INVESTIGATING CRITICAL LEVELS OF DRY ROTTING OF YELLOW YAM (DIOSCOREA CAYENENSIS) PLANTING MATERIAL, THE BENEFITS OF DISINFESTING THE HEADS OF PRATYLENCHUS COFFEAE AND OF AFTER-PLANTING NEMATICIDE TREATMENTS

IICA/JAMAICA

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D. G. Hutton, A. H. Wahab and J. Dehaney 2/

ABSTRACT

Several noxious nematodes are associated with yams (Dioscorea spp) in Jamaica but Pratylenchus coffeae is the only one found infesting yellow yam (D. cayenensis) tubers affected by a dry rot called "burning". There was earlier and significantly more sprouting of lightly or heavily dry-rotted yellow yam heads (planting material) which were dipped for 40 min in a 1500 ppm Oxamyl solution or lightly dry-rotted undisinfested heads and plants arising from them developed more vigourously (as measured by vine height and leaf size) compared with heavily dry-rotted undisinfested heads. There was significantly less bearing plants in plots planted with the heavily dry-rotted undisinfested heads; greatest gross weights of tubers and 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 quantitative production; tubers from Oxamyl-treated plots showed significantly less of the dry rot. The dry rot appears to damage or destroy stem and root primordia resulting in badly affected

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2/ Nematologist, Plant Protection Division, MINAG, Agricultural Research Specialist, IICA and Soil Conservation Officer, MINAG, respectively.

planting material not sprouting or plants not being vigourous. Conditions favouring rapid development of the dry rot seem to prevail after heads are planted. Disinfestation suppresses populations of the nematodes associated with the dry rot and development of the rot itself. Results suggest that only those yellow yam heads with the least evidence of the dry rot or disinfested heads should be planted. It is recommended that an agency be established to see to the disinfestation of yam planting material in the first instance and eventually be responsible for providing "clean" planting material.

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INTRODUCTION

Yam (Dioscorea spp) tubers 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 characterised by cracking in the skin underlaid by a corky rot in the storage tissues (2,8). No yellow yam (D. cayenensis) tuber free of P. coffeae has yet been found by the senior author; to date, this is the only noxious nematode found infesting tubers of this cultivar. It seems that the dry rot, which spreads over the tuber's surface and progresses deeper into the yam tissues as tubers or parts of tubers are stored prior to being planted, damages or destroys stem and root primordia. Thus, plants arising from severely dry-rotted heads might be unthrifty or such heads might not sprout resulting in poor stands. In previous trials, disinfesting yam planting material by hot water or nematicide dips resulted in suppression of noxious nematodes and development of the dry rot, higher and earlier germination and vines that were more vigourous compared with undisinfested heads. In trials using yellow yams, significantly more Oxamyl-disinfested heads sprouted than undisinfested heads (1,7).

With certain crops (plantain, banana, some ornamentals, etc.), post-plant nematicide treatments are a standard feature of nematode control. In a trial with yellow yams, tubers from plots treated with a nematicide twice during the season were less affected by the nematode-related dry rot than tubers from untreated plots (7). If indeed the dry rot damages/destroys stem and root primordia, then any treatment which causes tubers or parts of tubers used as planting material to have less of the dry rot would be beneficial.

This trial was carried out to determine (i) the critical levels of dry rotting of yellow yam heads, i.e., the level at which significant damage/destruction of stem and root primordia might occur and the level of dry rotting which therefore is acceptable in

planting material, (ii) the benefits of disinfesting heads having the extremes of dry rotting (light or heavy) of noxious nematodes, Pratylenchus coffeae in this case, and (iii) the effects of post-plant nematicide treatments in reducing the levels of dry rotting on harvested tubers as well as on quantitative yields.

MATERIALS AND METHODS

Light and severely dry rotted yellow yam heads were selected from a batch of recently-harvested tubers. The first group consisted of heads with less than 15% of the surface having symptoms of the dry rot and with depth of any dry rot ranging from 1 - 2 mm (avg. 1.5 mm). The second group consisted of heads with more than 66% of the surface having the dry rot with depth of the rot ranging from 4 - 11.5 mm (avg. 6.6 mm). One-half of the yams from each group were dipped for 40 min in a 1500 ppm 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 giving a crop density of 10,000 plants/ha. The site had been cropped to yellow yams continuously for at least 10 years. Eleven, 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 giving 12 treatments viz:

1. Heavily dry-rotted heads dipped in Oxamyl; Ethoprop applied post-planting

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

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

4. Heavily dry-rotted heads untreated; Ethoprop applied post-planting

5. Heavily dry-rotted heads untreated; Oxamyl applied post-planting

6. Heavily dry-rotted heads untreated; no post-plant treatment

7. Lightly dry-rotted heads dipped in Oxamyl; Ethoprop applied post-planting

8. Lightly dry-rotted heads dipped in Oxamyl; Oxamyl applied post-planting

9. Lightly dry-rotted heads dipped in Oxamyl; no post-plant treatment

10. Lightly dry-rotted heads untreated; Ethoprop applied post-planting

11. Lightly dry-rotted heads untreated; Oxamyl applied post-planting

12. Lightly dry-rotted heads untreated; no post-plant treatment.

The 12 treatments were replicated thrice using a randomised complete block design. The nematicides applied after planting were sprinkled onto the ground around plants then worked in lightly.

Six, seven, nine, 11 and 22 weeks after planting, sprouted heads were counted. At six, nine and 11 weeks, vine height was measured. The width of leaves was taken at six (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 soil and tuber skin (peeling) was again counted. Each tuber was rated for the nematode-related dry rot on a 1 - 5 scale where 1,2,3,4 and 5 signified that 1-20%, 21-40%, 41-60%, 61-80% and 81-100% respectively of the tuber's surface was affected by the dry rot. Gross tuber 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 co-operatively by the Inter-American Institute for Co-operation on 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 six and 14 weeks from sowing. Economy of staking was achieved by using one 6-8 meter long bamboo stake for every four plants.

RESULTS

Heavily dry rotted heads which remained undisinfested of P. coffeae took longer to sprout compared with heavily dry rotted disinfested heads and lightly dry rotted disinfested or undisinfested heads. Six, seven, nine 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 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 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 contained comparatively low levels of the nematode. Treatments with Ethoprop or Oxamyl suppressed P. coffeae but roots of plants from the Ethoprop-treated plots harboured lowest levels of the nematode at 39 weeks. However, at harvest there was no difference in the levels of P. coffeae in soil nor skin of tubers irrespective of whether plots were treated with a nematicide or not (Table 2).

There was no evidence that the post-plant nematicide treatments influenced gross tuber production but Oxamyl treatments resulted in significant reductions in the dry rot ("burning")

observed on harvested tubers (Table 3). However, planting lightly dry-rotted heads or heads disinfested of P. coffeae clearly influenced gross tuber yields. There was significantly less bearing among plants from heavily dry-rotted undisinfested heads compared with those from lightly dry-rotted undisinfested heads or disinfested heads. Lowest tuber yields were observed in plots planted with heavily dry-rotted undisinfested heads. Highest yields were produced by plants arising from lightly dry-rotted disinfested heads (Table 3).

DISCUSSION

Results from this trial indicate that as the nematode-related dry rotting on yellow yam heads becomes more severe, the more unfit these heads become as planting material. Degras and Mathurin (4) reported that as tubers of certain Dioscorea spp mature, undifferentiated cellular blocks appear in the deep cortical layers. These cellular blocks are later involved in morphogenesis generally according to a gradient in favour 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 favour rapid development of populations 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 and disinfested planting material produced vigorous plants (6).

Results of this trial demonstrate that there are advantages to using planting material with little evidence of the dry rot; disinfestation provides further benefits, especially increased tuber yields. In the case of heads severely affected by the dry

rot, disinfestation results in earlier and more sprouting, increased vigour of plants and increased quantitative yields. It appears that poor stands and more non-tuber bearing plants were the important factors related to decreased quantitative yields when heavily dry-rotted undisinfested heads were planted compared with lightly dry-rotted heads or disinfested heads.

Post-plant applications of Oxamyl and Ethoprop suppressed levels of P. coffeae in the soil about and roots of the yellow yam plants. Applications of Oxamyl resulted in significantly less dry rotting of harvested tubers thus enhancing the suitability of these tubers as planting material.

The authors recommend that the Ministry of Agriculture or a designated agency establish pilot schemes in the major yam-growing areas for the purpose of disinfesting yam planting material, preferably with Oxamyl. We further recommend the establishment of large-scale field trials designed to assess the economic benefits of disinfested planting material. These actions followed by the deployment of an agency to provide "clean" yam planting material are seen as imperative if increased production and productivity of yams are to be realised in Jamaica.

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

TREATMENTS	Sprouting after planting (%)					Plant height (m)			Leaf width (cm)	
	6 wk	7 wk	9 wk	11 wk	22 wk	6 wk	9 wk	11 wk	6 wk 1st node	17 wk 2nd node
Heavily dry-rotted[a] heads disinfested with Oxamyl[c]	20	43	72	91	99	0.42	1.23	1.90	6.7	13.5
Heavily dry-rotted[a] undisinfested heads	15	27	64	77	92	0.38	0.90	1.68	6.4	12.9
Lightly dry-rotted[b] heads disinfested with Oxamyl[c]	35	51	88	97	99	0.29	1.12	1.99	6.6	13.6
Lightly dry-rotted[b] 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

a More than 66% of surface of head affected by the dry rot and depth of rot 4 - 11.5 mm (avg. 6.6 mm).

b Less than 15% of surface of head affected by the dry rot and depth of rot 1 - 2 mm (avg. 1.5 mm).

c Dipped for 40 min in a 1500 ppm solution.

TABLE 2. - Numbers of *Pratylenchus coffeae* found in soil about, roots of and skin of tubers borne by yellow yam (*Dioscorea cayenensis*) plants in a trial investigating critical levels of dry rotting of planting material (heads), the benefits of disinfesting the heads and the use of post-plant nematicide treatments

TREATMENTS		NUMBERS OF P. COFFEAE			
Before planting	After planting	At 39 weeks		At harvest (47 wk)	
		Per 100 ml soil	Per 10 gm root	Per 100 ml soil	Per 10 gm tuber skin
Heavily dry-rotted[a] heads disinfested with Oxamyl[c]	Ethoprop[d]	17	20	19	70
	Oxamyl[e]	3	160	21	40
	None	90	1270	20	110
Heavily dry-rotted[a] undisinfested heads	Ethoprop[d]	3	30	8	50
	Oxamyl[e]	1	200	9	60
	None	20	290	23	80
Lightly dry-rotted[b] heads disinfested with Oxamyl[c]	Ethoprop[d]	3	30	25	80
	Oxamyl[e]	5	340	2	40
	None	73	2250	26	90
Lightly dry-rotted[b] undisinfested heads	Ethoprop[d]	3	90	5	70
	Oxamyl[e]	3	330	27	100
	None	130	860	29	80
LSD 5%		62	795	-	-

a More than 66% of surface area of head affected by the dry rot and depth of rot 4 - 11.5 mm (avg. 6.6 mm).

b Less than 15% of surface area of head affected by the dry rot and depth of rot 1 - 2 mm (avg. 1.5 mm).

c Dipped for 40 min in a 1500 ppm solution.

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

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

TABLE 3. - Qualitative and gross tuber yields of yellow yam (*Dioscorea cayenensis*) in a trial to investigate critical levels of dry rotting of planting material (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[f] on tubers	Tuber yields per plot planted with 10 heads (kg)		
Before planting	After planting			Total	Heads	Marketable
Heavily dry-rotted[a] heads disinfested with Oxamyl[c]	Ethoprop[d]	94	3.2	40.93	11.93	25.27
	Oxamyl[e]	94	2.9	41.27	10.83	25.53
	None	94	3.7	41.97	11.80	21.33
Heavily dry-rotted[a] undisinfested heads	Ethoprop[d]	86	3.5	37.60	9.60	21.73
	Oxamyl[e]	78	2.6	29.30	9.03	17.57
	None	81	3.4	33.47	10.93	13.60
Lightly dry-rotted[b] heads disinfested with Oxamyl[c]	Ethoprop[d]	94	3.0	38.70	11.10	24.90
	Oxamyl[e]	100	3.1	50.33	12.90	30.37
	None	100	3.3	46.10	12.13	27.80
Lightly dry-rotted[b] undisinfested heads	Ethoprop[d]	90	3.7	35.60	11.47	21.80
	Oxamyl[e]	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	-	-

a More than 66% of surface of head affected by the dry rot and depth of rot 4 - 11.5 mm (avg. 6.6 mm).

b Less than 15% of surface of head affected by the dry rot and depth of rot 1 - 2 mm (avg. 1.5 mm).

c Dipped for 40 min in a 1500 ppm solution.

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

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

f 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.

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