THE JOURNAL OF AGRICULTURE
OF THE UNIVERSITY OF PUERTO RICO

Issued quarterly by the Agricultural Experiment Station of the University of Puerto Rico, Mayagüez Campus, for the publication of articles and research notes by staff members or others, dealing with scientific agriculture in Puerto Rico and elsewhere in the Caribbean Basin and Latin America.

Vol. LXIX JULY 1985 No. 3

Critical Levels of Dry Rotting of Yellow Yam (*Dioscorea cayenensis*) Planting Material and Control of *Pratylenchus coffeae*[1]

D. G. Hutton, Abdul H. Wahab, Joseph Dehaney and Alejandro Ayala[2]

ABSTRACT

Of the noxious nematodes associated with yams (*Dioscorea* spp.) in Jamaica, *Pratylenchus coffeae* is the only one found infesting yellow yam (*D. cayenensis*) edible roots affected by a dry rot called "burning." There was earlier and significantly more sprouting of lightly or heavily dry-rotted yellow yam "heads" which were dipped for 40 min in a 1500 p/m oxamyl solution or lightly dry-rotted undisinfested heads and plants arising from them developed more vigorously than heavily dry-rotted undisinfested heads. There was significantly less bearing plants in plots planted with heavily dry-rotted undisinfested heads; greatest gross weights of marketable yams were borne in plots planted with lightly or heavily dry-rotted disinfested heads and lightly dry-rotted undisinfested heads. Oxamyl or ethoprop applied 11, 22 and 33 weeks after planting suppressed populations of *P. coffeae* in soil and roots at 39 weeks but did not influence yields; yams from oxamyl-treated plots showed significantly fewer symptoms of dry rot. The dry rot appears to damage or destroy stem and root primordia resulting in badly affected planting material not sprouting or plants not being vigorous. Conditions favoring rapid development of the dry rot seem to prevail after heads are planted. Disinfection suppresses populations of nematodes associated with dry rot and development of the rot itself.

INTRODUCTION

Yam (*Dioscorea* spp.) edible roots in Jamaica are affected by a dry rot called "burning" or "burn", with which parasitic nematodes (*Pratylenchus coffeae, Scutellonema bradys* and *Hoplolaimus* sp.) are associated. The dry rot is characterized by a cracking of the skin which is underlain by a corky rot in the storage tissues (2, 6). No yellow yam (*D. cayenensis*) free of *P. coffeae* has thus far been found. This is the only noxious nematode found infesting this cultivar in Jamaica. It seems that the dry rot, which spreads over the edible root surface and progresses deeper into the tissues when yams are stored before planting, damages or destroys

[1] Manuscript submitted to Editorial Board May 7, 1984.

[2] Nematologist, Ministry of Agriculture/Jamaica; Former Agricultural Research Specialist, IICA/Jamaica, now Assistant Agricultural Development Officer/U.S. AID/Haiti; Soil Conservation Officer, Ministry of Agriculture/Jamaica; and Nematologist, College of Agricultural Sciences, University of Puerto Rico, Mayagüez Campus.

stem and root primoridia. Thus, plants arising from severely dry-rotted heads[3] might be unthrifty or such heads might not sprout causing poor stands. In previous trials, disinfesting yam planting material by hot water or nematicide dips suppressed noxious nematodes, reduced dry rot, promoted higher and earlier germination and more vigorous vines than undisinfested heads. In trials with yellow yams, significantly more oxamyl-disinfested heads sprouted than undisinfected heads (1, 5).

With certain crops, such as plantains, bananas and some ornamentals, post-plant nematicide treatments are a standard feature in nematode control. In a trial with yellow yams, edible roots from plots treated twice during the season with a nematicide were less affected by the nematode-related dry rot than those from untreated plots (5).

The experiment herein reported attempted to determine what are the critical levels of dry rotting of yellow yam heads, i.e., the level at which significant damage or destruction of stem and root primordia might occur and the level of dry rotting which therefore is acceptable in planting material; how disinfesting benefits heads with dry rotting (light or heavy) by noxious nematodes, *Pratylenchus coffeae* in this case; and how post-plant nematicide treatments reduce the levels of dry rotting on harvested yams and increase yields.

MATERIALS AND METHODS

Light and severely dry rotted heads were selected from a batch of recently harvested yams. The first group consisted of heads with less than 15% of the surface showing symptoms of dry rot and with depth of any dry rot ranging from 1 to 2 mm. The second group consisted of heads with more than 66% of the surface showing dry rot with depth of the rot ranging from 4 to 11.5 mm. One-half of the yams from each group were dipped for 40 min in a 1500 p/m solution of oxamyl-methyl N′N′-dimethyl-N-[methylcarbamoyl)oxy)-1-thiooxamimidate. Three days later, the heads were planted 0.67 m apart on continuous contour mounds spaced 1.5 m apart for a crop density of 10,000 plants/ha. The site had been cropped to yellow yams continuously for at least 10 years. At 11, 22 and 33 weeks after planting, plots were treated with oxamyl G (12.2 kg ai/ha), or ethoprop G (O-ethyl S, S-dipropyl phosphorodithioate); 13.9 kg ai/ha), or left untreated for the following 12 treatments:

Heavily dry-rotted heads dipped in oxamyl; ethoprop applied post-planting.

Heavily dry-rotted heads dipped in oxamyl; oxamyl applied post-planting.

Heavily dry-rotted heads dipped in oxamyl; no post-plant treatment.

Heavily dry-rotted heads untreated; ethoprop applied post-planting.

[3] Planting material.

Heavily dry-rotted heads untreated; oxamyl applied post-planting.
Heavily dry-rotted heads untreated; no post-plant treatment.
Lightly dry-rotted heads dipped in oxamyl; ethoprop applied post-planting.
Lightly dry-rotted heads dipped in oxamyl; oxamyl applied post-planting.
Lightly dry-rotted heads dipped in oxamyl; no post-plant treatment.
Lightly dry-rotted heads untreated; ethoprop applied post-planting.
Lightly dry-rotted heads untreated; oxamyl applied post-planting.
Lightly dry-rotted heads untreated; no post-plant treatment.

The 12 treatments were replicated thrice in a randomized complete block design. The nematicides were sprinkled after planting unto the ground, around plants and then worked-in lightly.

At 6, 7, 9, 11 and 22 weeks after planting, sprouted heads were counted. At 6, 9 and 11 weeks, vine height was measured. The width of leaves was taken at 6 weeks (first node) and 17 weeks (second node). Samples of soil and root material were taken at 39 weeks for estimating levels of *P. coffeae*.

At harvest (47 weeks), *P. coffeae* in the soil and root skin (peeling) was again counted. Each yam was rated for the nematode-related dry rot on a 1 to 5 scale where 1, 2, 3, 4 and 5 signified that 1 to 20%, 21 to 40%, 41 to 60%, 61 to 80% and 81 to 100%, respectively, of the root surface was affected by the dry rot. Gross root weight, weight of heads and weight of marketable yams produced by each plant were recorded.

This trial was carried out at Olive River, an adjunct to the Allsides Pilot Development Project, on a site farmed cooperatively by the Inter-American Institute for Cooperation to Agriculture and the Ministry of Agriculture, Jamaica. Plots were fertilized with a mixture of $N:P_2O_5:K_2O$ (12:24:12) at the rate of 1460 kg/ha, split in two applications at 6 and 14 weeks from planting. Economy of staking was achieved by using one 6- to 8-m long bamboo stake for every four plants.

RESULTS AND DISCUSSION

Heavily dry rotted heads which remained undisinfested of *P. coffeae* took longer to sprout compared to heavily dry rotted disinfested heads and lightly dry rotted disinfested or undisinfested heads. At 6, 7, 9 and 11 weeks after planting, significantly more of the lightly dry rotted disinfested or undisinfested heads had sprouted compared with heavily dry rotted undisinfested heads. Sprouting of heavily dry rotted heads dipped in oxamyl occurred significantly earlier than heavily dry rotted undisinfested heads. Overall, lightly dry rotted heads which remained undipped sprouted earliest (table 1). Plants arising from heavily dry

rotted undisinfested heads were the least vigorous as measured by vine height and leaf size (table 1).

At 39 weeks from planting, highest numbers of *P. coffeae* were found in the soil and root samples from plots which received no post-plant nematicide treatment. However, soil and root samples from plots in which undisinfested, heavily dry rotted heads were planted and which received no post-plant nematicide treatment had relatively low levels of the nematode. Treatments with ethoprop or oxamyl suppressed *P. coffeae*, but roots of plants from the ethoprop-treated plots harbored lowest levels

TABLE 1.—*Earliness of sprouting of yellow yam* **(Dioscorea cayenensis)** *planting material (heads) and growth and development of plants in a trial to investigate critical levels of dry rotting and the benefits of disinfesting the heads*

Treatments	Sprouting at indicated weeks after planting					Plant height at indicated weeks after planting			Leaf width at indicated weeks after planting	
	6	7	9	11	22	6	9	11	6 (1st node)	17 (2nd node)
			%				*m*		*cm*	
Heavily dry-rotted[1] heads disinfested with Oxamyl[2]	20	43	72	91	99	0.42	1.23	1.90	6.7	13.5
Heavy dry-rotted[1] undisinfested heads	15	27	64	77	92	0.38	0.90	1.68	6.4	12.9
Lightly dry-rotted[3] heads disinfested with Oxamyl[2]	35	51	88	97	99	0.29	1.12	1.99	6.6	13.6
Lightly dry-rotted[3] undisinfested heads	40	58	90	96	99	0.38	1.32	2.22	6.9	13.5
LSD 5%	9.0	10.7	8.3	9.4	—	—	—	0.37	—	0.56

[1] More than 66% of surface of head affected by the dry rot and depth of rot 4–11.5 mm (mean 6.6 mm).

[2] Dipped for 40 min in a 1500 p/m solution.

[3] Less than 15% of surface of head affected by the dry rot and depth of rot 1–2 mm (mean 1.5 mm).

of the nematodes at 39 weeks. However, at harvest, there was no difference in the levels of *P. coffeae* in the soil nor skin of roots irrespective of whether plots were treated with a nematicide (table 2).

There was no evidence that the post-plant nematicide treatments influenced gross yam production, but oxamyl treatments reduced dry rot on harvested yams significantly (table 3). However, planting lightly dry-rotted heads or heads disinfested of *P. coffeae* clearly influenced gross edible root yields. There was significantly less bearing among plants from heavily dry-rotted undisinfested heads than from those from lightly dry-

rotted undisinfested or disinfested heads. Lowest yields were observed in plots planted with heavily dry-rotted undisinfested heads. Highest yields were obtained from plants from lightly dry-rotted disinfested heads (table 3).

Results from this trial indicate that as the nematode-related dry rotting on yellow yam heads becomes more severe, the more unfit are these heads for planting material. Degras and Mathurin (3) reported that as yams of certain *Dioscorea* spp. mature, undifferentiated cellular blocks

TABLE 2.—*Qualitative and gross tuber yields of yellow yam* **(Dioscorea cayenensis)** *in a trial to investigate critical levels of dry rotting of heads and the benefits of disinfesting the heads of* **Pratylenchus coffeae** *at planting followed by post-plant nematicide treatments*

Treatments		Bearing plants (%)	Level of dry rotting[1] on tubers	Tuber yields per plot planted with 10 heads (kg)		
Before planting	After planting			Total	Heads	Marketable
Heavily dry-rotted[2]	Ethoprop[3]	94	3.2	40.93	11.93	25.27
heads disinfected	Oxyamyl[4]	94	2.9	41.27	10.83	25.53
with Oxamyl[5]	None	94	3.7	41.97	11.80	21.33
Heavily dry-rotted[2]	Ethoprop[3]	86	3.5	37.60	9.60	21.73
undisinfested heads	Oxamyl[4]	78	2.6	29.30	9.03	17.57
	None	81	3.4	33.47	10.93	13.60
Lightly dry-rotted[6]	Ethoprop[3]	94	3.0	38.70	11.10	24.90
heads disinfested	Oxamyl[4]	100	3.1	50.33	12.90	30.37
with Oxamyl[5]	None	100	3.3	46.10	12.13	27.80
Lightly dry-rotted[6]	Ethoprop[3]	90	3.7	35.60	11.47	21.80
undisinfested heads	Oxamyl[4]	94	3.5	41.97	13.00	26.00
	None	94	4.3	37.47	12.17	20.40
LSD 5%		9.4	0.7	10.40	—	—

[1] Dry rotting rated on a 1–5 scale where 1, 2, 3, 4 and 5 = 1–20%, 21–40%, 41–60%, 61–80%, and 81–100%, respectively of the head's surface having the dry rot.

[2] More than 66% of surface of head affected by the dry rot and depth of rot 4 to 11.5 mm (mean 6.6 mm).

[3] 13.9 kg ai/ha of Ethoprop 10G at 11, 22 and 33 weeks.

[4] 12.2 kg ai/ha of Oxamyl 10G at 11, 22 and 33 weeks.

[5] Dipped for 40 min in a 1500 p/m solution.

[6] Less than 15% of surface of head affected by the dry rot and depth of rot 1 to 2 mm (mean 1.5 mm).

appear in the deep cortical layers. These cellular blocks are later involved in morphogenesis, generally according to a gradient in favor of the stem end of the tuber. It appears that as the dry rot spreads and penetrates deeper into the yam head, these cellular blocks are injured or destroyed. The ability of badly affected heads to produce vigorous plants would gradually diminish and eventually, when all primordia are destroyed, such heads would not germinate. It seems that when yam heads are planted, soil temperature and moisture favor rapid development of pop-

ulations of noxious nematodes and of the nematode-related dry rot, and as a consequence, primordia are injured or destroyed. Disinfestation of yam planting material has been shown to suppress populations of invading nematodes and development of the dry rot; disinfested planting material produced vigorous plants (4).

Results of this trial demonstrate that there are advantages in using planting material with little evidence of the dry rot; disinfestation pro-

TABLE 3.—*Qualitative and gross edible root yields of yellow yam* **(Dioscorea cayenensis)** *in a trial to investigate critical levels of dry rotting of planting material and the benefits of disinfesting the heads of* **Pratylenchus coffeae** *at planting followed by post plant nematicide treatments*

Treatments		Bearing plants	Level of dry rotting[1] on tubers	Tuber yields per plot planted with 10 heads		
Before planting	After planting			Total	Heads	Marketable
		%			*kg*	
Heavily dry-rotted[2]	Ethoprop[3]	94	3.2	40.93	11.93	25.27
heads disinfested	Oxamyl[5]	94	2.9	41.27	10.83	25.53
with Oxamyl[4]	None	94	3.7	41.97	11.80	21.33
Heavily dry-rotted[2]	Ethoprop[3]	86	3.5	37.60	9.60	21.73
undisinfested heads	Oxamyl[5]	78	2.6	29.30	9.03	17.57
	None	81	3.4	33.47	10.93	13.60
Lightly dry-rotted[6]	Ethoprop[3]	94	3.0	38.70	11.10	24.90
heads disinfested	Oxamyl[5]	100	3.1	50.33	12.90	30.37
with Oxamyl[3]	None	100	3.3	46.10	12.13	27.80
Lightly dry-rotted[6]	Ethoprop[3]	90	3.7	35.60	11.47	21.80
undisinfested heads	Oxamyl[5]	94	3.5	41.97	13.00	26.00
	None	94	4.3	37.47	12.17	20.40
LSD 5%		9.4	0.7	10.40	—	—

[1] Dry rotting rated on a 1–5 scale where 1, 2, 3, 4 and 5 = 1–20%, 21–40%, 41–60%, 61–80%, and 81–1000%, respectively of the head's surface having the dry rot.

[2] More than 66% of surface of head affected by the dry rot and depth of rot 4–11.5 mm (mean 6.6 mm).

[3] 13.9 kg ai/ha of Ethoprop 10G at 11, 22 and 33 weeks.

[4] Dipped for 40 min in a 1500 p/m solution.

[5] 12.2 kg ai/ha of Oxamyl 10G at 11, 22 and 33 weeks.

[6] Less than 15% of surface of head affected by the dry rot and depth of rot 1–2 mm (mean 1.5 mm).

vides further benefits, especially increased yields. In the case of heads severely affected by the dry rot, disinfestation results in earlier and more sprouting, increased vigor of plants and increased yields. It appears that poor stands and more non-bearing plants were the important factors related to decreased yields when heavily dry-rotted undisinfested heads were planted compared to lightly dry-rotted heads or disinfested heads.

Post-plant applications of oxamyl and ethoprop suppressed levels of *P. coffeae* in the soil and roots of the yellow yam plants. Applications of oxamyl resulted in significantly less dry rotting of harvested edible roots thus enhancing their suitability as planting material.

RESUMEN

De los nematodos que afectan el ñame (*Dioscorea* spp.) en Jamaica, el *Pratylenchus coffeae* es el único que se ha encontrado que afecte el ñame amarillo *D. cayenenis*, causando una podredumbre seca. Las plantas que se desarrollan de los pedazos de tubérculos afectados leve o severamente por la podredumbre seca que se sumergieron por 40 minutos en una solución de 1,500 ppm de "oxamyl", fueron más vigorosas que las de pedazos severamente afectados que no se desinfectaron. En las parcelas sembradas con pedazos sin desinfectar se desarrolló un mayor número de plantas estériles. En las sembradas con pedazos leve o severamente afectados, pero desinfectados, se obtuvieron los rendimientos más elevados de ñames comerciales. El tratamiento de los pedazos con "oxamyl" o "ethropop" 11, 22 y 33 semanas después de sembrados propició la multiplicación de *P. coffeae* en el suelo y en las raíces, pero no propició el aumento en rendimiento.

LITERATURE CITED

1. Coates-Beckford, P. L., 1978. *In*: Investigations 1976. Bull. No. 66 (New Series), Min. of Agric., Jamaica. pp. 52–9.
2. Coates-Beckford, P. L. and Brathwaite, C. W. D., 1977. Nematropica 7 (2): 20–6.
3. Degras, L. and Mathurin, P., 1980. *In*: A Newsletter for Research on Yam, Intl. Seminar on Yam, INRA, Petit-Bourg, Guadeloupe, pp. 27–8 (Abstr.).
4. Hutton, D. G., *In*: Investigations 1978. Bull. 68 (New Series), Min. Agric. Jamaica.
5. ——, *In*: Investigations 1979. Bull. 69 (New Series), Min. of Agric., Jamaica.
6. Nwankiti, A. O. and Arene, O. B., 1978. PANS 24 (4): 486–94.