could be caused by nematodes (*Pratylenchus coffeae*). At times, both fungi and nematodes could be found together causing root rot of yams.

Table 1 : Field performance of yam varieties and their's anthracnose susceptibility during 1982-1983 growing season

Yam species	Variety	Tuber Description	Yield Components			Estimated anthracnose severity (%)				
			Tuber Weight (kg)	Mean No. Tubers/ Plant	Total Weight (kg/plot)	90 1/	114	140	173	205
D. alata	Gunung	very irregular large lobules	4.1	1.4	67.1	0	0	0	0	2.5
	Forastero	long, round no roots on tuber	2.3	1.2	33.0	0	0	0	0.1	0.6
	Purmay	irregular shape purple skin	1.5	1.4	25.0	0	0.5	2.5	1.3	3.8
	Binugas	round, well shaped	4.4	1.2	62.4	0	0	0	0.3	1.3
	Kinampay	semi-round to round	2.4	1.7	48.4	0	0	0.1	0	1.8
	Gemelos	rounded tubers in pairs	1.3	2.5	37.3	0	0.5	5.0	15.3	76.2
	Moresby	round to elongated	0.6	2.3	16.4	0	0.5	2.8	27.5	76.2
	Florido	ovaled and smooth	1.4	3.1	50.1	0	0	0.1	3.0	28.2
D. rotundata	Guinea Blanco	long, smooth tubers	1.8	1.8	33.4	0	0	0	0	0
	Guinea Negro 2/	long, smooth	1.1	1.2	15.4	0	0	0	0	0

1/ Days after planting.

2/ Harvested after 7 months in the field, the other varieties at 11 months.

Stem canker : Brown lesions at the base or at other vine sections is the characteristic symptom. This result in early death of infected tissue and the portions above the cankers. Plants with stem canker show dead vines and others starting to yellow. The fungus that causes this disease of yams is a race of *Fusarium oxysporum* and could be responsible for up to 15 per cent of dead plants in the field.

Vascular wilt : The first visible symptoms is leaf wilt having vines dying from the tip to the base (die-back). The name of the disease refers to a symptom that occurs at the vascular system on the vines where a reddish coloration is found on the vascular bundles. To diagnose this disease it is necessary to examine the internal part of the vines since wilt symptoms could also be caused by other diseases or conditions (root, rot, stem canker or drought). A race of *F. oxysporum* causes this disease and it is tuberborne. We have outlined the following recommendations for the control of root rot, stem canker and vascular wilt of yams :

1. Select healthy, sound high quality seed-tubers produced by vigorous healthy plants. Use seed-tubers or seed-pieces from 4 to 8 ounces.

2. Plant in good soil with good drainage.

3. Utilize pre-emergence herbicide to control weeds. Weeds, beside competing for soil nutrients they also harbour pests and pathogens. Weeds could also promote environmental or microclimate conditions that favour the development of disease.

4. Use fungicides, nematicides or both before planting (ROMAN et al., 1984, MIGNUCCI et al., 1984a, 1984b). Treat seed-tuber or seed-pieces two days before planting to assure that cut surfaces heal.

5. Select resistant or tolerant varieties using the following table :

Variety	Tuber Rot		Root Rot	Stem Canker	Vascular Wilt
	During Storage	In the Field			
Guinea Blanco	HS	MS	HS	S	S
Guinea Negro	HS	MS	MS	MS	NI
Florido	R	R	S	R	R

Key: R= resistant; S= susceptible; MS= moderately susceptible
HS=highly susceptible; NI= no information is available

6. After harvest do no make mounds of yam residues near the plantation since they could serve as foci for pathogens and pests.

7. When cutting tubers into seed pieces, disinfest knives. Use a solution made of a few drops of liquid detergent and 10 per cent clorine solution.

Virus diseases : Plants infected by virus have one or more of the following symptoms : change of foliage color an texture and reduction of the leaf lamina. Leaves may also show distortions and malformations. In the case of mosaic, leaves become mottled with dark gren and chlorotic patches. Deformations include rolling, curling and elongation of the leaves. Yam plants infected by virus are usually smaller and produce fewer and smaller tubers than healthy plants. Yam viruses are tuberborne. Two or more virus have being identified causing diseases on yams. Apparently most, if not all of the commercial varieties of yams are susceptible to one or more virus. Virus infection can eliminate economic production is some fields and the use of infected seed-tubers perpetuates the disease. In Puerto Rico, we have observed mosaic symptoms on both Guinea Blanco (*D. rotundata*) as well as in Florido (*D. alata*). Yellowing and leaf deformations, causing "witches broom" has being observed mainly on Guinea Blanco. Very shiny and hard leaves that are narrower at the apex sometimes forming like a string has being observed in Florido. Because of its symptom the last disease have been named "shoe string virus".

To control virus diseases on yams we have delineated the following recommendations :

1. Select seed-tubers from vigorous healthy plants. Plants have to be tagged when still green to detect virus symptoms. When the plants are at senescence, it is impossible to distinguish healthy plants from infected ones. This practice is highly recommended since the virus can be propagated and perpetuated by planting virus infected tuber-pieces.

2. When harvesting tubers prematurely from living plants, remember to avoid plants showing virus symptoms.

3. In premature harvest, disinfest harvesting instrument between plants using the solution described earlier.

4. Keep the planting and surroundings free from weeds. They could harbor the virus or the insects that transmit them.

Anthracnose : In Puerto Rico, yam anthracnose is commonly called "candelilla" that means sudden burn. The vines and the newly formed leaves show a dieback, the tissues become necrotic and macerated and look burned. Some leaves could show irregular spots. This disease occurs at any time during emergence or before plant senescence. When the disease is

severe, defoliation occurs leaving only the naked burned vines. On Yam varieties which show some tolerance only the leaf veins on the underside show necrosis. This symptom is a diagnostic characteristic typical of anthracnose disease in many other crops and in yams is observed in all susceptible varieties. Yam anthracnose is caused by *Colletrotrichum gloeosporioides*. We have found that the fungus is tuberborne.

To reduce losses due to anthracnose the following measures need to be include in an integrated control program.

1. Plant resistant or tolerant varieties/species where the disease is prevalent. We have observed that Florido could produce tubers adequately if planted intermixed with Guinea Blanco since later is resistant to the disease. Binugas and Kinampay are good yielding varieties and their tuber characteristic are similar to Florido. In areas where Florido has being devastated by anthracnose these two varieties could replace them. The table below presents the information on variety susceptibility to anthracnose.

Variety	Reaction to anthracnose
Florido	HS
Forastero	MS
Binugas	R
Gunung	R
Kinampay	R
Purmay	R
Gemelos	HS
Moresby	HS
Guinea Blanco	R
Guinea Negro	R

key: R= resistant; S=susceptible; HS=highly susceptible; MS=moderately susceptible

2. Treat seed-tuber with pre-plant fungicides since *C. gloeoesporioides* is tuber borne.

3. Montly foliar spray of fungicides singly or in mixtures or on an alternate schedule, should be applied when the first symptoms appear on susceptible varieties. Fungicide selection should be done on those that have resulted effective, following the manufactures recommendations and according to the regulations in each country. In P.R., difolatan, benomyl, thiabendazole and chlorothalonil have partially controlled the disease. Using a tolerant or resistant variety can be alternative to a spray program and/or to reduce the number of applications.

Curvularia leaf spot : The spots caused by *Curvularia* are mainly on the leaves but also appear on petioles and vines. Lesions are small, almost round, color is black to dark brown, sometimes with a yellow halo. Guinea Blanco, Guinea Negro and Florido are susceptible to *Curvularia*. These spots are caused by two species, *C. erasgrotidis* and *C. geniculata* that are tuberbone. To control *Curvularia* leaf spot, the following recommendations are to be integrated in a control program.

1. Use pre-plant fungicides on seed-tubers or seed-pieces.

2. Use foliar fungicides when the first spots appear in the field.

3. Select resistant yam varieties. The following table presents those varieties evaluated in P.R.

Yam Variety	Reaction to Curvularia leaf spot
Guinea Blanco	S
Guinea Negro	S
Florido	S
Binugas	S
Forastero	S
Purmay	S
Gemelos	R
Gunung	R
Kinampay	R
Moresby	R

key: S=susceptible; R=resistant

4. Practice sanitation measures in the field eliminating plant residues after harvest by incorporating in the ground, etc. since plant residues harbor the pathogens.

Cercospora leaf spot : The symptoms is a round to oval leaf spot with gray center surrounded by a yellow halo in some varieties. The spots are found on leaves, petioles and vines. Defoliation could also occur. A species of *Cercospora* have been found causing the spots. Sometimes both *Cercospora* and *Curvularia* leaf spots have been found in the same leaf. For the control of *Cercospora* leaf spot, follow the recommendations outlined for *Curvularia* leaf spot control.

Leaf Scorch : This condition is characterized by extensive blotches occuring between the main veins of the leaf. The blotches color varies from light brown to tan that sometimes has a silvery cast to it. The blotches seem to occur only on the epidermis tissue. The cause of Scorch is unknown. A similar condition has been described in Africa () and a

similar condition has been atributed to *Botryodiplodia theobromae* (Ministry Overseas Development, 1978). In Puerto Rico yam varieties have shown different degrees of reactions towards Scorch as tabulated below.

Variety	Scorch reaction
Guinea Blanco	R
Binugas	S
Florido	S
Forastero	HS
Gemelos	HS
Gunung	R
Kinampay	HS
Moresby	HS
Purmay	S
Smooth Statia	S

Key: R= resistant; S= susceptible; HS= highly susceptible

Vine Blight : Dieback and drying of the vines is observed on this disease. The vines become bleached, light tan-to off white color. This disease have been observed during unusual high temperatures (88°-95°F), however such conditions are rare in the yam growing zone in Puerto Rico. The vine blight is caused by *Botryodiplodia theobromae* and have being observed on *D. rotundata* plants. We don't have information on control measures for this disease.

Rectangular leaf spot : This disease was first observed in Puerto Rico on wild *D. alata* plants. The angular shape of the brown lesions limited by the veins give the appearance of a chess board to the diseased leaves. The spots are caused by the foliar nematode *Aphelenchoides* sp. possibly *A. ritzemabosi* although it has some similarities to *A. besseyi*. To control rectangular leaf spot it is important to erradicate the diseased plants and eliminate the crop residues by burning.

REFERENCES

KERMARREC A. and A. ANAIS, 1974.- Presence of *Aphelenchoides besseyi* in foliage and tubers of yam (*Dioscorea trifida*) in the French West Indies. Nematropica 4(1):2-3.

MIGNUCCI J.S. and M. CORDERO-GARCIA, 1981a.- La semilla de name : plagas y enfermedades. Agric. Exp. Sta. and Agric. Extension Service, University of Puerto Rico. Bulletin. 13 p.

MIGNUCCI J.S. and J. GREEN, 1981b.- Yam anthracnose : disease assessment, yield loss, and chemical control. Phytopathology 72:453 (Abstr.).

MIGNUCCI J.S., J. GREEN and P.R. HEPPERLY, 1981c.- Yam anthrac nose control. 1980. Amer. Phytopath. Soc. Fungicide and Nematicide Test Results, 37:90.

MIGNUCCI J.S., H. VELEZ-MARTINEZ and P.R. HEPPERLY, 1981d.- Yam seed-piece treatments. 1981. Amer. Phytopath Soc., Fungicide and Nematicide Test Results: 37:187.

MIGNUCCI J.S., J. GREEN, M. CORDERO and P.R. HEPPERLY, 1982.- Disease losses of yam (*Dioscorea* spp.) in Puerto Rico. Phytopathology 72:894.

MIGNUCCI J.S., C. DE KOK, M. SANTIAGO, J. GREEN, P.R. HEPPERLY, H. VELEZ and TORRES-LOPEZ, 1984a.- Yam (*Dioscorea* spp) management for control of tuber decay. In Symposium of the International Society for Tropical Root Crops, 6th. Lima 1983 Proceedings, International Potato Center, CIP, pp 607-613.

MIGNUCCI J.S., P.R. HEPPERLY, H. VELEZ and R. TORRES-LOPEZ, 1984b.- Yam Protection I : Seed piece treatment with fungicides. J. Agric. Univ. of P.R. 68:185-192.

MIGNUCCI J.S., M. SANTIAGO and J. GREEN, 1983.- Integrated control of yam tuber decay in Puerto Rico. Phytopathology 73:801.

MIGNUCCI J.S., M. CORDERO and H. CIBES-VIADE, 1985.- Enfermedades, Plagas y Deficiencias Nutricionales en las plantas de name (Diseases, Pests and Nutritional Deficiencies of Yam Plant), Mayaguez, P.R. 00708. Bulletin, in press. Available for free distribution on August 1985.

Ministry of Overseas Development, 1978.- Pest Control in Tropical Root Crops, PANS Manual N°. 4. Centre of Overseas Pest Research, London U.K. 235 p.

RAMOS-BUSIGO, DORA and J.S. MIGNUCCI, 1985.- Fusarium causes diseases of yam in Puerto Rico. Fusarium Notes-An International Newsletter. Ed. C.E. Windels, Univ. of Minnesota and FAO, United NAtions, p. 4.

ROMAN J., D. ORAMAS and J. GREEN, 1984.- Nematicide evaluation for the control of the nematodes of yam (*Dioscorea rotundata*). Journal Univ. of Puerto Rico. 68:157-160.