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Developing systems for sustainable production of export grade dasheen (*Colocasia esculenta* (L.) Schott var. *esculenta*) in Dominica

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ABSTRACT

Sustainability of the dasheen market share was constrained by incorrect projections, resulting from a lack of a detailed understanding of how agro-ecological zones, seasonality and agronomic practices influenced dasheen corm yield and shape in Dominica. Corm yield and shape are the two most important criteria for grading corms for export. Experiments addressing the above, examined the effects of planting depths and spacing on corm yield and shape. The experiments were conducted during the wet and dry season, in Grand Bay, on soils characterized as plastic sticky clay loams without a silica pan, a moisture supply capacity which is low to very low and an average annual rainfall of approximately 2400 mm (zone D3) and in Wet Area on soils characterized as sandy clay loams, with a moisture supply capacity which is moderately high and an average annual rainfall of 5300 mm (zone A2). Results showed that average corm weight per plant of 946 g and 995 g and mean yields per hectare of 12.9 and 14.1 t/ha were obtained in Grand Bay and Wet Area during the wet season, were not significantly different. In the dry season, Wet Area plant (913 g) and per hectare yield (12.3t), were significantly ($p<0.01$) higher, when compared to plant (645 g) and per hectare yield (7.9 t) obtained in Grand Bay. The oval corm shape obtained in Wet Area, during the wet and dry season, were significantly ($p<0.01$) different from the irregular (partially dumb-bell) shape corms obtained in Grand Bay across seasons. In Grand Bay, variation in plant spacing was the major factor influencing individual corm yield, whereas in Wet Area it was plant depth. Per hectare yield was influenced by both spacing and plant depth in Wet Area and by spacing in Grand Bay. Sustainable production of export grade corms, were suited to Wet Area throughout the year. In Grand Bay production was possible during the wet season.

Key words: *Colocasia esculenta* (L.) Schott var. *esculenta*, Plant spacing, Planting depth, Agro-ecological zones, Seasons, Corm yield and shape

INTRODUCTION

Dasheen is an important staple in the Caribbean and is widely grown in St. Vincent, Jamaica, Dominican Republic and the Commonwealth of Dominica. The corms are traditionally an important energy source and the young leaves are used as a vegetable, mainly for the preparation of a popular dish called "Calalou". Dasheen production is suited to the high rainfall (3800 to 5000 mm annually) conditions, which exist in certain

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locations of Dominica (Barker, 1981). Dominica, although a relatively small root crop producer, in terms of the total quantities produced, has the highest per capita production for all root crops (342 kg) among Caribbean countries (Ferguson, 1985). After Jamaica, Dominica is the second largest regional producer of dasheen, which is also the most important root crop produced in the country (Ferguson, 1985). The per capita production of dasheen in Dominica is 146 kg. This is the highest per capita production of any single root crop in the region (Ferguson, 1985).

Dasheen is grown year round throughout Dominica; the major producing areas are Wet Area, Grand Bay, Grand Fond and Belles. The dasheen cultivar called "Comme" or "Common dasheen", is the predominant variety grown and is recommended for export. This cultivar forms a single corm, which tends to be oval to round in shape (Prevost, 1977; Robin, 1993). Among the known cultivars it suckers the least and therefore has the least scars (Prevost, 1977). Dasheen corms weighing between 0.91 and 1.85 kg (Crucefix, 1992), oval to round in shape, scar and disease free (Medlicott, 1990) are considered the highest grade for export.

In recent years, there has been an increasing demand for dasheen in the drier Leeward and United States Virgin Islands, French West Indies and the expanding ethnic market in the United States of America, United Kingdom and Holland. This has resulted in a five-fold increase in dasheen exports over the past ten years.

As dasheen production and exports are on the increase and contractual arrangements are sort by importers in North America and Europe, projections on yields are becoming more and more important for the exporters. General and outdated figures on yield and shape (two of the most important export grading criteria) are used to make overall projections. These outdated figures are the cause of inaccurate projections, as they do not take into consideration how factors such as varietal differences (Lewis, 1975a; Lewis, 1975b), spacing (Prevost, 1977; Cable and Asghar, 1981), depth of planting (Robin, 1990), nitrogen fertilizer (de la Pena, 1983), moisture (Ezumah and Plucknett, 1981; Pardarles, 1985; Kay, 1987), weed competition (Gurnah, 1985), soil type (Pardales, 1987), temperature (de la Pena, 1983) and altitude (Bourke, 1982) influence yield and shape of the dasheen corm.

A study was therefore conducted to examine how variations in crop density and planting depth affected yield and shape of the "Common" dasheen grown in the wet and dry seasons, in two contrasting agro-ecological zones of Dominica.

MATERIALS AND METHODS

Experiments were conducted in two of the major dasheen producing areas: Grand Bay located in zone A2 and Wet Area located in zone D3. Table 1 describes the two locations. The experiments examined the effects of three planting depths: 20, 25 and 30 cm and three spacing: 55 x 55 cm (33,025 plants per hectare (pph), 65 x 65 cm (23,645 pph) and 75 x 75 cm (17,760 pph) in a 3x3 factorial arrangement. The nine treatments were laid out as a randomized complete block, with three replicates at each site. Plots were 3.75 x 4.5 m. Each plot contained a total of 56, 40 and 30 experimental plants, for the treatments 55 x 55 cm, 65 x 65 cm and 75 x 75 cm, respectively. Both sites were cleared of vegetation and sprayed with paraquat (25 ml/L) before planting.

Table 1. Some relevant climatic, topographic and soil physical characteristics, for the two agro-ecological zones in Dominica.

Average annual rainfall (mm)	2400 mm	5300mm
Rainfall pattern	Dry season -Jan. to May	Mild or no dry season
Moisture regimes	Ustic	Udic
Moisture supplying capacity	Low to very low	Moderately high
Temperature	27(°C)	25(°C)
Altitude	235 m	500 m
Natural vegetation	Dry scrub	Tropical moist forest
Soil types	Smectoids, Kandoids latosolics, young soils.	Kandoids latosolics, Alophonic latosolics, young soils.
Soil physical characteristics	Clay loam	Sandy clay loam
Sand	37%	60%
Silt	23%	19%
Clay	40%	25%
Bulk density	1.1 g/cc	0.6 g/cc
Porosity	0.6	0.8
Mean annual soil temperature	Isohyperthermic >25(°C)	Isothermic 15 - 22(°C)

Suckers of the "Common" dasheen, with the upper 2 to 4 cm of the corm intact, a basal diameter of 5.0 to 7.0 cm, and a mean weight of 245±15 g, were used as planting material. Suckers were selected from the most vigorous plants, cleaned of all roots, dead tissue and soil; then dipped in a solution of bleach (containing 2% sodium hypochlorite) for 15 to 20 minutes. Petioles were cut back to a length of 25 to 30 cm. Planting material came from the same source.

Wet and dry season plantings in Wet Area and Grand Bay were carried out in May and December/January, respectively. The experimental plots were kept weed-free during the first three months. Paraquat (20 cc/l) was used to control weeds before canopy formation. Subsequent weeding was done manually. Fifty seven grams of fertilizer NPK (16:8:24 + 2 MgO) was banded around the plants at 0.5 and two months after planting. Within one to two weeks after the second fertilizer application, soil was mounded to a height of 6 to 8 cm around the base of each plant petiole, by moving soil from within a radius of 30 to 35 cm around each plant. Manual harvesting with a fork and/or cutlass took place seven to nine months after planting.

Data was collected on the following: rainfall, soil physical and chemical characteristics, yield and corm shape. Corm shape was approximated by the diameter (at the middle of the corm) to length ratio (DLR) of each corm. Table 2 shows the various shapes and the corresponding DLR ranges. Corms from sample plants in each plot were used.

Table 2. Shape descriptions, acceptability and diameter/length ratios (DLR) ranges of "Common" dasheen corms, produced in Dominica.

Agro-ecological characteristics	Location	
	Grand Bay	Wet Area
Shape description	Acceptability	DLR range
"Dumb-bell" shape	Least acceptable	0.35 -0.5
Partial "dumb-bell" shape		0.5 - 0.6
Oval		0.6 - 8.5
Round	Most acceptable	0.85 – 1.0

RESULTS

Rainfall. Cumulative monthly rainfall in Wet Area both in the wet (4,180 mm) and dry (3,890 mm) seasons and rainfall received by the crop during the critical growth period (0 to six months after planting), also during the wet (990 mm) and dry (1300 mm) seasons were higher in Wet Area. Though cumulative monthly rainfall levels for Grand Bay in the wet (1230 mm) and dry (1200 mm) seasons were almost similar during the critical growth periods, monthly rainfall patterns were more inconsistent during the dry season (Tables 3 and 4).

Table 3. Comparison of the cumulative monthly rainfall (mm) received by the dasheen plants during the wet season at Grand Bay and Wet Area in Dominica.

Location	Months after planting				
	1.5	3	4.5	6	9
Grand Bay	340	550	980	1230	2000
Wet Area	480	1150	1700	2220	4180

Table 4. Comparison of the cumulative monthly rainfall (mm) received by the dasheen plants during the dry season at Grand Bay and Wet Area in Dominica.

Location	Months after planting						
	3	4	5	6	7	8	9
Grand Bay	450	600	810	1200	1320	1785	2070
Wet Area	1000	1290	1775	2500	3175	3585	N.A.

N.A. – not available

Yield. Spacing and depth treatments had no significant effects on average main corm weights during the wet season, in the both locations (Tables 5 and 6). However, corm weights were within the recommended export weight specifications for all spacing and plant depths of 25 to 30 cm. In the dry season, as plant spacing increased from 55 x 55 cm to 75 x 75 cm there was a significant ($p<0.01$) increase in average main corm weight from 514 to 808 g in Grand Bay; however, corm weights did not meet export specifications (Table 5). In Wet Area, plant depth increases from 20 to 30 cm significantly ($p<0.01$) increased average main corm weight from 782 to 1110 g during the dry season and only corms planted at depths of 30 cm met export specifications (Table 6).

Table 5. Effect of plant spacing on the average main corm weight of the dasheen plant during the wet and dry seasons in Grand Bay and Wet Area locations of Dominica.

Plant Spacing cm	Main corm weight / plant (g)			
	Grand Bay		Wet Area	
	Wet	Dry	Wet	Dry
55 x 55	930	514	950	858
65 x 65	1004	612	958	886
75 x 75	905	808	1077	993
S.E.D. (16 df)	104	75	106	82
F test	NS	**	NS	NS

NS – Not Significant

** - Significant at the 1% level.

Table 6. Effect of plant depth on the average main corm weight of the dasheen plant during the wet and dry seasons in Grand Bay and Wet Area locations of Dominica.

Plant depth cm	Main corm weight / plant (g)			
	Grand Bay		Wet Area	
	Wet	Dry	Wet	Dry
20	877	624	874	782
25	923	634	964	846
30	1038	677	1146	1110
S.E.D. (16 df)	104	75	106	82
F test	NS	NS	NS	**

NS – Not Significant
** - Significant at the 1% level.

Table 7 shows that yield per hectare increased significantly as plant density increased from 75 x 75 to 55 x 55 cm in Wet Area in both wet ($p<0.01$) and dry ($p<0.001$) seasons. In Grand Bay this trend occurred only in the wet season ($p< 0.01$). Table 8 shows that increasing plant depth from 20 to 30 cm also significantly ($p<0.05$) increased yield in Wet Area from 10.9 to 14.2 t/ha in the dry season. Though not significant, yield increases were also observed for plantings in Grand Bay during the wet and dry season and in Wet Area in the wet season. Both plant spacing and depth treatments significantly increased yield per hectare during the dry season in the Wet Area.

Table 7. The effects of plant spacing, on the mean dasheen corm yields during the wet and dry seasons, in Grand Bay and Wet Area locations of Dominica.

Plant Spacing cm	Yield (t/ha)			
	Grand Bay		Wet Area	
	Wet	Dry	Wet	Dry
55 x 55	18.2	7.5	17.9	16.2
65 x 65	10.4	6.9	12.9	9.9
75 x 75	10.3	9.2	11.5	10.8
S.E.D. (16 df)	1.4	1.1	1.8	1.2
F test	**	NS	**	***

NS - Not Significant
** - Significant at the 1% level.
*** - Significant at the 0.1% level.

Table 8. The effects of plant depth on the mean dasheen corm yields during the wet and dry seasons in Grand Bay and Wet Area locations of Dominica.

Plant depth cm	Yield (t/ha)			
	Grand Bay		Wet Area	
	Wet	Dry	Wet	Dry
20	11.3	7.6	12.3	10.9
25	13.1	7.7	13.4	11.9
30	14.5	8.3	16.5	14.2
S.E.D. (16 df)	1.4	1.1	1.8	1.2
F test	NS	NS	NS	*

NS – Not Significant
* - Significant at the 5% level.

Summary comparisons shown in Table 9, show no significant differences between average main corm weight obtained in Grand Bay (946 g) and Wet Area (995 g) during the wet season. However, during the dry season, average main corm weights of 645 g and 913 g obtained in Grand Bay and the Wet Area, respectively, were significantly different ($p<0.001$). Per hectare yields followed a similar trend.

Table 9. Summary of comparison of mean dasheen corm yield during the wet and dry seasons in the Grand Bay and Wet Area locations of Dominica.

Corm Characteristics	Season	Grand Bay	Wet Area	SED	F test
Yield (g/plant)	Wet	946	995	116	NS
	Dry	645	913	24	* * *
Yield (t/ha)	Wet	12.9	14.1	1.6	NS
	Dry	7.9	12.3	0.5	* * *

Corm shape. Corm shape changed significantly ($p<0.05$) from an oval (DLR 0.599) to a more irregular shape (DLR 0.532), as plant depth increased from 20 to 30 cm during the wet season in Grand Bay (Table 10). In Wet Area, the decrease in DLR values in response to increasing plant depth was not significant in the wet season; DLR values remained within the oval range of 0.66 to 0.617 at plant depths between 20 and 30 cm. In the dry season plant depth increases significantly decreased DLR values in Wet Area; however, as in the dry season DLR changes remained within the oval range of 0.761 to 0.673 at plant depths between 20 and 30 cm. This response indicates that corm shape in Wet Area remained relatively oval irrespective of plant depth used. In Grand Bay corm shape was also influenced by plant spacing and plant depth interactions during the wet season (Table 11).

Table 10. Effect of plant depth on dasheen corm shape (mean diameter/length ratios) during the wet and dry season in Grand Bay and Wet Area locations in Dominica.

Plant depth cm	Diameter / length ratios			
	Grand Bay		Wet Area	
	Wet	Dry	Wet	Dry
20	0.599	0.561	0.660	0.761
25	0.589	0.550	0.637	0.718
30	0.532	0.550	0.617	0.673
S.E.D. (16 df)	0.017	0.019	0.022	0.013
F test	*	NS	NS	***

NS – Not Significant
** - Significant at the 1% level.
*** - Significant at the 0.1% level.

Table 11. Effect of plant depth and spacing interaction on dasheen corm shape (mean diameter/length ratios) during the wet dry season in Grand Bay, Dominica.

Plant depth cm	Plant spacing (cm)		
	55 x 55	65 x 65	75 x 75
20	0.533	0.561	0.588
25	0.549	0.540	0.561
30	0.560	0.562	0.529
S.E.D. (16 df)	0.019		
F test	*		

Significant at the 5% level.

Table 11 also indicates, that at depths of 20 and 25 cm corm shape change from an irregular DLR of 0.533 and 0.549 to a less irregular (almost oval) shape with DLR of 0.588 and 0.561, as spacing increased from 55 x 55 cm to 75 x 75 cm. However, at plant depths of 30 cm, corm shape changes became more irregular as DRL changed from 0.560 to a 0.529, when plant spacing increased from 55 x 55 cm to 75 x 75 cm ($p<0.05$). Table 12 shows that in the wet and dry season, corms produced in the Grand Bay were more irregular and had average DLR's of 0.573 and 0.555, respectively. Corms produced in Wet Area had average DLR's of 0.638 in the wet season and 0.717 in the dry season ($p<0.001$) and were oval to round in shape.

Table 12. Summary of comparison of mean dasheen corm shape characteristics, during the wet and dry seasons in the Grand Bay and Wet Area locations of Dominica.

Corm characteristics	Season	Grand Bay	Wet Area	SED	T-test
Corm Shape (DLR)	Wet	0.573	0.638	0.02	* * *
	Dry	0.555	0.717	0.01	* * *

* * * - Significant at the 0.1% level

DISCUSSION

For wet season plantings, though rainfall levels differed in Grand Bay (1230 mm) and Wet Area (2220), rainfall was not a limiting factor for yield. Weed growth, however, was much higher in the Wet Area, and may have contributed to the reduction in mean leaf number, mean leaf size, mean leaf area and mean leaf area index after maximum values were reached at 4.5, 6.0, 4.5 and 4.5 months after planting (MAP). Excessive weed growth is normal in high rainfall locations, especially when there is an early decrease in leaf size and area. Gurnah (1985) found dasheen to be sensitive to weed growth throughout most of the crop cycle, especially during early growth. Hammerton (1985), also reported that dasheen was sensitive to weed competition in the first three months and then in the last two months of the crop cycle. In the first three months the crop canopy was insufficient to suppress weeds; toward harvest, the new leaves became progressively smaller in size, thus opening up the canopy.

Appendix 1 shows that during the wet season in Grand Bay, mean leaf number (5.4), mean leaf size (703 cm^2), mean leaf area (3627 cm^2) and mean leaf area index (0.9) at harvest (8 to 9 MAP), were higher than those in Wet Area, where mean leaf number, size, area and leaf area index during the wet season were 4.0, 518 cm^2, 2074 cm^2 and 0.5, respectively, at 8 to 9 MAP. Sustained leaf growth may have enhanced photosynthetic activity and corm development, which in turn may have led to more sustained tuber development in Grand Bay location during the wet season, resulting in the comparable wet season yields with Wet Area. Sunell and Arditti (1983) reported similar findings.

Competition for soil nutrients was further enhanced as a result of continuous leaching of applied fertilizer by the heavy rains in Wet Area and Appendix 2 shows that soil fertility levels were much lower in Wet Area.

In Grand Bay, dry season plantings produced significantly lower yield (645 g/plant and 7.9 t/ha) than that obtained in Wet Area (913 g/plant and 12.3 t/ha). The higher levels of cumulative monthly rainfall (3858 mm) in Wet Area compared to 2070 mm in Grand Bay during the crop cycle contributed to the yield differences. Higher levels of rainfall (2500 mm) were experienced during the critical growing periods (from planting to six months) in Wet Area as compared to 1200 mm in Grand Bay. Appendix 1 shows that maximum leaf number and area were significantly lower in Grand Bay during the dry season. Insufficient soil moisture has been shown to reduce leaf development (Ezumah and Plucknett, 1981) and yields (Sivan, 1970; de la Pena, 1983). Kay (1987) also indicated that dasheen grows best with rainfall of about 2500 mm.

The dry season plantings in Grand Bay, though not significant, showed that per hectare yields were lowest at the highest plant density. This was not consistent with previous research findings (Sivan et al., 1972; de la Pena, 1978; Pardales and Villanueva 1984). Extreme moisture stress increased competition for moisture and nutrients at closer densities, thus reducing vegetative growth and yield. Enzuma and Plucknett (1981) indicated that insufficient moisture supply is one of the important factors limiting vegetative development. Pardales (1985) also indicated that moisture insufficiency and warm soil temperatures during establishment and active growing phase of the crop (as was experienced in Grand Bay), result in inferior growth and development. The usual physical and agronomic manifestations of stressed dasheen plants are impaired vegetative growth and development and depressed corm yields (Pardales, 1979; Pardales and Villanueva, 1984). These characteristics were also observed in Grand Bay.

In Wet Area, plant spacing and depth variations did not significantly affect corm shape during the wet season. This finding indicates that the average corm yield per plant and mean corm yield per hectare may be increased while simultaneously maintaining export weight and shape specifications. The irregular rainfall patterns experienced in Grand Bay may have resulted in irregular growth patterns. Corms grown under erratic rainfall conditions, as experienced in Grand Bay, showed peculiar "dumb bell" shapes, reflecting globose growth during periods of active vegetative growth and constrictions, during periods of maturation. Similar observations were made by Plucknett et al. (1970). In the Wet Area the more consistent and higher levels of rainfall were more conducive to normal plant growth and uniform corm development. Soil type may have also affected corm shape. Table 1 and Appendix 3 and 4, show that the clayey soils in Grand Bay, with an average bulk density of 1.1 g/cc and average porosity of 0.6, are likely to offer greater resistance to tuber bulking, when compared to the sandy clay loam soils of Wet Area, with average bulk density of 0.6 g/cc and porosity of 0.8. Gumbs and Ferguson (1975) and Ferguson and Gumbs (1977), indicated that compaction of sandy clay loam soils to bulk densities of 1.3 and 1.6 g/cc reduced yield and shape uniformity of yam tubers, compared to the non-compacted soil of bulk density 1.1 g/cc. Similar inferences could be made in the case of dasheen. Conditions in Wet Area were generally suitable for bulking and development of corms with shapes which satisfied the export specifications. Appendix 5 shows that in Wet Area, 62.7%, and in Grand Bay, 38.15% of the corms produced in the wet season satisfied the export shape specifications. In the dry season, 89.1% and 31.7% of the corms produced in Wet Area and Grand Bay, respectively, satisfied the export shape specifications.

CONCLUSION AND RECOMMENDATIONS

Production of export grade dasheen throughout the year is more suited to the Wet Area and areas with similar agro-ecological zones. The consistent rainfall patterns and high levels of rainfall in both the wet and dry season and moderately high moisture supply capacity, allow for consistent plant growth thus high yields. The sandy clay loam soils in the Wet Area are amenable to bulking; this coupled with the consistent plant growth allows corms to develop oval shapes. The opportunity also exists in the Wet Area to optimize production of export grade corms through combinations of close (55 X

55 cm) spacing and deep (30 cm) plantings across seasons. In Grand Bay export grade corms were only obtained during the wet season. The highly irregular rainfall patterns and low levels of rainfall during the dry season reduced marketable yields significantly. This coupled with irregular corm shapes, which may have been due partly to the clayey soils and irregular growth patterns, indicated that production should be restricted to the wet season.

Appendix 1. Summary comparison of the mean dasheen growth parameters observed during the wet and dry seasons in the Grand Bay and Wet Area locations of Dominica.

Growth characteristics	Season	Grand Bay	Wet Area	S.E.D.	Ftest
Maximum number of leaves	Wet	7.2	7.0	0.28	NS
	Dry	5.7	7.0	0.24	* *
Number of leaves at 8 – 9 MAP	Wet	5.4	4.0	0.39	* * *
	Dry	5.7	6.7	0.29	* *
Maximum leaf size cm^2	Wet	725	867	81	NS
	Dry	818	925	111	NS
Leaf size at 8-9 MAP cm	Wet	703	518	46	* * *
	Dry	620	788	115	NS
Maximum leaf area cm^2	Wet	4545	5670	790	NS
	Dry	4655	6479	699	*
Leaf area at 8 – 9 MAP cm^2	Wet	3627	2074	711	*
	Dry	3696	5555	1027	NS
Maximum LAI	Wet	1.1	1.4	0.17	NS
	Dry	1.1	1.6	0.18	NS
LAI at 8-9 MAP	Wet	0.9	0.5	0.16	*
	Dry	0.9	1.4	0.26	NS

NS - Not significant
* - Significant at the 5% level
** - Significant at the 1% level
* * * - Significant at the 0.1% level

Appendix 2. Some soil chemical characteristics (pH, Ca, Mg, K, P) of the experimental sites in the Grand Bay and Wet Area locations of Dominica.

Sample depth	Grand Bay					Wet Area				
cm	pH	Ca	Mg	K	P	p^H	Ca	Mg	K	P
20	4.8	2.88	1.42	1.30	6.2	4.6	0.83	0.59	0.74	6.5
25	4.8	2.97	1.38	1.24	4.4	4.6	0.72	0.60	0.64	7.4
30	4.8	3.39	1.45	1.12	3.9	4.6	1.21	0.57	0.50	6.4

Appendix 3. Sand, silt and clay percentages of the experimental sites in the Grand Bay and Wet Area locations of Dominica.

Sample depth	Grand Bay				Wet Area			
cm	% sand	% silt	% clay	soil type	% sand	% silt	% clay	soil type
20	37.8	27.2	35.4	C/CL/SL	61.0	13.0	26.0	SCL
25	37.7	20.7	41.7	C/CL	53.0	22.7	24.3	SCL
30	36.5	20.8	42.8	C/CL	65.0	20.3	23.8	SCL

C=Clay, CL=Clay loam, SL=Sandy loam, SCL=Sandy clay loam

Appendix 4. Bulk density, porosity and penetrometer resistance of the experimental sites in the Grand Bay and Wet Area locations of Dominica.

Sample depth	Grand Bay			Wet Area		
cm	Bulk Density g/cc	Porosity	Penetrometer Resistance kg/cm	Bulk Density g/cc	Porosity	Penetrometer Resistance kg/cm
20	1.23	0.58	1.75	0.54	0.79	1.48
25	1.00	0.62	1.96	0.61	0.77	1.45
30	1.00	0.62	2.22	0.55	0.79	1.75

Appendix 5 Summary of comparison of the mean percentage number of dasheen corms which satisfied export weight (0.9–1.85 kg), shape (DLR 0.6 – 1.0) and combinations of weight and shape specifications, during the wet and dry seasons; in the Grand Bay and Wet Area locations of Dominica.

Parameter	Season	Grand Bay	Wet Area	S.E.D	F test
Marketable by weigh	Wet	49.9	51.7	11.2	NS
	Dry	20.8	46.6	3.5	* * *
Marketable by shape	Wet	38.1	62.7	9.9	*
	Dry	31.7	89.1	3.9	* * *
Marketable by weight and shape	Wet	20.1	31.2	4.8	*
	Dry	6.4	42.2	3.4	* * *

NS - Not significant
* - Significant at the 5% level
* * * - Significant at the 0.1% level

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