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**PROCEEDINGS
OF THE
CARIBBEAN FOOD CROPS SOCIETY**



**TENTH ANNUAL MEETING
PUERTO RICO**

1972

VOLUME X

FACTORS AFFECTING TOMATO PRODUCTION IN THE LEEWARD ISLANDS: TIME OF PLANTING

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Of the factors that affect tomato production in the Leeward Islands, the most important are those that limit the seasonality to crops planted in the period September-November, for maturity in December-March which coincides with the dry season and also the period of lowest mean minimum temperature. For most of the year the crop can be regarded as 'out-of-season', and substantial imports are made in all the territories to satisfy local demands.

It has been recognized that low production during the off-season is associated with high night temperatures which inhibit fruit setting. Went (1944) gives the optimum range in night temperature for fruit setting for some varieties as 15° to 20°C, but other varieties will set fruit at night temperatures of 23° to 27°C (Schaible, 1962). Studies at the University of the West Indies aimed at breeding cultivars that would set fruit under conditions of high night temperature as well as high relative humidity have been discontinued. However, in conjunction with the University of Florida, the Ministry of Agriculture, Montserrat and the Regional Field Experimental Programme of the University of the West Indies have been examining certain lines bred in Florida for high fruit set under conditions in the Leewards. Some of this material show good promise for future work.

The varieties used for production in the territories are those available commercially from the United States of America. Most of these perform well when grown in season, but yields tend to be low at other times of the year.

Other factors recognized as limiting production to a few months in the year include the role of soil-water-plant relationships as affected by both dry and wet season conditions, the control of pests and diseases particularly during the wet season, and the control of nematodes which have caused serious economic losses in recent times.

In the first phase of this study, a series of variety trials was begun in 1969 and carried out until 1971. The performances of the cultivars were examined and the results are presented in this paper.

MATERIALS AND METHODS

Soils

In Antigua the trials were carried out at Diamonds Estate on soils of the Fitches series. This is a grumusol (Ahmad, 1968) that has developed over limestone, and is widely distributed in the north-east of the island. The land-use pattern on these soils has been the mono-culture of sugar cane in the areas with good rainfall with sea-island cotton and scrub pastures in the drier area. With the movement towards crop diversification, the Fitches series is important for vegetable production.

In St. Kitts the trials were located at Ottleys and Mt. Pleasant Estates on soils of Mansion clay loam and Sandy Bay loam series, respectively. Mansion clay loam has been classified as a young soil and Sandy Bay loam as a protosol (Lang and Carroll, 1966). These soils have also been under sugar cane cultivation for a long period of time.

In Montserrat the trials were sited at Farrells, on Riley's Sandy clay loam and at Trants on Grove Sandy loam, both classified as Protosols (Lang, 1967).

Experimental

The experiments were designed as randomized complete blocks with the number of treatments being the number of varieties being evaluated and the number of replicates being not less than four. The actual design for each experiment is shown in the tables. Each plot consisted of six rows 24 feet long and three feet apart with plants two feet apart in the rows. A basal dressing of 12-22-18 NPK fertilizer was applied at the rate of 500 lb./acre, and a side dressing of 30 lb. N/acre supplied at formation of first fruits. The tomato plants were established from transplants raised in nursery beds.

An application of diphenamid was made at the rate of 5 lb./acre at transplanting, and subsequent weed control was carried out by hand. Insecticides used to control insects included: Sevin, Dipterex, Malathion, and Basudin. Fungicides employed for disease control were: Zineb, Dithane M 45, Antracol and Kocide 101.

RESULTS AND DISCUSSION

The mean yields of marketable fruit are shown in Tables 1 to 3. Certain of the varieties tested were consistent in performing well throughout the year. The cultivars Floradell, Floradou and Tropic Gro were the best performers at all seasons, while Indian River and Homestead 61 were of value under dry season conditions.

During the programme it was not possible to include all the varieties in the 19 trials reported here, since seed supplies of some of the varieties were at times limiting. However, a few cultivars were dropped at various stages of the programme. For example, although there was a strong market preference (particularly among hoteliers) for Oxheart, this variety was dropped from further testing as it did not stand up well to packing for shipment and in the field was very susceptible to damage by rats. Urbana was seriously affected by bacterial spotting and was eliminated. Plants of Beefsteak grew vigorously but did not produce flowers while fruits of Supermarket tended to be small.

At various times the varieties were assessed for market acceptability on the basis of shape and size, seed content and colour (both exterior and interior). Floradell, Indian River and Tropic Gro were the varieties preferred.

The data summarized in Table 4 show the effect of season on the performance of the best varieties. Three seasons were recognized, viz: (1) 'in season', from 16 September to 15 December, (2) 'wet season,' from May to 15 September and (3) a 'dry off-season' from 15 December to April. Generally, the highest yields were obtained during the 'in-season' period, but good yields were also realized in St. Kitts during the wet off-season. During the dry off-season yields were at their lowest. The average yields from the experiments carried out in these periods were 28, 23 and 17 tons/hectare, respectively.

It is well to note that the failure of trials (not included in this paper) conducted in Antigua and Montserrat in the wet off-season was not due to poor fruit set, but rather to the water-logged conditions that were experienced in these two territories on heavier textured soils during the rainy season. The freely drained nature of the soils in St. Kitts allowed for cultivation even under relatively high rainfall conditions.

In Appendix 1, the cost of production of tomatoes is shown, using the labour rate for Antigua, which is about twice that for St. Kitts or Montserrat. It can be seen that even if off-season yields are placed as low as 8,000 and 12,000 lb. in the dry and wet seasons the net returns per acre would be \$400* and \$1,600, respectively, for fruit costing 30¢ per lb. At this time imported fruit cost \$1.00 to \$1.50 per lb.

ACKNOWLEDGEMENTS

I wish to express my thanks to Messrs. C. Quashie, (St. Kitts) D. Barker (Montserrat), and J. Spencer (Antigua) Field Assistants in the Regional Field Experimental Programme of the University of the West Indies for the valuable assistance they rendered in the course of this work.

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*E.C. \$100 = U.S. 0.54.

Table 1. Mean Yields of Marketable Tomato Fruit in Tons/acre (Tons/hectare)
1969 - 70 series

Experiment Site and Soil Rainfall, in.*	Date		Variety	Mean Yields
	Planting	Harvesting		
1. Antigua Diamonds Fitches clay 16.0	31 Oct. 1969	9 January 11 March 1970	Manalucie	12.0(30.1)
			Manapal	11.9(29.9)
			Indian River	11.8(29.6)
			Oxheart	10.4(26.1)
			Urbana	10.2(25.6)
			Rutgers	9.6(24.1)
				C.V. = 13.0%
2. Antigua Diamonds Fitches clay 3.2**	4 Dec. 1969	3 Feb. - 31 March 1970	Manalucie	9.6(24.1)
			Manapal	9.3(23.3)
			Indian River	9.1(22.8)
			Rutgers	8.9(22.3)
			Urbana	7.7(19.3)
			Oxheart	6.2(15.6)
				C.V. = 15.3%
3. Montserrat Farels- Riley's sandy clay loam 10.9	22 Dec. 1969	5 March - 6 April 1970	Indian River	13.7(34.4)
			Oxheart	11.9(29.9)
			Urbana	11.5(28.9)
			Manalucie	10.5(26.4)
			Rutgers	9.4(23.6)
			Manapal	9.3(23.3)
				C.V. = 21.5%
4. Montserrat Trents Grove Logmy sand 2.4	9 Feb. 1970	7 April 11 May 1970	Supermarket	6.5(16.3)
			Indian River	6.0(15.1)
			Manalucie	4.8(12.0)
			Oxheart	4.5(11.3)
			Manapal	4.4(11.0)
			Roma	4.4(11.0)
				C.V. = 35.9%
5. St. Kitts Ottleys Mansion clay loam	3 Oct. 1969	1 Jan. 18 April 1970	Indian River	19.0(47.7)
			Urbana	18.5(46.4)
			Rutgers	16.0(40.2)
			Manapal	15.9(39.9)
			Manalucie	15.2(38.1)
			Oxheart	13.2(33.1)
				C.V. = 17.9%

The lines indicate common subsets at the 5.0% level of significance according to Duncan's Multiple Range Test.

* Precipitation during first two months of crop plus that recorded during 15 day period prior to planting.

** The plants were irrigated a few times.

Table 2. Mean Yields of Marketable Tomato Fruit in Tons/acre (Tons/hectare)
1970 - 71 series

Experiment Site and Soil Rainfall, in.*	Date		Variety	Mean Yields	
	Planting	Harvesting			
1. Antigua Diamond's Fitches clay 27.5	27 Oct. 1970	3 Feb. - 22 March 1971	Floradell	5.6(14.0)	
			Tropic Red	5.4(13.5)	
			Indian River	5.1(12.7)	
			Homestead 61	4.8(12.0)	
			Floralou	4.6(11.5)	
			Manapal	4.6(11.5)	
			Tropic Gro	4.4(11.0)	
			Manalucie	3.9(9.7)	
			Marglobe	3.5(8.7)	
			Beefstrak	3.2(8.0)	
			C.V. = 18.4%		
2. Antigua Diamond's Fitches clay 8.0	18 Jan. 1971	22 March - 23 April 1971	Floradell	2.4(6.0)	
			Floralou	2.2(5.3)	
			Indian River	2.2(5.4)	
			Homestead 61	2.1(5.2)	
			Marglobe	1.9(4.9)	
			Tropic Gro	1.8(4.5)	
			Manalucie	1.6(4.0)	
			Manapal	1.6(3.9)	
			C.V. = 22.6%		
			Beefsteak	2.3(5.8)	
			Indian River	2.1(5.3)	
3. Montserrat Bethel not available	Jan. 1971	23 March - 27 April 1971	Marglobe	2.0(4.9)	
			Floralou	1.9(4.8)	
			Manalucie	1.7(4.4)	
			C.V. = 22.8%		
			Floradell	13.4(33.6)	
			Floralou	11.6(29.1)	
			Indian River	10.6(26.6)	
			Manapal	8.7(21.8)	
			Manalucie	8.5(21.3)	
			Homestead 61	8.5 (21.3)	
			Marglobe	8.4(21.1)	
C.V. = 15.0%					
5. St. Kitts Ottleys Mansion clay loam 20.2	9 July 1970	21 Sept.- 22 Oct. 1971	Tropic Gro	13.2(33.1)	
			Tropic Red	12.6(31.6)	
			Floradell	11.8(29.6)	
			Indian River	10.0(25.1)	
			Floralou	9.2(23.1)	
			Marglobe	9.0(22.6)	
			Homestead 61	7.6(19.1)	
			Manapal	6.7(16.8)	
			Manalucie	6.5(16.6)	
			C.V. = 16.3%		
			Tropic Gro	7.5(18.8)	
6. St. Kitts Ottleys - Mansion clay loam 15.3	11 Aug. 1970	19 Oct. 11 Dec. 1970	Floradell	3.3(8.3)	
			Marglobe	3.2(8.0)	
			Floralou	2.5(6.3)	
			Homestead 61	2.3(5.8)	
			Indian River	2.0(5.0)	
			Manapal	1.8(4.5)	
			Beefsteak	1.6(4.0)	
			Manalucie	1.3(3.3)	
			C.V. = 32.1%		

Table 2. Cont.

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Experiment Site and Soil Rainfall, in.*	Planting	Date		Variety	Mean Yields	
			Harvesting			
7. St. Kitts Ottleys Mansion clay loam 20.1	7 Sept. 1970		6 Nov. 1970	Tropic Gro	6.8(17.0)	
			7 Jan. 1971	Floralou	5.8(14.5)	
				Marglobe	5.5(13.8)	
				Indian River	4.9(12.3)	
				Floradell	4.6(11.5)	
				Homestead 61	4.1(12.3)	
				Manapal	3.4(8.5)	
				Manalucie	3.3(8.3)	
				Beefsteak	3.2(8.0)	
				C.V. = 29.4%		
8. St. Kitts Ottleys Mansion clay loam 28.9	20 Nov. 1970		19 Jan.	Floradell	4.2(10.5)	
			25 Feb. 1971	Homestead 61	4.0(10.0)	
				Indian River	3.1(7.8)	
				Floralou	3.0(7.5)	
				Manalucie	2.5(6.3)	
				Marglobe	2.5(6.3)	
				Manapal	2.3(5.8)	
				Beefsteak	1.9(4.8)	
				C.V. = 25.8%		
9. St. Kitts Mt. Pleasant sandy clay loam 38.1	10 Dec. 1970		13 Feb.	Homestead 61	15.8(39.7)	
			19 March 1971	Marglobe	15.5(39.2)	
				Floralou	14.7(36.9)	
				Floradell	13.1(32.9)	
				Indian River	12.7(31.9)	
				Manapal	11.8(29.6)	
				Manalucie	11.7(29.4)	
				Beefsteak	10.5(26.1)	
				C.V. = 10.9%		

Table 3. Mean Yields of Marketable Tomato Fruit in Tons/acre (Tons/hectare)
1971-72 series

Experiment Site and Soil Rainfall, in.	Planting	Date		Variety	Mean Yields
			Harvesting		
1. St. Kitts Mt. Pleasant Sand clay loam 11.4	4 March 1971		24 April-	Floralou	8.9(22.3)
			5 June, 1971	Homestead 61	8.2(20.6)
				Floradell	7.6(19.0)
				Indian River	7.4(18.5)
				Marglobe	6.6(16.6)
				Manalucie	6.2(15.6)
				Manapal	5.4(13.6)
2. St. Kitts Mt. Pleasant Sandy clay loam 6.9	17 May 1971		22 July-	Indian River	8.5(21.4)
			17 August 1971	Floralou	7.0(17.5)
				Floradell	6.8(17.1)
				Manalucie	6.4(16.1)
				Marglobe	5.6(14.0)
				Manapal	5.0(12.5)
3. St. Kitts Mt. Pleasant Sandy clay loam 9.5	3 July 1971		6 Sept.-	Floralou	6.4(16.1)
			11 Oct. 1971	Floradell	5.3(13.2)
				Indian River	4.1(10.2)
				Manalucie	3.9(9.7)
				Manapal	3.8(9.5)
				Marglobe	2.9(7.2)
4. St. Kitts Mt. Pleasant Sandy clay loam 15.1	19 Aug. 1971		19 Oct.-	Floralou	16.2(40.7)
			22 Dec. 1971	Marglobe	14.5(36.3)
				Floradell	13.2(33.2)
				Manapal	12.6(31.6)
				Manalucie	9.7(24.2)
				Indian River	7.7(19.4)
5. St. Kitts Mt. Pleasant Sandy clay loam 14.4	28 Aug. 1971		22 Oct.-	Floradell	3.3(8.4)
			22 Dec. 1971	Better Boy	2.2(5.4)
				Tropic Gro	1.8(4.4)
				Indian River	1.6(4.1)

Table 4. Best Mean Yields of Marketable Tomato Fruit in Tons/acre (Tons/hectare) according to season

In-Season			Off-Season-Wet			Off-Season-Dry		
15 September - 14 December			May - 14 September			15 December - April		
Expt. No.	Variety	Yield	Expt. No.	Variety	Yield	Expt. No.	Variety	Yield
1	Manalucie	12.0(30.1)	9	Floradell	13.4(33.6)	3	Indian	13.7(34.4)
2	Manalucie	9.6(24.1)	10	Tropic Gro	12.6(31.6)	4	River	6.5(16.3)
5	Indian		11	Tropic Gro	7.5(18.8)	7	Floradell	2.4(6.0)
	River	19.0(47.7)	12	Tropic Gro	6.8(17.0)	8	Beefsteak	2.3(5.8)
6	Floradell	5.6(14.0)	16	Indian		15	Floralou	8.9(22.3)
13	Floradell	4.2(10.5)		River	8.5(21.4)			
14	Homestead	15.8(39.7)	17	Floralou	6.4(16.1)			
			18	Floralou	16.2(40.7)			
			19	Floradell	3.3(8.4)			

APPENDIX 1. COST OF PRODUCTION

Estimated Costs of Production and Net Returns per acre of Tomatoes: Leeward Islands

(a) <u>Labour</u>	<u>Amount</u> (Man-hours)*	<u>Costs and Value**</u> EC \$
Nursery	60	48
Transplanting	80	64
Weed control (Chemical & Mechanical)	200	160
Pest & Disease Control (Knapsack sprayers)	250	200
Fertilizer application	35	28
Harvesting	480	384
Sorting for Market	200	160
Value of Supervision		300
Total Cost of Labour		\$1,344
 (b) <u>Supplies</u>		<u>Costs and Value</u>
Seeds		5
Chemicals - Weedicides		55
Insecticides		25
Fungicides		52
Fertilizer - Nematicides		100
Fertilizers		50
		\$ 287
 (c) <u>Services</u>		
Ploughing	40	
Harrowing (including nematicide application)	20	
Rent - 6 months	9	
Transport	300	
Total Cost of Services	\$ 369	
 Total costs (a), (b), (c) - \$2,000		

Labour rate: \$0.80/hr.

NET RETURNS

Costs of fruit at 30¢ per lb.

		Marketable Yield		lb/acre	
8,000	10,000	12,000	15,000	20,000	
\$ 4,000	\$ 1,000	\$ 1,600	\$ 2,500	\$ 4,000	

* The number of man-hours required for all operations (except nursery) was calculated on the basis that labour would be employed for a full 8-hour day. Labour rate: \$0.80/hr.
 ** EC. \$1.00 = \$ US 0.54