CARIBBEAN FOOD CROPS SOCIETY

27

Twenty Seventh Annual Meeting 1991

DOMINICA

Vol. XXVII

EFFECT OF FUNGICIDE TREATMENT ON POST-HARVEST LOSSES OF CASSAVA (*Manihot esculenta* Crantz) CULTIVARS IN PUERTO RICO

F. M. Cárdenas-Guillen[1], P. Hepperly, and F. Vázquez[2]

[1]University of Puerto Rico and
[2]USDA, ARS Tropical Agriculture Research Station
Box 70, Mayaguez, Puerto Rico

ABSTRACT

In many tropical regions, cassava is a major food source, especially for subsistence farmers. It is high in carbohydrates and very productive in semi-arid regions and poor, acid soils. Production of cassava has consistently increased in recent years, but post-harvest deterioration continues as a major obstacle to its greater commercialization. Over 40 introduced and local cultivars were planted at Isabela, Puerto Rico, to determine post-harvest losses as influenced by fungicide treatment, cultivar, and storage time. Root deterioration was rated at four and 16 days after harvest using the CIAT scale. Hydrogen cyanide (HCN) content was determined at harvest; and dry matter content and culinary quality were measured at harvest and on the two-post harvest dates. Before storage, roots were either not treated or submerged in 4,000 ppm thiabendazole in aqueous solution. Some of the introduced cultivars showed superior storage and culinary qualities compared to the Puerto Rican commercial cultivars evaluated. Resistant cultivars and fungicide treatment were highly effective in delaying post-harvest deterioration. When treated with fungicide, 10 cultivars had maintained less that 5% root deterioration at 16 days after harvest. PI 12903 had outstanding culinary quality even after 16 days' storage. Only Brava and PI 9608 contained dangerously high levels of HCN, exceeding 115 ppm.

INTRODUCTION

Cassava is the fourth most important source of food energy in the tropics. Two-thirds of its production is consumed directly by humans, and the rest is either used as animal feed or processed industrially (Cock, 1982). In Puerto Rico in 1987-88, 52,000 cwt of cassava were produced (Rivera, 1989). Local production does not meet island demand, and substantial quantities of cassava are imported, mainly from the Dominican Republic, Costa Rica, and Colombia.

Post harvest deterioration of cassava is considered a serious limitation to its greater use and commercialization (Booth, 1976). Within two to three days after harvest, cassava roots may deteriorate significantly from physiological and microbial decay. The goal of our research was to determine to what extent varietal selection and fungicide treatment can decrease post-harvest losses and extend the marketing period of cassava.

MATERIALS AND METHODS

In 1989-90, over 40 cassava cultivars were grown in single-row field plots at the Isabela Substation of the Tropical Agriculture Research Station, USDA-ARS, in Mayaguez, P.R. Isabela is situated in the northwest sector of Puerto Rico and has a subhumid climate (1,658 mm mean annual rainfall). The soil is a leached sandy Coto clay Oxisol.

Cassava root hydrogen cyanide (HCN) content was determined at harvest by the CIAT rapid evaluation method. Dry matter (DM) content and culinary quality (CQ) were measured at harvest and four and 16 days after. To determine DM, samples were dried at 60ºC for 72 hours under forced air and weighed before and after the drying period. The criteria for CQ included cooking time, fiber content, and taste. Roots were either not treated or treated with thiabendazole fungicide before storage. Fifty per cent of the whole roots was submerged in a 4,000 ppm aqueous solution of the fungicide for 30 min. at 28ºC. All roots were stored in closed polyethylene bags under shade at 28ºC. On the two post-harvest dates, five rnadomly-selected roots of each cultivar were cut in four cross-sections to determine the extent of decay using the CIAT visual scale for physiological and pathological deterioration (CIAT, 1982).

RESULTS AND DISCUSSION

Dry Matter Content.

Most cultivars showed low levels of dry matter. However, six cultivars had acceptable levels that exceeded 30%. Generally, losses of less than 10% were found in dry matter after 16 days of storage whether roots were treated with fungicide or not (Table 1).

HCN.

Cyanide content varied from 15 to 150 ppm (Table 2). Brava and PI 9608 exceeded recommended levels of HCN. The other cultivars were mainly below 100 ppm and would not be considered dangerous to eat under normal conditions.

Culinary Quality.

The cultivars PI 12903, Pana Monacillos, Cubana, Inglesa, D-D-1, and Llanera had outstanding culinary quality even exceeding that ot the test cultivars used commercially in Puerto Rico (e.g., Hondureña and Venezolana). PI 12903 appeared superior to all other cultivars in terms of culinary quality after storage and had low storage losses (Tables 3 and 4).

Post-Harvest Losses.

After four and 16 days, ten and five cultivars had maintained less an 5% storage, respectively, even without fungicide treatment (Table 4).

Table 1. Dry matter content at harvest and during storage of cassava cultivars grown in Isabela, Puerto Rico, in 1989-90 and treated with thiabendazole fungicide or not treated.

Cultivar	Dry matter content (%)					
	Treated			Not treated		
	Days after harvest			Days after harvest		
	0	4	16	0	4	16
PI 9608	28.8	28.4	27.3	28.8	28.5	27.3
Jamaica	32.5	32.0	32.0	32.5	31.9	32.0
PI 19902	30.1	29.5	29.5	30.1	30.0	28.0
Brava	33.8	33.6	32.1	33.8	33.5	32.1
Mc 22	30.1	29.4	29.3	30.1	28.4	29.0
PI 9570	26.6	25.7	24.0	26.6	25.9	24.3
PI 12903	30.8	30.3	28.1	30.8	30.0	29.5
Pana	33.5	32.9	32.1	32.5	31.9	30.1
PI 9569	29.9	29.6	29.7	29.9	29.5	28.8
Jordan	34.5	32.7	31.9	34.5	33.4	32.1
PI 9566	22.9	21.5	21.0	22.9	22.0	21.7
Tri 0256	24.1	23.9	22.3	24.1	23.6	23.0
Tri 1556	27.9	27.4	27.6	27.9	26.9	27.0
Tri 0157	19.9	19.3	19.0	19.9	19.0	18.9
Pana Monacillos	30.0	29.8	29.8	30.0	30.1	28.7
Cubana	30.6	30.4	30.1	30.6	30.2	29.1
Inglesa	24.4	24.2	24.1	24.5	24.0	23.2
Coreana	27.3	26.4	26.6	27.3	27.1	26.0
Mameya	19.5	17.5	17.0	19.5	18.7	18.6
PI 9600	33.6	31.5	30.1	33.6	32.1	ND
PI 9591	33.5	32.2	31.0	32.5	31.8	32.0
PI 9581	27.6	27.2	26.1	27.6	27.5	27.6
Tri 1457	22.3	22.2	21.8	22.3	22.1	21.6
Venezolana	30.6	30.0	29.7	30.6	30.1	30.7
Pata de Paloma	29.8	28.7	28.3	29.8	29.1	ND
SD 2	32.3	31.4	ND	32.3	30.2	ND
D-D-1	24.8	24.6	24.1	24.8	23.8	ND
Llanera	25.0	24.3	24.1	25.0	24.9	23.1
Compadre Márquez	33.4	32.2	32.0	33.4	32.0	31.2
Sel. 6	30.2	30.0	ND	30.2	28.1	ND
PI 899	25.3	24.2	24.2	25.2	25.0	ND
Dorado	20.0	20.0	19.4	20.0	19.0	18.7
Sin Nombre	28.7	27.6	ND	28.7	27.1	ND
Hondureña	28.7	26.7	26.0	28.7	28.0	27.0
Color de Rosa	27.0	25.3	25.8	27.0	25.3	25.0
Venezolana	27.6	27.1	26.9	27.6	26.8	26.5

ND - No data.

For determining dry matter content, samples were weighed before and after drying at 60ºC for 72 hours under forced hot air.

Thiabendazole was applied as Mertect 75W, which was suspended in water at 28ºC. The test solution had 4,000 ppm thiabendazole, and roots were submerged for 30 minutes before storage.

Table 2. Cyanide (HCN) content at harvest of cassava cultivars grown in Isabela, Puerto Rico, in 1989-1990 according to the CIAT rapid evaluation method.

Cultivar	HCN (ppm)	Cultivar	HCN (ppm)
PI 9608	115-150	Mc 22 S14	60-85
PI 12900	40-60	PI 9567	25-40
Jamaica	25-40	PI 9607	85-115
PI 19902	85-115	PI 9600	60-85
Brava	115-150	PI 9561	60-85
MC 22	85-115	PI 9581	85-115
PI 9570	25-40	Tri 1457	25-40
PI 12903	25-40	Venezolana	40-60
Pana	60-85	Pata de Paloma	60-85
PI 9569	25-40	SD 2	60-85
Jordan	40-60	D-D-1	85-115
PI 9566	25-40	Llanera	40-60
Tri 0256	15-25	Compadre Márquez	60-85
Tri 1556	25-40	Sel. 6	85-115
Tri 0157	25-40	PI 899	85-115
Pana Monacillos	15-25	Dorado	40-60
Cubana	85-115	Sin nombre	60-85
Inglesa	25-40	Hondureña	25-40
Coreana	40-60	Color de Rosa	60-85
Mameya	85-115	Venezolana	40-60
PI 12901	60-85		

Table 3. Culinary quality at harvest and during storage of cassava cultivars grown in Isabela, Puerto Rico, in 1989-1990 and treated with thiabendazole fungicide or not treated.

Cultivars	Culinary quality					
	Treated			Not treated		
	Days after harvest			Days after harvest		
	0	4	16	0	4	16
PI 9608	p	p	p	p	p	p
Jamaica	m	m	m	m	m	m
PI 19902	m	m	m	m	m	m
Brava	p	p	p	p	p	p
MC 22	m	m	m	m	m	m
PI 9570	m	m	m	m	p	p
PI 12903	g	g	g	g	g	g
Pana	g	m	p	g	p	p
PI 9569	g	g	m	g	g	p
Jordan	g	g	m	g	g	m
PI 9566	m	m	m	m	m	p
Tri 0256	m	m	m	m	m	m
Tri 1556	m	m	m	m	m	m
Tri 0157	m	m	m	m	m	m
Pana Monacillos	g	g	g	g	g	m
Cubana	g	g	g	g	g	m
Inglesa	g	g	g	g	g	m
Coreana	p	p	p	g	g	m
Mameya	m	m	m	m	m	m
PI 12901	g	p	p	g	p	p
Mc 22 S14	m	m	m	m	m	m
PI 9567	g	p	p	g	p	p
PI 9607	m	m	m	m	m	p
PI 9600	m	p	p	m	m	p
PI 9591	m	m	p	m	m	p
PI 9581	m	p	p	m	p	p
Tri 1457	g	m	m	g	g	m
Venezolana	g	g	m	g	m	m
Pata de Paloma	m	m	m	m	m	p
SD 2	m	p	p	m	p	p
D-D-1	g	g	g	g	m	p
Llanera	g	g	g	g	g	m
Compadre Márquez	g	m	p	g	m	p
Sel. 6	m	m	p	m	m	p
PI 899	m	m	p	m	m	p
Dorado	m	m	m	m	m	m
Sin Nombre	m	m	m	m	m	m
Hondureña	m	m	p	m	p	p
Color de Rosa	m	m	m	m	p	p
Venezolana	g	m	m	g	m	m

g = good, m = mediocre, and p = poor, based on cooking time, fiber content, and taste evaluation.

Table 4. Losses in stored roots of more than 40 cassava cultivars grown in Isabela, Puerto Rico, in 1989-1990, treated with thiabendazole fungicide or not treated.

Cultivars	Percentage deterioration			
	Treated		Not treated	
	Days of storage		Days of storage	
	4	16	4	16
PI 9608	0.0	11.1	6.7	17.6
Jamaica	0.8	1.7	0.8	5.0
PI 19902	2.5	2.6	4.4	9.2
Brava	1.7	2.5	1.7	3.4
Mc 22	12.5	14.7	17.5	17.9
PI 9570	3.3	5.3	56.7	60.0
PI 12903	0.0	1.1	2.2	5.1
Pana	27.8	40.8	53.4	78.4
PI 9569	2.2	24.4	6.6	56.6
Jordan	0.0	15.0	6.6	35.0
PI 9566	14.4	47.6	34.4	47.8
Tri 0256	21.0	22.1	22.2	26.6
Tri 1556	0.0	9.9	1.7	34.6
Tri 0157	3.4	4.4	8.8	19.6
Pana Monacillos	1.6	2.2	13.4	15.4
Cubana	1.6	4.4	6.6	34.4
Inglesa	0.0	5.6	1.6	20.0
Coreana	16.6	23.8	19.2	81.8
Mameya	0.0	1.7	0.0	5.1
PI 12901	30.0	63.4	53.4	93.4
Mc 22 S14	30.0	34.0	31.4	96.6
PI 9567	65.0	85.4	74.4	83.4
PI 9607	13.3	49.0	16.7	83.2
PI 9600	36.7	40.6	38.3	88.2
PI 9591	28.8	30.8	34.4	52.6
PI 9581	28.0	30.0	28.3	71.6
Tri 1457	3.4	19.1	4.2	47.4
Venezolana	2.2	16.7	16.6	18.8
Pata de Paloma	8.4	14.2	26.6	61.8
SD 2	41.0	73.4	53.4	72.2
D-D-1	1.1	1.6	1.1	25.8
Llanera	0.8	2.2	10.0	39.0
Compadre Márquez	13.4	50.0	14.2	53.4
Sel. 6	20.0	32.2	35.0	85.0
PI 899	7.7	19.9	11.0	37.4
Dorado	0.0	0.0	3.4	3.4
Sin Nombre	2.0	16.0	6.7	100.0
Hondureña*	48.8	51.2	60.0	66.6
Color de Rosa	1.1	11.0	3.4	27.8
Venezolana*	26.8	35.0	40.8	91.6

*Hondureña and Venezolana are local commercial varieties in the area surrounding the Substation.

Means based on 5 sample roots measured in 4 cross-sections.

With fungicide treatment, after four and 16 days, 21 and 10 cultivars had maintained less than 5% storage loss, respectively.

A small number of cassava cultivars, including Cubana, Mameya, Dorado, Jamaica, and PI 12903, when stored without fungicide treatment, showed little deterioration even after 16 days' storage. In both storage periods, fungicide treatment increased the number of cultivars that were stored without marked losses compared to nontreated controls.

REFERENCES

Booth, R.H. 1976. Storage of fresh cassava (Manihot esculenta): post-harvest deterioration and its control. Exp. Agr. 12(2): 103-111.

CIAT. 1982. Cassava: Research, production, and utilization. Carlos Dominguez, editor. Cali, Colombia. 512pp.

Cock, J.H. 1982. Cassava: A basic energy source in the tropics. Science 218(4554): 755-756.

Rivera, A.A. 1989. Cassava production (in Spanish). Ext. Serv. College of Agricultural Sciences, University of Puerto Rico, Mayaguez.