QUALITY AND PERFORMANCE OF EIGHT TOMATO CULTIVARS IN A NUTRIENT FILM TECHNIQUE SYSTEM

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SUMMARY

Tests showed that fruits of eight tomato cultivars grown by nutrient film technique were significantly different in respect of mineral, soluble solids and acidity content and in electrical conductivity and firmness values. The cultivars also differed in yield, but there were no differences in nitrate or β-carotene content. The fruit flavour of the cultivars was considered by taste panels to be similar. Fruit of all the cultivars stored well at 18-22 °C over a 14-day period.

There was a rise and later a decline in the values for soluble solids, electrical conductivity and titratable acidity between the first (24 April) and last (29 September) laboratory testing dates. Fruit grown by nutrient film technique had less Na, K, Mg, NO₃ and alcohol-insoluble solids than fruit from peat or soil; values for Ca, vitamin C and β-carotene were between those found in tomatoes from peat and soil.

INTRODUCTION

Since its description by Cooper (1975), the nutrient film technique (NFT) has been adopted by a proportion of commercial glasshouse growers. There are approximately three hectares of NFT-grown tomatoes in Ireland. Preliminary studies on the compositional quality of tomato fruit from NFT were reported from this laboratory by Gormley & Egan (1978a), and several other workers (Adams & Winsor, 1977; Adams, 1978; Granges, 1980) have also reported their findings on the composition and quality of tomatoes grown in this way.

The Commission of the European Communities initiated a program in 1980 to study the quality and nutritive value of intensively produced tomatoes under the Agro Food Program of the Standing Committee for Agricultural Research. The present study was carried out under this program (Contract 1081) and investigated the performance, composition, colour, firmness, electrical conductivity (EC) and sensory quality of fruit of eight tomato cultivars grown by the NFT system. The
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alcohol-insoluble solids (AIS), nitrate (NO₃⁻) and vitamin contents of the fruit were investigated in view of the importance of these constituents for human nutrition; special attention was given to the mineral content because of the increased medical interest in major and trace element nutrition in humans (Love, 1979). Data for AIS, NO₃⁻ and mineral contents of tomatoes grown in peat and soil are also included here for comparison.

**Materials and Methods**

**Growing program**

Tomato plants of the eight modern cultivars 'Bellina', 'Dombó', 'Mondial', 'Nemato', 'Ostona', 'Shirley', 'Sonatine' and 'Virosa', propagated in peat compost, were planted into an NFT system on 20 February 1981. The design of the system has been described previously (Maher, 1977, 1980). The nutrient solution was pumped throughout the system from a single tank, which represents practicality and which permitted continuous monitoring and re-adjusting — where necessary — of the levels of the various nutrients in the solution. The conductivity and the pH of the solution were automatically maintained at 2500 µS and 6.0 respectively and the temperature in the tank was kept at 15 °C by means of an immersion heater. The maximum drop in temperature of the circulating solution was 1.5 °C, and the day and night temperature minima in the greenhouse over the period of the study were 20 and 5 °C. The polythene gullies were 14 m long and laid on polystyrene boards 25 cm wide and 2.5 cm thick, with the boards resting directly on the greenhouse floor, which was graded to a slope of 1 in 60. The flow rate through each gulley was 1.5 litres per minute.

The experimental design was a randomized block with four replicates, and plant density was 2.86 plants m⁻². The data were subjected to analysis of variance. The reservations (on statistical grounds) expressed by Jarrett & Chanter (1981) with regard to a single-tank design for an NFT system are noted (see Discussion); these authors pointed out that 'contamination' of the nutrient solution by a particular treatment could be circulated to all plants in the system.

Comparisons were made between the AIS, NO₃⁻, vitamin and mineral contents of the NFT-grown fruit and these values for fruit grown in peat and soil, using the cultivars 'Sonatine' and 'Virosa'. The peat-grown fruit was produced using a feed of 280 mg/l of K and 140 mg/l N: details of this peat experiment will appear in a later paper (Maher, Gormley & Monaghan, in preparation). These two cultivars were also grown in soil, using the same feed according to the Kinsaley production program for early tomatoes (Maher & Mahon, 1974); there were four replicates in the soil trial.
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(October) tested fruit of 'Bellina', 'Dombo' (July only), 'Mondial', 'Nemato' and 'Ailsa Craig'. There were twelve tasters in the 5-sample panels and fifteen in the 4-sample one, giving a total of 60 responses each time. A sample comprised half a tomato fruit sliced into three, and each panel member was asked to rank the samples in order of preference. The results of each panel were analysed statistically by referring to a rank total table (Gormley & Sherington, 1978).

RESULTS

Crop performance (Table I)

At the growing temperatures used the cultivar 'Dombo' produced short internodes with twisted foliage. This cultivar was difficult to manage and suffered a high loss from Botrytis cinerea. It gave a low yield of 4.2 kg m\(^{-2}\) to 30 June and 9.5 kg m\(^{-2}\) to 30 September, and more than 72% of the fruit was non-Class 1. Since 'Dombo' behaved so differently from the other cultivars it was excluded from the statistical analysis of the yield data.

The other cultivars grew satisfactorily until the end of May, when there was a check to growth. At this stage some of the root systems appeared to be dead. No pathogens were detected but etridiazole was applied to the NFT solution as a precaution against Pythium spp. Subsequently, fresh roots were generated and growth recovered, but yield was adversely affected. To the end of June the cultivars 'Ostona', 'Mondial' and 'Virosa' gave the highest total yields (Table I); 'Mondial' had the highest cumulative yield at 30 September, followed by 'Shirley', 'Ostona' and 'Virosa'. 'Mondial' also had the highest proportion of non-Class 1 fruit, apart from the unsatisfactory 'Dombo'. There was no Class 1 fruit of any cultivar in the <40 mm size category.

Table I: Performance of seven tomato cultivars grown by NFT.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Total yield (kg/m(^2)) to:</th>
<th>% non-Class 1</th>
<th>% (wt) of Class 1</th>
<th>of diam. (mm):</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 June</td>
<td>30 Sept.</td>
<td>40-47</td>
<td>47-57</td>
<td>57</td>
</tr>
<tr>
<td>Bellina</td>
<td>10.4</td>
<td>17.3</td>
<td>4</td>
<td>5</td>
<td>5.0</td>
</tr>
<tr>
<td>Mondial</td>
<td>13.4</td>
<td>21.7</td>
<td>9</td>
<td>8</td>
<td>5.0</td>
</tr>
<tr>
<td>Nemato</td>
<td>11.0</td>
<td>17.9</td>
<td>3</td>
<td>8</td>
<td>5.0</td>
</tr>
<tr>
<td>Ostona</td>
<td>13.8</td>
<td>20.3</td>
<td>4</td>
<td>8</td>
<td>5.0</td>
</tr>
<tr>
<td>Shirley</td>
<td>12.6</td>
<td>20.8</td>
<td>2</td>
<td>11</td>
<td>6.8</td>
</tr>
<tr>
<td>Sonatine</td>
<td>14.1</td>
<td>19.0</td>
<td>2</td>
<td>14</td>
<td>6.9</td>
</tr>
<tr>
<td>Virosa</td>
<td>13.0</td>
<td>20.2</td>
<td>3</td>
<td>9</td>
<td>6.7</td>
</tr>
<tr>
<td>S.E.</td>
<td>0.3</td>
<td>0.6</td>
<td>1.2</td>
<td>1.0</td>
<td>1.8</td>
</tr>
</tbody>
</table>

† ** P<0.01; *** P<0.001.
Tomato cultivars in a nutrient film technique system

Fruit grading
The NFT fruit was picked twice weekly (80% red/20% yellow stage) between 14 April and 3 September and the weights in Class 1 and non-Class 1 were obtained. The weights of Class 1 fruit in the size-grades <40, 40-47, 47-57 and >57 mm diameter were also recorded.

Tests on frozen fruit
Samples of tomatoes from NFT, peat and soil (10 fruits per plot) picked on 25 May at the 80% red/20% yellow stage were frozen as whole fruits in triple polythene bags in a deep-freeze cabinet for analysis at a later date. The freezing and thawing procedures used were those reported by Buret, Gormley & Roucoux (1983). The thawed samples were macerated, and 40 g of the macerate was ashed and then digested with 12 M HCl. The digested samples were analysed for Na, K, Ca, Mg, Zn, Cu and Cr (termed minerals in this paper) by atomic absorption spectrophotometry.

β-Carotene was determined on 20-g lots of macerate by the procedure of Liu & Luh (1977), using a spectrophotometer at 451 nm. Vitamin C content was determined by the 2,6-dichlorophenolindophenol procedure (Pearson, 1962).

Alcohol-insoluble solids were determined by adding 20 g of macerate to boiling aqueous ethanol to give a final alcohol concentration of 80%. Nitrate was determined on a 20-g sample of macerate by the method of Elliott & Porter (1971): pH was adjusted to 5-6 with 0·1 M NaOH.

Tests on fresh fruit
Fresh fruit of the cultivars grown by NFT underwent quality tests five times during the season, on 24 April, 8 June, 25 June, 24 August and 29 September, with the exception of 'Dombo' fruit, which was tested only on 8 and 25 June. Fruit of all the cultivars from the 25 June sampling was also stored for 14 days at 18-22 °C and tested after seven and 14 days. Tests for soluble solids (SS), titratable acidity (TA) and EC were done on a macerate (obtained from 10 fruits per plot) by procedures reported by Buret et al. (1983). Colour and firmness were measured on each of 10 fruits per plot with a Hunter Colour Difference Meter and a shear press respectively, as outlined by Gormley & Egan (1978b).

Flavour evaluation
Rank type taste panels tested fruit of the cultivars from NFT in July and again in October, using two panels each time because of the number of samples. Samples of fruit of 'Ailsa Craig' grown in soil were included for each panel because of the reputed good flavour of this tomato. In panels 1 (July) and 3 (October), fruit of 'Shirley', 'Ostona', 'Virosa', 'Sonatine' and 'Ailsa Craig' was compared, whilst panels 2 (July) and 4
Tomato cultivars in a nutrient film technique system

Mineral, nitrate, AIS and vitamin contents of fruit (Tables II and III)

The fruit of 'Mondial' accumulated less Na than that of 'Neinato' and 'Ostona', whilst 'Ostona' and 'Bellina' fruit had the highest K content and 'Shirley' fruit the lowest (Table II). Fruit of 'Mondial' and 'Bellina' had the most Ca and that of 'Shirley', 'Virosa' and 'Sonatine' the least. Values for Mg content were fairly uniform and there were no significant differences in β-carotene and NO₃⁻ contents, with mean values of 0.47 and 0.46 mg/100 g fresh material respectively. Alcohol-insoluble solids content ranged from 1.57% for 'Bellina' and 'Sonatine' to 1.32% for 'Mondial'. Fruit Cr content was generally zero except in one or two samples where traces were found. As in the case of yield, data for 'Dumbo' fruit were omitted from the statistical analysis; values for this cultivar were: Na 1.1, K 298, Ca 10.4, Mg 9.3, Zn 0.0, Cu 0.04 and vitamin C 7.9 (all mg/100 g fresh material) and AIS content 1.57%.

Table II
Mineral composition and AIS and vitamin C contents of fruit of seven tomato cultivars grown by NFT.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Na (mg/100 g fresh material)</th>
<th>K (mg/100 g fresh material)</th>
<th>Ca (mg/kg fresh material)</th>
<th>Mg (mg/kg fresh material)</th>
<th>vit. C (mg/kg fresh material)</th>
<th>Zn (mg/kg fresh material)</th>
<th>Cu (mg/kg fresh material)</th>
<th>AIS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bellina</td>
<td>1.5</td>
<td>2.31</td>
<td>11.6</td>
<td>7.2</td>
<td>10.1</td>
<td>6</td>
<td>2</td>
<td>1.57</td>
</tr>
<tr>
<td>Mondial</td>
<td>1.1</td>
<td>2.08</td>
<td>11.8</td>
<td>9.4</td>
<td>9.3</td>
<td>4</td>
<td>2</td>
<td>1.32</td>
</tr>
<tr>
<td>Neinato</td>
<td>2.4</td>
<td>2.29</td>
<td>10.5</td>
<td>7.2</td>
<td>10.1</td>
<td>5</td>
<td>2</td>
<td>1.47</td>
</tr>
<tr>
<td>Ostona</td>
<td>2.1</td>
<td>2.13</td>
<td>9.8</td>
<td>7.5</td>
<td>10.8</td>
<td>5</td>
<td>2</td>
<td>1.53</td>
</tr>
<tr>
<td>Shirley</td>
<td>1.4</td>
<td>1.89</td>
<td>9.4</td>
<td>6.5</td>
<td>10.7</td>
<td>5</td>
<td>2</td>
<td>1.39</td>
</tr>
<tr>
<td>Sonatine</td>
<td>1.5</td>
<td>2.13</td>
<td>9.0</td>
<td>6.7</td>
<td>10.5</td>
<td>5</td>
<td>2</td>
<td>1.57</td>
</tr>
<tr>
<td>Virosa</td>
<td>1.3</td>
<td>2.07</td>
<td>9.6</td>
<td>6.4</td>
<td>10.5</td>
<td>5</td>
<td>1</td>
<td>1.37</td>
</tr>
</tbody>
</table>

F-test†

| S.E. | 0.20 | 0.77 | 0.34 | 0.17 | 0.51 | 0.3 | 0.2 | 0.06 |

† * P < 0.05; ** P < 0.01; *** P < 0.001.

Table III
Mineral composition and AIS, NO₃⁻, vitamin C and β-carotene contents of tomato fruit (cvs. 'Sonatine' and 'Virosa') grown by NFT and in peat and soil.

<table>
<thead>
<tr>
<th>Growing medium</th>
<th>Na (mg/kg fresh material)</th>
<th>K (mg/kg fresh material)</th>
<th>Ca (mg/kg fresh material)</th>
<th>Mg (mg/kg fresh material)</th>
<th>vit. C (mg/kg fresh material)</th>
<th>Zn (mg/kg fresh material)</th>
<th>Cu (mg/kg fresh material)</th>
<th>AIS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peat</td>
<td>2.4</td>
<td>238</td>
<td>8.6</td>
<td>8.2</td>
<td>1.1</td>
<td>10.8</td>
<td>0.51</td>
<td>2</td>
</tr>
<tr>
<td>NFT</td>
<td>1.4</td>
<td>184</td>
<td>9.3</td>
<td>6.5</td>
<td>0.4</td>
<td>10.5</td>
<td>0.43</td>
<td>5</td>
</tr>
<tr>
<td>Soil</td>
<td>2.1</td>
<td>233</td>
<td>10.9</td>
<td>6.7</td>
<td>1.4</td>
<td>9.6</td>
<td>0.36</td>
<td>10</td>
</tr>
</tbody>
</table>

† Means are for 8 NFT plots, 24 peat plots and 8 soil plots.
Fruit from NFT had less Na, K, Mg, NO₃ and AIS than fruit from peat or soil (Table III); values for Ca, vitamin C and β-carotene were between those found for tomatoes from peat and soil. These data were not analysed statistically.

**Fruit soluble solids, acidity and electrical conductivity values** (Tables IV and V)

Fruit of 'Mondial' and 'Virosa' had the lowest SS values and that of 'Bellina' the highest, whilst 'Ostona' fruit was the most acidic and had the highest EC value (Table IV). The rank correlation coefficient between TA and EC was +0·94, whereas corresponding values for SS and TA and SS and EC were +0·47 and +0·46 respectively (based on data in Table IV).

Soluble solids, TA and EC values were highest at the June testing dates and tended to fall later in the season (Table V). There was only one significant \( (P<0·05) \) time × cultivar interaction; this occurred for the cultivar 'Shirley', which had the lowest SS value on the first testing date and the highest on the final two dates.

Data for 'Dombo' fruit are excluded from Tables IV and V as the samples were tested only on the two June dates. Mean SS, TA and EC values for 'Dombo' were 5·5°brix, 7·8 meq and 616 µS respectively.

**Fruit colour and firmness** (Tables IV and V)

There were no significant differences in fruit colour between the cultivars (mean Hunter a/b value, 1·04), but the fruit of 'Sonatine' was firmest and that of 'Ostona' softest (Table IV). Fruit removed on the first testing date (24 April) was less red in colour than that picked on other dates (Table V), but in the case of firmness there was no consistent pattern of change over the season. 'Dombo' fruit had mean Hunter a/b and firmness values of 1·21 and 3355 g respectively, making it the reddest and firmest of the cultivars.

Correlation coefficients between Hunter a/b and firmness were small on each of the testing dates, with a mean of +0·04 and a range of -0·52 to +0·54. This finding was not unexpected, as the range in fruit colour on an individual testing date was small.

**Fruit flavour**

Fruit of 'Ailsa Craig' was rated by taste panel 2 (July) better for flavour \( (P<0·05) \) than the fruit of 'Bellina', 'Dombo', 'Mondial' or 'Nemato', but panel 3 (October) rated it poorer-flavoured \( (P<0·05) \) than that of 'Shirley', 'Ostona', 'Virosa' or 'Sonatine'. Panels 1 and 4 detected no statistically significant flavour differences. However, with panels 1 (July) and 3 (October) there was a trend (almost significant at \( P<0·05 \)) in favour of the fruit of 'Shirley' and 'Ostona'. There was also a
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Table IV
Composition and firmness of fruit of seven tomato cultivars grown by NFT. (Data are means for 5 testing dates.)

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Soluble solids (%)</th>
<th>Titratable acidity (meq/100 g puree)</th>
<th>Electrical conductivity (µS)</th>
<th>Firmness (g) for 5 mm fruit compression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bellina</td>
<td>51</td>
<td>7.8</td>
<td>560</td>
<td>2840</td>
</tr>
<tr>
<td>Mondial</td>
<td>47</td>
<td>7.7</td>
<td>553</td>
<td>2630</td>
</tr>
<tr>
<td>Nenato</td>
<td>49</td>
<td>7.8</td>
<td>545</td>
<td>2660</td>
</tr>
<tr>
<td>Ostara</td>
<td>50</td>
<td>8.7</td>
<td>595</td>
<td>2570</td>
</tr>
<tr>
<td>Shirley</td>
<td>50</td>
<td>8.5</td>
<td>591</td>
<td>2700</td>
</tr>
<tr>
<td>Sonatine</td>
<td>50</td>
<td>8.2</td>
<td>572</td>
<td>2890</td>
</tr>
<tr>
<td>Virosa</td>
<td>48</td>
<td>8.0</td>
<td>591</td>
<td>2580</td>
</tr>
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</table>

F-test:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>S.E.</td>
<td>0.06</td>
<td>0.22</td>
<td>0.30</td>
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</tbody>
</table>

† Determined on 1 part puree + 9 parts distilled water.
* P < 0.05; ** P < 0.01; *** P < 0.001.

Table V
Composition, colour and firmness of NFT-grown tomato fruit on five dates during the 1981 season. (Data are means for 7 cultivars.)

<table>
<thead>
<tr>
<th>Testing date</th>
<th>Soluble solids (%)</th>
<th>Titratable acidity (meq/100 g puree)</th>
<th>Electrical conductivity (µS)</th>
<th>Hunter colour (a/b)</th>
<th>Firmness (g) for 5 mm fruit compression</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 April</td>
<td>4.6</td>
<td>8.2</td>
<td>581</td>
<td>0.87</td>
<td>3020</td>
</tr>
<tr>
<td>8 June</td>
<td>5.5</td>
<td>8.0</td>
<td>599</td>
<td>1.12</td>
<td>2720</td>
</tr>
<tr>
<td>25 June</td>
<td>5.2</td>
<td>9.5</td>
<td>626</td>
<td>1.01</td>
<td>2320</td>
</tr>
<tr>
<td>24 August</td>
<td>4.4</td>
<td>6.8</td>
<td>517</td>
<td>0.99</td>
<td>2030</td>
</tr>
<tr>
<td>29 September</td>
<td>4.9</td>
<td>7.1</td>
<td>517</td>
<td>1.31</td>
<td>2390</td>
</tr>
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F-test:

<p>| | | | |</p>
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<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>S.E.</td>
<td>0.06</td>
<td>0.22</td>
<td>0.04</td>
</tr>
</tbody>
</table>

† Determined on 1 part puree + 9 parts distilled water.
* P < 0.05; ** P < 0.01; *** P < 0.001.

seasonal effect in that 'Ailsa Craig' fruit was better-rated for taste in July than in October.

Fruit storage

Although the fruit of all the cultivars stored well over the 14-day period at 18-22 °C, some inter-cultivar differences were recorded in the tests which followed. Fruit SS levels for 'Shirley', 'Bellina' and 'Virosa' remained relatively constant over the first seven days of storage,
whereas the values for the other five cultivars increased by 6-10%. After 14 days, fruit of 'Mondial' and 'Ostona' had much higher SS levels than at the start of the storage period. Fruit of 'Dombo' increased in acidity by 15.5% over the first seven storage days, but after 14 days all eight cultivars had lost from 10·3 to 29·6% of their original TA.

'Dombo' fruit softened less than the others during the first seven days: after 14 days, the fruit of 'Nemato' was softest, having lost 65·5% of its original firmness, whilst that of 'Virosa' was firmest, having lost 50·2%. Mean values for SS, TA, EC, colour and firmness for all the cultivars at the start of the storage period were respectively 5·3%, 9·0 meq, 631 µS, 1·03 (a/b) and 2386 g. Corresponding values on day 7 were 5·7%, 9·4 meq, 643 µS, 1·59 (a/b) and 1387 g; and on the 14th day, 5·5%, 7·1 meq, 602 µS, 1·73 (a/b) and 831 g.

**Discussion**

The reader's attention is drawn to the reservations of Jarrett & Chanter (1981) regarding the use of a single-tank design for experiments with NFT systems. Their concern about the possible effect of root exudates circulating in the NFT solution to plants in all the plots of an experiment is a real one, and the results of the present experiment must be interpreted bearing their reservations and conclusions in mind. However, it must also be pointed out that from a practical point of view it is extremely difficult to have several tanks per treatment or a separate tank for every plot. The reservations of Jarrett and Chanter warrant further investigation because, if fully justified, they raise the parallel issue of the greenhouse atmosphere, in that tomato leaves may well emit volatile compounds (such as ethylene) which could diffuse rapidly through the greenhouse and might influence plant growth. In such a situation plots would no longer be independent, and this could invalidate the designs of many greenhouse experiments. However, these issues require an interdisciplinary approach between plant biochemists and statisticians and are not topics for the present study, which is orientated towards commercial practice.

The performance of the cultivars grown by the NFT system was satisfactory except for that of 'Dombo', which was not suited to the temperature regime used. However, we have reported the results from this cultivar — based on the two dates when its fruit was tested — because it is a 'beefsteak' tomato.

Whilst there was a considerable variation in AIS content between cultivars (Table II), the over-all level of AIS in tomatoes is low (Table III). The AIS level reflects particularly the dietary fibre content, which is about 80% of the AIS value. Published data for the dietary fibre content of tomatoes (McCance & Widdowson, 1978) show a figure of 1·5%, equivalent to an AIS value of about 1·88%, which is higher than
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that found for seven of the cultivars tested in NFT and equal to that found for 'Dombo' fruit.

The SS values for the seven cultivars were similar to those reported for fruit grown in peat but lower than for fruit from soil or peat/soil (Gormley & Gallagher, 1974). They were higher than values for commercially-grown NFT fruit or for tomatoes from a wide range of sources obtained at the Dublin market (Gormley & Egan, 1982). Values for TA were similar to those reported by Adams & Winsor (1977) for NFT-grown fruit.

Electrical conductivity values for all the cultivars were low, and seem to follow a general trend suggesting that the intensive growing of tomatoes gives lower EC values. The findings compare unfavourably with EC values of 626, 706, 726 and 786 µS found in commercial samples (from peat and soil) tested respectively in 1980, 1972, 1973 and 1974 (Gormley & Egan, 1982), and with values of 832 and 772 µS found for NFT fruit grown at Kinsealy (Gormley & Egan, 1978a). High EC values are desirable in view of their association with good flavour (Gormley, 1972).

The rise and subsequent decline in SS values found for NFT fruit in the course of the season was an effect similar to that found by Winsor & Adams (1976) for soil-grown tomatoes, and contrasts with the steady increase in sugar content over the season later reported by the same workers for NFT-grown fruit. Adams & Winsor (1977) attributed the absence of any decline in the content of sugars in 1976 to the very sunny weather in July, August and September of that year. They also found a rise and a decline in both TA and K values over the season, which was paralleled by TA and EC values in the present study.

The values for the other constituents shown in Tables II and III generally agree with data published by McCance & Widdowson (1978) with the exception of Zn, Cu and vitamin C, for which the previously reported values of 0.20, 0.10 and 20 mg/100 g fresh material respectively are much higher than those found in the present study. Bohart (1940) and Hopkins & Eisen (1959) respectively reported Cu ranges of 0.06-0.26 and 0.01-0.16 mg/100 g fresh weight for tomatoes, whilst Beeson (1941) gave values of 1.2-6.7 mg/100 g dry weight for Zn content. Translation of Beeson's figures to a fresh weight basis suggests a higher Zn content than that found for NFT-grown fruit in this study (Table III).

The vitamin C content of NFT-grown fruit was similar to that found for peat-grown fruit and higher than that for fruit grown in soil (Table III). The values shown are low relative to most published data (Hobson & Davies, 1971), but vitamin C values can vary widely because of different light intensities during growing. Gormley & Egan (1978a) found that peat-grown fruit had a higher vitamin C content than fruit from NFT, which agrees with the findings in the present study.
Granges (1980) reported similar vitamin C levels from the two media. Granges also found that soil-grown fruit had a β-carotene content 70% higher than in fruit grown by NFT, but this was not corroborated in the present study.

Fruit from NFT had a lower NO₃ content than that from peat or soil (Table III). This is a bonus for NFT-grown fruit in view of the current concern about the NO₃ content of foods. Kenny & Walshe (1975) have reported NO₃ ranges of 1.0–4.0 mg/100 g fresh weight for commercially grown Irish tomatoes and 0.0–0.03 mg/100 g for imported tomatoes: it is likely that the latter were grown outdoors at low fertilizer levels.

CONCLUSIONS

The eight tomato cultivars tested performed satisfactorily in nutrient film technique growing system with the exception of 'Dombo', which was not suited to the temperature regime used. Levels of Na, K and NO₃ in NFT-grown tomatoes were lower than in fruit from peat and mineral soil. Electrical conductivity values for NFT-grown fruit were low for each cultivar and throughout the season, and further research is required on methods of raising these values.

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REFERENCES

Tomato cultivars in a nutrient film technique system


