

Suitable tomato varieties for the canneries in Ghana

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SYNOPSIS

Two trials for testing the suitability of 42 imported varieties for commercial growing in Ghana were conducted at Nyankpala (guinea savanna zone) and at Vea dam site (sudan savanna zone). At Nyankpala variety CPC 2 gave reasonably higher yields than the control variety Roma, but there was wide variation in control plot yields. At Vea, Red Top and MH/VF 145-21-4P gave the best yields (5.05 and 4.24 tons/acre). Laboratory analyses for pulp yield, total soluble solids in pulp, content of reducing sugars and acidity indicated that MH/VF 145B, Pearson A-1 and VF Roma had desirable qualities. These last-named varieties are recommended for further trials.

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Introduction

In Ghana tomato is usually not consumed raw but is always cooked in the daily meal. The fresh tomatoes are not available throughout the year, and, especially during the period between February and August, the prices of fresh tomatoes shoot up. Tomato paste serves as an ideal substitute for fresh tomatoes during this period of scarcity.

In 1966 Ghanaian canneries provided only 3% of the country's total consumption of tomato products. The main reasons for this low production by local canneries were the scarcity and high price of raw tomatoes. It was stated during the

RÉSUMÉ

S. S. APTE, R. E. DIRKS, K. K. EYESON, A. K. GHANSAH et A. R. SUNDARARAJAN: *Variétés de tomates convenant à la conserverie au Ghana*. Deux séries d'études pour se rendre compte si 42 variétés importées de tomates convenaient à une culture commerciale au Ghana furent faites à Nyankpala (zone de savanne guinéenne) et près du barrage de Vea (zone de savanne soudanienne). A Nyankpala, la variété CPC 2 a fourni un rendement à la production assez nettement plus élevé que la variété de contrôle Roma, mais il y a eu des variations de production importantes dans les parcelles de contrôle. A Vea, les variétés Red Top et MH/VF 145-21-4P ont donnés les meilleures récoltes (12.679 et 10.645 kg/ha). Des analyses de laboratoire sur la proportion de pulpe, la proportion des matières solubles dans la pulpe, la proportion de sucres réducteurs, et l'acidité ont montré que les variétés MH/VF 145B, Pearson A-1 et VF Roma présentaient les caractéristiques souhaitées. Les variétés cidessus désignées sont recommandées pour des essais futurs.

Food Industries Seminar in Accra in May 1967 that the locally produced tomato paste was noticeably inferior to any of the imported brands with regard to colour, texture, smell and taste (Schurmann, 1967). The reason for the poor quality of local tomato paste is the use of the wrong type of raw tomatoes for preparing it. The locally grown tomato has a corrugated surface, hard core, many seeds, low total solids and pale orange-red coloured pulp. These characters make the local tomato most unsuitable for processing.

An urgent need to look for suitable varieties for processing was felt when it was announced that

two Government canneries, at Wenchi and Pwalugu, would go into operation in 1968. The raw tomato requirements according to Reusse (1968) are: Wenchi, 8000 tons per season or 55 tons per day for 150 days; and Pwalugu, 16 000 tons per season or 110 tons per day for 150 days.

This paper presents an account of two trials planned and organized by the USAID Mission to Ghana, the Crops Research Institute and the

Food Research Institute together with the FAO Food Research and Development Unit and the Irrigation Division of the Ministry of Agriculture. One trial was sited at Nyankpala agricultural station in the guinea savanna zone in the Northern Region and the other about 100 miles north, at Veve dam site in the sudan savanna zone in the Upper Region.

Thirty-two processing varieties imported from Ferry Morse Seed Company in the USA were used

TABLE 1
Description of Standard Varieties used in Processing

Variety	Plant type	Fruit size and shape	Disease resistance	Use
MH/VF 145-22-8 ..	D, Compact	Small, elongated globe	FV	Processing
MH/VF 145-21-4 P ..	D, Medium	Small, round	FV	Processing
MH/VF 145 B ..	D, Small	Small, long globe	FV	Processing
MH/VF 145-F 5 ..	D, Compact	Small, deep globe	FV	Processing
MH/VF 13 L ..	D, Small	Small, rounder	FV	Processing
Marzano P-4 ..	D, Med. Large	Small, elongated	V	Processing
Heinz 1548	not available			
J. Moran	L, Large	Large, flattened	None	Processing, fresh market
Heinz 1409	D, Med.	Medium, flattened globe	F	Processing
Heinz 1370	D, Compact	Medium, flattened globe	F	Processing
Chico Grande ..	D	Medium, blocky pear	Not known	Processing, fresh market
Heinz 1350	D, Compact	Medium, flattened globe	FV	Processing
Early Pak 7	not available			
Chico	D, Med.	Small, pear	FS	Processing
Ace	D, Med. Large	Large, flattened globe	None	Canning, fresh market
CPC 2	D, Med.	Large, flattened globe	FV	Canning
MH/VF 145-7879 ..	D, Compact	Medium, deep globe	FV	Processing
Pearson A-1	D, Large	Large, deep globe	V	Processing and fresh market
Pearson Improved ..	D, Large	Large, deep globe	V	Processing and fresh market
Pearson A-1 Improved	D, Large	Large, deep globe	V	Processing and fresh market
Pearson S	D, Large	Large, deep globe	V	Processing and fresh market
Red Top	D, Small	Small, oval long	None	Paste
VF 14	D, Medium	Large, flattened globe	FV	Processing
Roma	D, Small	Small, oval long	F	Paste
VF 36	D, Medium	Large, globe	FV	Processing, fresh market
VF 428 F 2	D, Med. Large	Medium to large globe	FV	Processing, fresh market
VFN 8	D, Medium	Medium deep oval	VN	Canning, fresh market
VF 1402	not available			
VF Roma	D, Medium	Small, pear to plum	VF	Processing
VF Red Top 9	D, Medium	Small, pear	V	Processing
San Marzano	Ind, Large	Medium oblong	None	Paste
Rutgers FM Select ..	Ind, Large	Large, globe	F	Processing, fresh market

Explanation: D = Determinate; Ind = Indeterminate; F = *Fusarium* wilt; N = Root-knot nematode; S = *Stemphylium* (grey leaf spot); V = *Verticillium*.

in both trial sites and, in addition, 10 varieties sent by E. A. Kerr of Vineland Station, Ontario, Canada, were used at Nyankpala only (as the supply of seeds was limited). A description of Ferry Morse varieties, based on their catalogue, is given in Table 1.

Nyankpala trial

Materials and methods

The seeds were sown in soil blocks on 8 Nov 67 and the seedlings transplanted to the field on 12 Dec 67. Eighteen plants were sown in a plot in three rows, $2\frac{1}{2}$ ft between rows and between plants in the rows. Since Roma variety had already been grown in the country in previous years and had shown promise, it was decided to compare other varieties against it. Accordingly, out of 18 plants in each plot, 12 were of the varieties to be tested and six were Roma planted one in each of the three rows but in a randomized manner. Thus in each of the 42 plots there were 12 plants of each of the varieties to be tested and six plants of Roma which formed the control.

Applications of N, P and K fertilizer were given before transplanting at the rates of 40, 160 and 160 lb/acre respectively. In addition, 33 lb/acre N were applied 4 weeks after transplanting. Sevin and Diathane sprays were given fortnightly.

Out of the 42 varieties, four died, viz Chico Grande, Pearson A-1 Improved, Red Top, and San Marzano L.F., leaving only 38 varieties for comparison.

Results and discussion

The yield of the different varieties and that of control (Roma) on each of the plots is given in Table 2.

Roma itself showed wide variation in fruit yields per plant (lowest 10.7 oz and highest 57.8 oz) due to differences in soil fertility of the different plots. Hence the performance of each of the varieties was compared with that of Roma in its own plot.

It will be seen from the results that only nine of the varieties gave higher yields than that of Roma. Of these only one variety, CPC 2, gave reasonably higher yields than that of Roma. However, four varieties, MH/VF 13L, Heinz 1350, MH/VF 145 F5 and Heinz 1548, had yield performances significantly below that of the control.

The roots of the plants of all the varieties showed moderate to heavy formation of root nodules caused by nematodes. Leaf diseases such as *Septoria* were in most of the varieties either not visible or only slightly visible.

Ve a dam site

Materials and methods

Work carried out in the field. Seeds of 32 processing varieties were sown on 7 Nov 67. The seedlings were transplanted on 11 Dec 67.

Each group of 30 plants representing one variety was grown in one row. Thus, there were 32 rows of 30 plants each. Spacing was 3 ft between rows and 2 ft between plants in the same row. The yields were converted to tons/acre for purposes of comparison. Also the % of soluble solids of mature fruits was measured in the field by brixometer at 'green', 'colour break' and 'fully ripe' stages (Table 3).

As the average yields obtained by local farmers with indigenous varieties are 2 tons/acre, the yields obtained in this trial are very low. Only four varieties, MH/VF 145-21-4P, Marzano P-4, Red Top and Roma, gave reasonably good yields.

Analyses carried out in the laboratory. The mature fruits of the different varieties were transported to the Food Research Institute laboratory in Accra for analyses, each packed separately in a polythene bag. They were stored in a refrigerator for a few days till they were analysed.

Varying quantities of the tomato fruits of each of the varieties, depending on the quantity of good fruits available, were carefully washed in cold tap water and immediately wiped with a clean dry towel. The fruits were then cut with a clean stainless steel knife into eight to ten small bits, and put through a clean and dry Toshiba multipress centrifugal juice extractor. The pulpy juice forced out through the polythene filter fitted in the periphery of the centrifuge was collected in a tared 600-ml beaker and weighed. The weight of the pulpy juice was obtained by difference and the percentage calculated. The skin and seeds were carefully scraped out from the polythene filter with the blunt part of the stainless steel knife, transferred to a tared watch glass and weighed and the percentage was then calculated.

The methods followed were those of the Association of Official Agricultural Chemists (1965).

TABLE 2

Performance of Plants of Different Varieties compared with that of corresponding Controls of Roma in each of the Plots

Plot no.	Name of variety	Mean wt of fruits/plant (oz)	Roma: Mean wt of fruit/plant (oz)	Plot no.	Name of variety	Mean wt of fruits/plant (oz)	Roma: Mean wt of fruit/plant (oz)
1	MH/VF 145-22-8	16.3	17.2	22*	Red Top	—	18.7
2	MH/VF 145-21-4P	18.0	23.8	23	VF 14	24.8	20.5
3	MH/VF 145 B	30.1	36.2	24	Roma	24.9	16.0
4	MH/VF 145 F5	28.7	47.8	25	VF 36	28.3	26.8
5	MH/VF 13 L	27.9	57.1	26	VF 428 F2	33.5	26.2
6	Marzano P-4	32.9	34.7	27	VF N 8	33.7	44.2
7	Heinz 1548	28.2	44.8	28	VF 1402	36.7	31.7
8	J. Moran	36.0	36.8	29	VF Roma	48.4	57.8
9	Heinz 1409	19.4	24.2	30	VF Red Top 9	20.0	30.5
10	Heinz 1370	25.1	28.0	31†	M 323	48.0	49.8
11*	Chico Grande	—	32.6	32†	Vee Crop (V 6512)	33.0	40.8
12	Heinz 1350	27.7	47.5	33	Rutgers FM Select	14.0	14.8
13	Early Pak 7	24.5	22.3	34*	San Marzano L.F.	—	10.7
14	Chico	28.3	39.3	35†	N 84 C	27.4	31.6
15	Ace	23.5	26.1	36†	M 383	23.0	33.8
16	CPC 2	60.1	45.2	37†	N 175	42.4	52.2
17	MH/VF 145-7879	12.8	16.1	38†	N 33 A	36.9	43.3
18	Pearson A-1	17.3	25.5	39†	N 164	38.0	54.8
19	Pearson Improved	20.3	18.9	40†	N 25	44.4	53.5
20*	Pearson A-1 Improved	—	15.8	41†	M 101	37.6	36.1
21	Pearson S	17.0	22.3	42†	V 641	19.4	28.8

* Plants from these varieties died.

† Varieties obtained from Dr E. A. Kerr, Canada.

TABLE 3

Yield, Weight of Medium-sized Fruit and Brix S.S. % of Tomato Varieties Grown at Vea Dam Site

Name of variety	Yield (tons/acre)	Wt of medium- sized fruit (g)	Brix S.S. %			Remarks
			Green	Colour break	Fully ripe	
MH/VF 145-22-8 ..	1.55	91	2.0	3.5	4.0	Juicy
MH/VF 145-21-4P ..	4.24	58	2.9	2.9	3.0	Juicy
MH/VF 145 B ..	2.71	89	—	3.1	3.5	Juicy fruits
MH/VF 145 F5 ..	1.04	55	—	4.2	4.5	Little juice
MH/VF 13 L ..	1.84				not recorded	
Marzano P-4 ..	3.76	63	2.0	3.0	3.5	Little juice
Heinz 1548 ..	1.44				not recorded	
J. Moran ..	1.08	156			2.5	Juicy
Heinz 1409 ..	1.07	104	—	5.1	5.5	Little juice
Heinz 1370 ..	1.90	67	3.2	4.5	4.8	Very juicy
Chico Grande ..	0.57	77	3.0	3.0	4.0	Little juice
Heinz 1350 ..	0.66	56	—	5.2	5.2	Juicy
Early Pak 7 ..	1.51	78	1.5	1.5	2.0	Little juice
Chico ..	1.23	56	2.0	2.0	3.5	Orange, little juice
Ace ..	1.04	142			4.5	Very juicy
CPC 2 ..	2.71	100	1.5	2.0	3.0	Yellow orange, little juice
MH/VF 145-7879 ..					not recorded	
Pearson A-1 ..	0.72	110	2.0	2.5	3.5	Juicy
Pearson Improved ..	1.84	95	—	2.1	2.6	Orange, little juice
Pearson A-1 Improved ..					not recorded	
Pearson S ..	0.78	131	—	3.5	3.5	Orange, little juice
Red Top ..	5.08	58	3.0	3.8	4.6	Little juice
VF 14 ..	1.62	66			—	Little juice
Roma ..	3.73				not recorded	
VF 36 ..	0.94	75	1.0	3.0	4.0	Little juice
VF 428 F 2 ..	1.01	113	3.0	3.0	3.5	Less juicy
VFN 8 ..	1.34	65	2.4	4.0	4.0	Good juice
VF 1402 ..	0.51	103	3.5	4.0	5.0	Juicy
VF Roma ..	1.21	74	3.0	3.5	4.0	Little juice
VF Red Top 9 ..	2.08	64			—	
San Marzano L.F. ..	0.64	30	3.0	3.0	4.0	Juicy
Rutgers FM Select ..	0.18	105	2.5	3.0	4.5	Juicy

(1) *Soluble solids.* The pulp was filtered over a Whatman no. 1 filter paper and the filtrate was used to determine the % of soluble solids using an Abbe refractometer.

(2) *Reducing sugars.* 10 ml of the filtrate obtained as above was transferred by a pipette into a 100-ml measuring flask, made up to volume and aliquots used for the determination of reducing sugars by the Lane-Eynon method.

(3) *Acidity.* 10 ml of filtered pulp from (1) above were taken in a 100-ml Erlenmeyer flask and diluted with water to about 30 ml. Two drops of phenol-phthalein indicator were added and the

whole titrated against N/10 sodium hydroxide. The acidity was calculated as citric acid from the above titre value.

(4) *pH.* This was determined for the whole pulp with a glass electrode (Eil meter).

The results are presented in Tables 4 and 5.

Results and discussion

It will be seen from Table 4 that the weight of pulp, skin and seeds together do not add up to 100%. This happens because some portion of the material sticks to the surface of the machine and cannot be removed. Such differences do occur in small-scale laboratory experiments and do not

TABLE 4

Pulp Yield of Tomato Varieties

<i>Varieties of tomato processing types with determinate type of growth</i>	<i>Wt of tomatoes (g)</i>	<i>Tomato pulp yield (%)</i>	<i>Skin and seeds yield (%)</i>
MH/VF 145-22-8		not recorded	
MH/VF 145-21-4P	320.3	81.77	12.61
MH/VF 145 B	193.9	84.89	9.18
MH/VF 145 F 5	310.3	82.26	11.27
MH/VF 13 L	246.4	83.69	8.97
Marzano P-4	359.2	76.61	18.10
Heinz 1548	249.7	86.90	6.53
J. Moran	429.8	76.24	15.47
Heinz 1409	333.5	85.42	7.21
Heinz 1370	537.6	74.39	17.17
Chico Grande		not recorded	
Heinz 1350	385.2	85.15	12.90
Early Pak No. 7	508.0	81.87	12.36
Chico	581.2	75.48	21.27
Ace	429.7	84.52	10.84
CPC 2	476.0	73.55	17.64
MH/VF 145-7879	213.7	83.26	7.99
Pearson A-1	626.1	81.79	15.17
Pearson Improved		not recorded	
Pearson A-1 Improved	494.9	79.93	12.33
Pearson S	517.0	85.61	11.08
Red Top	485.1	76.40	17.65
VF 14	335.9	85.20	7.62
Roma	921.4	85.58	10.86
VF 36	352.7	86.67	7.14
VF 428 F 2	805.1	81.60	15.90
VF N 8	361.1	78.84	15.89
VF 1402	401.7	81.50	9.96
VF Roma	565.8	76.31	20.13
VF Red Top 9	336.4	80.55	13.85
San Marzano L.F.	801.2	74.95	16.85
Rutgers FM Select	328.0	81.16	10.79

vitiate the overall conclusions drawn. There were, however, three cases (Chico Grande, MH/VF 145-22-8 and Pearson Improved) where the total of the pulp and the skin and seeds together were far below 90%. These have been left out of consideration since the figures are obviously due to experimental errors and only the results obtained in the remaining 29 varieties are considered here.

The pulp yield is over 85% of the weight of the fruits in seven varieties out of the 29 (24%), viz Heinz 1548, VF 36, Pearson S, Roma, Heinz 1409, VF 14 and Heinz 1350.

It will be seen from Table 5 that the % of soluble solids of pulp is 5.0 and over in the case

of five varieties (17%), viz Heinz 1409, MH/VF 145 B, Pearson A-1, VF 1402 and VF Roma.

If the total soluble solids % in the tomatoes (obtained by multiplying pulp yield % by soluble solids % divided by 100) is considered, then eight varieties (28%) give a figure of 3.8% and over. These are Heinz 1409, MH/VF 145 B, Pearson A-1, VF 1402, Pearson S, MH/VF 13 L, VF Roma and MH/VF 145-7879.

There are seven varieties (24%) with reducing sugars of 2.5% and over. These are VF Roma, Pearson A-1, MH/VF 145 B, MH/VF 145-7879, Pearson S, San Marzano L.F. and Marzano P 4.

There are nine varieties (31%) with acidity below 0.3%. These are Ace, J. Moran, Heinz

TABLE 5
Analysis of Pulp of Tomato Varieties

Varieties of tomato processing types with determinate type of growth	Soluble solids of pulp (%)	Total soluble solids of fruit (%)	Reducing sugars (%)	Acidity (citric acid) anhydrous (%)	pH value
MH/VF 145-22-8			not recorded		
MH/VF 145-21-4P	4.0	3.3	1.7	0.25	4.40
MH/VF 145 B	5.0	4.3	2.8	0.47	4.40
MH/VF 145 F 5	4.0	3.3	2.1	0.36	4.30
MH/VF 13 L	4.5	3.8	1.6	0.26	4.85
Marzano P-4	3.9	3.0	2.5	0.29	4.40
Heinz 1548	4.0	3.5	1.9	0.40	4.55
J. Moran	4.0	3.0	1.4	0.23	4.60
Heinz 1409	5.3	4.5	2.0	0.45	4.50
Heinz 1370	4.4	3.3	1.1	0.24	4.50
Chico Grande			not recorded		
Heinz 1350	3.6	3.1	1.1	0.31	4.40
Early Pak No. 7	3.8	3.1	2.1	0.37	4.25
Chico	4.0	3.0	1.1	0.34	4.30
Ace	4.4	3.7	1.2	0.22	4.65
CPC 2	3.0	2.2	1.1	0.27	4.30
MH/VF 145-7879	4.5	3.8	2.7	0.41	4.40
Pearson A-1	5.0	4.1	2.9	0.45	4.25
Pearson Improved			not recorded		
Pearson A-1 Improved	4.1	3.3	1.8	0.33	4.35
Pearson S	4.5	3.9	2.7	0.45	4.15
Red Top	4.7	3.6	2.3	0.32	4.55
VF 14	3.4	2.9	1.8	0.42	4.35
Roma	4.0	3.4	2.2	0.34	4.20
VF 36	3.8	3.3	1.6	0.38	4.30
VF 428 F2	3.8	3.1	2.2	0.45	4.20
VFN 8	4.0	3.1	1.8	0.32	4.25
VF 1402	5.0	4.1	2.4	0.42	4.65
VF Roma	5.0	3.8	3.0	0.43	4.25
VF Red Top 9	2.5	2.0	1.7	0.26	4.50
San Marzano L.F.	4.6	3.5	2.6	0.33	4.25
Rutgers FM Select C.	4.6	3.5	2.6	0.33	4.25

1370, MH/VF 145-21-4P, MH/VF 13 L, VF Red Top 9, CPC 2, Rutgers FM Select C. and Marzano P-4.

The pH values are indicative of the active acidity of the material including the buffering action of the pulp. The figures obtained are within the range considered normal in all the cases and therefore need no further discussion.

The characteristics considered desirable in tomatoes to be used for processing are a high yield of pulp, high content of soluble solids of pulp, high % of total soluble solids, high content of reducing sugars and low acidity.

If it is considered that soluble solids of pulp, total soluble solids and reducing sugars are the

more important criteria, it would appear that the varieties that may be recommended for cultivation on the basis of the present analytical data are: MH/VF 145 B, Pearson A-1 and VF Roma.

It is intended to carry out further trials with all the above varieties to obtain a clear indication concerning which varieties are most suitable for the canneries in Ghana.

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Note. Copies of the fuller cyclostyled draft of this paper, dated September 1968, are available to interested readers from the Crops Research Institute, Box 3785, Kumasi, Ghana.