A REPORT TO THE HORTICULTURAL DEVELOPMENT COUNCIL
18 LAVANT STREET, PETERSFIELD, HANTS, GU32 3EW

# TOMATOES: OPTIMUM PLANTING STAGE AND PLANT DENSITY FOR THE V-SYSTEM

FINAL REPORT

| | |
|---|---|
| **Project Number:** | PC64 |
| **Project Title:** | Tomatoes: Optimum planting stage and plant density for the V-System. |
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| **Project Coordinator:** | G Hayman |
| **Report Date:** | 1993 |
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| **Date Completed:** | November 1992 |
| **Key Words:** | tomatoes, V-System, density, planting stage |

**Authentication**

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

Signature .....M.P.Hardgrave.....

Mary Hardgrave
Project Leader

Date ...16/6/93....

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## Relevance to Growers and Practical Application

### Application

This project aimed to establish the optimum planting stage and early plant density for tomatoes grown on the V-System.

At 11,000 plants/acre total yield from the V-System equalled the double row, but early yield was reduced. At 9,200 plants/acre on the V-System yield and fruit quality were lower.

Delaying planting until the second truss was in flower did not affect yield but gave some improvements in fruit quality.

### Summary

### Objective

Difficulties and costs of substrate disposal have led to increased interest in growing in reduced volumes of substrate. The V-System involves growing a double row of tomatoes on a single row of substrate and therefore could halve both the cost of purchase and disposal.

This project aimed to establish the optimum planting stage and early plant density to maximise fruit yield, size and quality for this growing system.

### Treatments

A standard double row system, planted when the first flower was just opening at 11,000 plants/acre was compared with V-Systems planted at 11,000 plants/acre and 9,200 plants/acre. In the V-System treatments planting (slab contact) at first open flower was compared with delaying planting until the first flower on the second truss was just opening.

Sideshoots were taken in mid March to increase all plant densities to 13,800 shoots/acre.

### Results

1. Yield from all V-System treatments was lower than the double row treatment up to the end of May.

2. Total yield from the high density V-System treatment equalled the double row but yield from the low density treatment was lower.

3. Overall fruit quality from the V-System equalled that from the double row.

4. Fruit quality from the high density V-System was slightly better than that from the low density.

5. There was no difference in fruit size between the V-System and the double row when planted at the same density but reducing density in the V-System increased fruit size.

6. The V-System was more susceptible to Blossom-end rot.

## Action Points for Growers

1. When using the V-System the same density that would have been used for a double row system is recommended. Actual density should be chosen based on factors such as planting date, location and variety as usual.

2. Delaying planting could give benefits but should only be used if good management of the plants before slab contact can be achieved.

## Practical and Financial Benefits

The yield (and monetary) losses recorded with the V-System in this trial were related mainly to loss of marketable yield and fruit quality in May (due to Blossom-end rot). Ongoing HDC trials trials are investigating optimum irrigation regimes for the V-System and with this information irrigation regimes should be developed to minimise this problem. If this were the case yield and fruit quality from the V-System should equal that from the double row system.

The cost of purchasing and disposing of substrates would be halved and there are, therefore, financial benefits in using this system.

The reduced substrate volume makes reaction to nutritional changes faster and therefore control of the plant should be better.

## Objective

To evaluate the V-System as a viable alternative to the standard double row system of growing tomatoes. In particular to establish the effect of plant growth stage when slab contact was made, and early plant density on fruit yield and quality.

## Introduction

The difficulties and costs of substrate disposal have become increasingly important in recent years, particularly in areas of high intensity protected cropping. This has led to increased interest in the possibilities of growing in reduced volumes of substrate. The V-System of production involves growing a double row of tomatoes in a single row of substrate. The system therefore halves the costs of both purchase and disposal of rockwool.

Some early attempts to use the system by growers have showed some losses in early yield, possibly due to competition for light by closely spaced plants. There is therefore a need to establish the optimum planting stage and early plant density to eliminate this problem.

**Materials and Methods**

| | |
|---|---|
| Sowing Date: | 20 November 1991 |
| Planting Date:<br>(slab contact) | 3 January 1992 - Early planting<br>29 January 1992 - Late planting |
| First Harvest: | 16 March 1992 |
| Final Harvest: | 16 November 1992 |
| Plant Populations: | 9,200 plants/acre and 11,000 plants/acre, increasing to 13,800 shoots/acre |
| Irrigation: | Double row 150 ml per 100J or every 2 hours. V-System 105 ml every 70J or every 1 hour, 40 minutes. |
| Varieties: | Liberto<br>Spectra<br>Pronto |
| Pollination: | Bumble bees |
| Carbon Dioxide: | 1,000 vpm until end of April then 600 vpm to 5% vent and 350 vpm with >5% vent |
| Shelf Life Conditions: | 20°C. 12 hours illumination/24 hours<br>65% RH |

Treatments

1. Standard double row system (control)
   Plant spacing: 46 cm (11,000 plants/acre)
   Sideshoots: One every 4 plants
   Planting stage: Direct from propagation area, 1st flower just showing

2. V-System - High density, early planting
   Plant spacing: 23 cm (11,000 plants/acre)
   Sideshoots: One ever 4 plants
   Planting stage: 1st flower just showing

3. V-System - Low density, early planting
   Plant spacing: 27.5 cm (9,198 plants/acre)
   Sideshoots: One every 2 plants
   Planting stage: 1st flower just showing

4. V-System - High density, late planting
   Plant spacing: 23 cm (11,000 plants/acre)
   Sideshoots: One every 4 plants
   Planting stage: Plants spaced in growing house at 1st flower and slab contact made at 1st flower on truss 2.

5. V-System - Low density, late planting
   Plant spacing: 27.5 cm (9,198 plants/acre)
   Sideshoots: One every 2 plants
   Planting stage: Plants spaced in growing house at 1st flower and slab contact made at 1st flower on truss 2.

Records

The crop was harvested and graded 3 times each week. Yield in size grades and percentage in each class was recorded. Shelf life and detailed fruit quality assessments were made 3 times during the season. Full nutrient analysis of slab and drip solution was carried out weekly, in addition to daily monitoring.

Experimental Design

The trial comprised 15 treatments in a 5 growing system by 3 variety factorial structure. The experimental area covered 15 rows (as 3 sets of 5 rows) and each row was sub-divided into three plots. Systems were allocated to whole rows, there were three replicates of each system assigned in three randomised blocks of the five treatments. The three cultivars were assigned to the three plots within a row. A cultivar was assigned to the same relative plot position across the five rows in one replicate block. The position was changed for each of the three blocks, positions were assigned in a 3x3 Latin Square design.

## Results

### Yield and Fruit Quality

As there were no significant variety x growing system interactions all results are expressed as the mean of the 3 varieties.

Table 1 shows that early yield (March and April) was significantly higher from the double row than from any of the V-System treatments. This difference was also evident throughout May, but there were no differences between the systems for the remainder of the season until October when the same effect was recorded. Total yield for the season was therefore higher from the double row system.

The high early density treatment significantly outyielded the low density treatment at first and this effect continued until the end of June. Final yield was not significantly different between the 2 density treatments.

There was no difference in yield between the early and delayed planting treatments.

**Table 1a: Marketable Yield (kg/m²)**

| | Mar/ Apr | May | Jun | Jul | Aug | Sep | Oct/ Nov |
|---|---|---|---|---|---|---|---|
| Standard double | 6.85 | 9.19 | 9.96 | 10.53 | 8.15 | 7.34 | 7.57 |
| V-System: | | | | | | | |
| High Early | 6.66 | 8.11 | 10.31 | 10.60 | 8.07 | 7.41 | 7.10 |
| High Late | 6.62 | 8.03 | 9.93 | 10.32 | 7.70 | 7.07 | 6.58 |
| Low Early | 6.16 | 7.83 | 9.55 | 9.99 | 7.76 | 6.99 | 6.50 |
| Low Late | 6.03 | 7.68 | 9.60 | 10.17 | 7.94 | 7.09 | 6.93 |
| SED (8 df) | 0.24 | 0.261 | 0.166 | 0.330 | 0.221 | 0.276 | 0.15 |
| LSD (P = 0.05) | 0.54 | 0.60 | 0.38 | - | - | - | 0.35 |
| Significance: | | | | | | | |
| Double v V-System | * | *** | NS | NS | NS | NS | *** |
| High v Low density | * | NS | ** | NS | NS | NS | NS |
| Early v Late planting | NS | NS | NS | NS | NS | NS | NS |

**Table 1b: Marketable Yield (kg/m²)**

| | Total to End May | Total |
|---|---|---|
| Standard double | 16.04 | 60.30 |
| V-System: | | |
| High Early | 14.78 | 59.05 |
| High Late | 14.65 | 56.96 |
| Low Early | 13.99 | 55.51 |
| Low Late | 13.72 | 56.21 |
| SED (8 df) | 0.47 | 1.379 |
| LSD (P = 0.05) | 1.08 | 3.18 |
| Significance: | | |
| Double v V-System | ** | * |
| High v Low density | * | NS |
| Early v Late planting | NS | NS |

In March and April there was no difference in fruit quality between the double row and the V-System treatments but in May Blossom-end rot affected the trial, particularly the variety Spectra. The V-System treatments were affected more severely than the double row and there was a corresponding difference in percentage Class I fruit production (Table 2a).

There was no significant difference in fruit quality for the remainder of the season but from July onwards the V-System tended to produce slightly better quality than the double row.

The high early density treatment gave better fruit quality than the low density in July. This indicates that there was probably some loss of quality from fruit on sideshoots at this time and this treatment contained a higher percentage of shoots. Boxiness was the main defect during this period.

There was an indication that early fruit quality was better where slab contact was delayed but this was not statistically significant.

Table 2a: % Class I

| | Mar/ Apr | May | Jun | Jul | Aug | Sep | Oct/ Nov |
|---|---|---|---|---|---|---|---|
| Standard double | 88.2 | 85.0 | 82.0 | 65.7 | 64.9 | 61.3 | 67.1 |
| V-System: | | | | | | | |
| High Early | 87.7 | 75.0 | 81.6 | 67.0 | 64.1 | 63.1 | 67.9 |
| High Late | 88.4 | 78.3 | 81.8 | 68.9 | 65.6 | 61.6 | 70.0 |
| Low Early | 88.6 | 78.3 | 80.8 | 64.8 | 66.0 | 62.6 | 67.4 |
| Low Late | 90.2 | 79.8 | 82.0 | 65.9 | 65.1 | 64.2 | 71.9 |
| SED (8 df) | 1.14 | 2.16 | 1.33 | 1.55 | 1.98 | 2.24 | 1.68 |
| LSD (P = 0.05) | - | 5.0 | - | 3.6 | - | - | 3.88 |
| Significance: | | | | | | | |
| Double v V-System | NS | *** | NS | NS | NS | NS | NS |
| High v Low density | NS | NS | NS | * | NS | NS | NS |
| Early v Late planting | NS | NS | NS | NS | NS | NS | * |

Table 2b: % Class I

| | Total to End May | Total |
|---|---|---|
| Standard double | 86.4 | 73.4 |
| V-System: | | |
| High Early | 80.7 | 72.2 |
| High Late | 82.8 | 73.6 |
| Low Early | 82.9 | 72.3 |
| Low Late | 84.4 | 73.7 |
| SED (8 df) | 1.39 | 0.88 |
| LSD (P = 0.05) | 3.21 | - |
| Significance: | | |
| Double v V-System | * | NS |
| High v Low density | NS | NS |
| Early v Late planting | NS | NS |

Table 3 shows Class II fruit production. There was no difference between the double row and the V-System except in May when quality dropped on the V-System.

In July there was increased Class II fruit from the low density treatment.

Waste fruit levels were low except in May when Blossom-end rot was a particular problem. The problem was worse on the V-System, particularly the high density treatment (Table 4).

There was an indication in the early part of the season that delayed planting reduced waste compared with early planting.

In July and August the double row system produced more waste than the V-System.

Table 3a: Percentage Class II

| | Mar/ Apr | May | Jun | Jul | Aug | Sep | Oct/ Nov |
|---|---|---|---|---|---|---|---|
| Standard double | 11.0 | 13.7 | 16.7 | 32.8 | 33.7 | 37.1 | 31.5 |
| V-System: | | | | | | | |
| High Early | 11.5 | 19.8 | 17.0 | 32.1 | 35.2 | 35.3 | 30.1 |
| High Late | 11.3 | 17.9 | 17.4 | 30.5 | 33.4 | 36.5 | 28.6 |
| Low Early | 10.1 | 17.9 | 18.1 | 34.5 | 33.1 | 35.5 | 29.8 |
| Low Late | 9.4 | 17.6 | 17.0 | 33.5 | 34.2 | 34.0 | 26.5 |
| SED (8 df) | 1.32 | 1.87 | 1.09 | 1.53 | 2.14 | 2.13 | 1.62 |
| LSD (P = 0.05) | - | 4.3 | - | 3.5 | - | - | - |
| Significance: | | | | | | | |
| Double v V-System | NS | * | NS | NS | NS | NS | NS |
| High v Low density | NS | NS | NS | ** | NS | NS | NS |
| Early v Late planting | NS | NS | NS | NS | NS | NS | NS |

Table 3b: Percentage Class II

| | Total to End May | Total |
|---|---|---|
| Standard double | 12.6 | 25.3 |
| V-System: | | |
| High Early | 16.1 | 26.1 |
| High Late | 14.9 | 25.1 |
| Low Early | 14.5 | 26.0 |
| Low Late | 13.9 | 25.1 |
| SED (8 df) | 1.30 | 0.82 |
| LSD (P = 0.05) | - | - |
| Significance: | | |
| Double v V-System | NS | NS |
| High v Low density | NS | NS |
| Early v Late planting | NS | NS |

**Table 4a: Percentage Waste**

| | Mar/ Apr | May | Jun | Jul | Aug | Sep | Oct/ Nov |
|---|---|---|---|---|---|---|---|
| Standard double | 0.7 | 1.3 | 1.2 | 1.5 | 1.4 | 1.6 | 1.4 |
| V-System: | | | | | | | |
| High Early | 0.8 | 5.2 | 1.4 | 0.9 | 0.7 | 1.6 | 2.0 |
| High Late | 0.3 | 3.8 | 0.8 | 0.6 | 1.0 | 1.9 | 1.4 |
| Low Early | 1.3 | 3.8 | 1.1 | 0.6 | 0.9 | 1.9 | 2.8 |
| Low Late | 0.4 | 2.6 | 1.1 | 0.5 | 0.7 | 1.8 | 1.6 |
| SED (8 df) | 0.31 | 0.59 | 0.35 | 0.29 | 0.34 | 0.50 | 0.67 |
| LSD (P = 0.05) | 0.72 | 1.4 | - | 0.67 | 0.8 | - | - |
| Significance: | | | | | | | |
| Double v V-System | NS | *** | NS | * | * | NS | NS |
| High v Low density | NS | ** | NS | NS | NS | NS | NS |
| Early v Late planting | * | NS | NS | NS | NS | NS | NS |

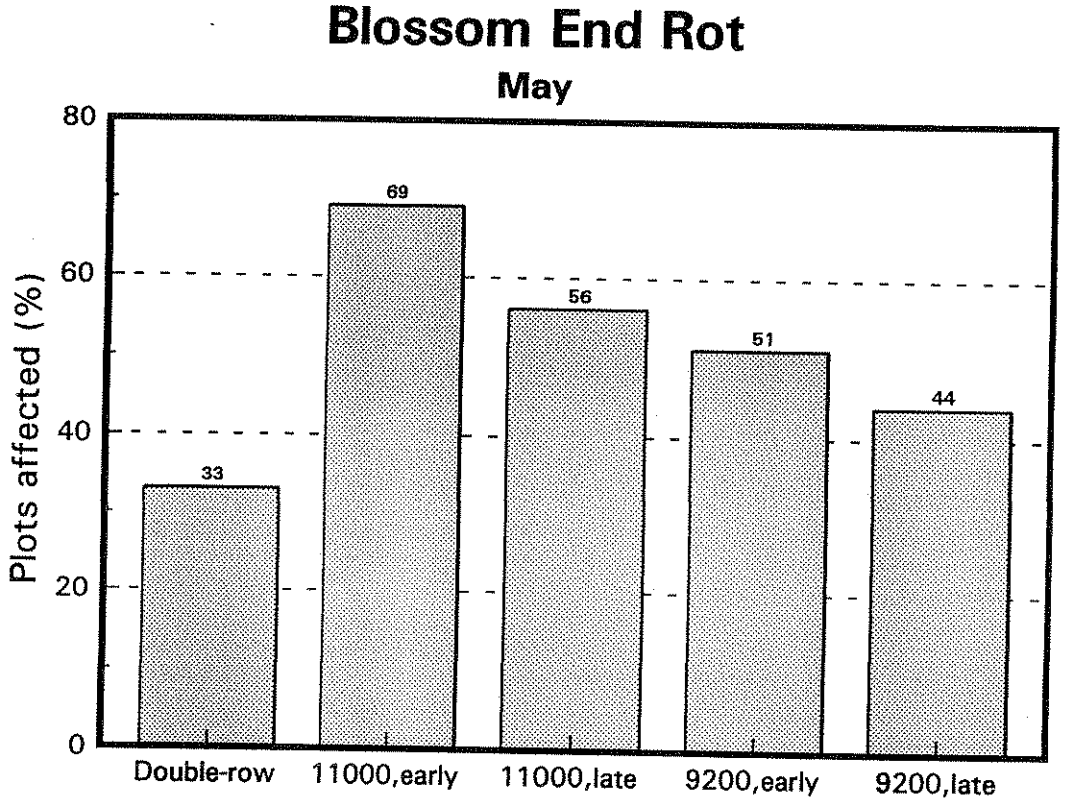
**Table 4b: Percentage Waste**

| | Total to End May | Total |
|---|---|---|
| Standard double | 1.1 | 1.3 |
| V-System: | | |
| High Early | 3.3 | 1.8 |
| High Late | 2.3 | 1.4 |
| Low Early | 2.7 | 1.5 |
| Low Late | 1.7 | 1.2 |
| SED (8 df) | 0.42 | 0.21 |
| LSD (P = 0.05) | 0.97 | 0.48 |
| Significance: | | |
| Double v V-System | ** | NS |
| High v Low density | NS | NS |
| Early v Late planting | * | * |

Blossom-end Rot

Figure 1 shows the percentage of plants affected by Blossom-end rot in May and clearly demonstrates the differences between the V-System treatments.

Figure 1



## Fruit Size

There was no difference in fruit size between the double row system and the high density V-System treatment until the end of May but the low density treatment produced approximately 10% more Grade C fruit (over 57 mm diameter) (Table 5b).

In June all of the V-System treatments produced significantly more large fruit than the double row. This could have been influenced by the low fruit production in the previous month.

Throughout the remainder of the season the growing systems did not influence fruit size but in October/November there was much more small fruit from the V-System (Table 7).

Planting stage did not influence fruit size.

Table 5a: Percentage Grade C

| | Mar/ Apr | May | Jun | Jul | Aug | Sep | Oct/ Nov |
|---|---|---|---|---|---|---|---|
| Standard double | 22.9 | 23.4 | 22.4 | 30.5 | 19.6 | 10.8 | 11.4 |
| V-System: | | | | | | | |
| High Early | 23.0 | 26.9 | 30.9 | 35.5 | 19.6 | 10.4 | 8.9 |
| High Late | 20.1 | 25.3 | 28.3 | 31.9 | 17.7 | 9.3 | 4.8 |
| Low Early | 30.9 | 33.9 | 30.1 | 31.3 | 17.0 | 6.4 | 4.2 |
| Low Late | 29.4 | 35.2 | 30.6 | 30.6 | 17.8 | 8.5 | 6.5 |
| SED (8 df) | 2.39 | 3.21 | 3.03 | 3.61 | 3.61 | 2.37 | 1.38 |
| LSD (P = 0.05) | 5.51 | 7.4 | 7.0 | - | - | - | 3.18 |
| Significance: | | | | | | | |
| Double v V-System | NS | * | * | NS | NS | NS | ** |
| High v Low density | *** | ** | NS | NS | NS | NS | NS |
| Early v Late planting | NS | NS | NS | NS | NS | NS | NS |

Table 5b: Percentage Grade C

| | Total to End May | Total |
|---|---|---|
| Standard double | 23.1 | 21.2 |
| V-System: | | |
| High Early | 25.0 | 23.8 |
| High Late | 22.8 | 21.3 |
| Low Early | 32.5 | 23.7 |
| Low Late | 32.5 | 23.9 |
| SED (8 df) | 2.73 | 2.35 |
| LSD (P = 0.05) | 6.28 | - |
| Significance: | | |
| Double v V-System | * | NS |
| High v Low density | ** | NS |
| Early v Late planting | NS | NS |

Table 6a: Percentage Grade D

| | Mar/ Apr | May | Jun | Jul | Aug | Sep | Oct/ Nov |
|---|---|---|---|---|---|---|---|
| Standard double | 74.4 | 73.4 | 74.9 | 68.2 | 79.4 | 87.6 | 84.0 |
| V-System: | | | | | | | |
| High Early | 72.8 | 70.0 | 67.3 | 63.2 | 79.4 | 86.9 | 82.1 |
| High Late | 75.0 | 71.0 | 69.5 | 66.9 | 81.1 | 88.1 | 85.7 |
| Low Early | 66.0 | 63.4 | 68.0 | 67.5 | 82.0 | 89.7 | 85.6 |
| Low Late | 66.8 | 61.7 | 67.3 | 68.1 | 81.3 | 90.2 | 85.9 |
| SED (8 df) | 2.11 | 2.97 | 2.72 | 3.34 | 3.57 | 2.23 | 1.63 |
| LSD (P = 0.05) | 4.86 | 6.8 | 6.3 | - | - | - | - |
| Significance: | | | | | | | |
| Double v V-System | * | * | * | NS | NS | NS | NS |
| High v Low density | *** | ** | NS | NS | NS | NS | NS |
| Early v Late planting | NS | NS | NS | NS | NS | NS | NS |

Table 6b: Percentage Grade D

| | Total to End May | Total |
|---|---|---|
| Standard double | 73.9 | 76.4 |
| V-System: | | |
| High Early | 71.4 | 73.1 |
| High Late | 72.9 | 75.2 |
| Low Early | 64.6 | 73.1 |
| Low Late | 64.0 | 73.3 |
| SED (8 df) | 2.46 | 2.02 |
| LSD (P = 0.05) | 5.66 | - |
| Significance: | | |
| Double v V-System | * | NS |
| High v Low density | ** | NS |
| Early v Late planting | NS | NS |

Table 7a: Percentage Grade E

| | Mar/ Apr | May | Jun | Jul | Aug | Sep | Oct/ Nov |
|---|---|---|---|---|---|---|---|
| Standard double | 2.6 | 2.9 | 2.6 | 1.3 | 0.9 | 1.5 | 4.4 |
| V-System: | | | | | | | |
| High Early | 3.9 | 2.6 | 1.7 | 1.2 | 0.9 | 2.7 | 8.8 |
| High Late | 4.8 | 3.1 | 2.0 | 1.1 | 1.2 | 2.5 | 9.0 |
| Low Early | 2.9 | 2.3 | 1.9 | 1.1 | 1.0 | 3.8 | 10.0 |
| Low Late | 3.5 | 2.5 | 1.9 | 1.2 | 0.9 | 1.2 | 7.4 |
| SED (8 df) | 0.41 | 0.47 | 0.34 | 0.32 | 0.31 | 0.70 | 1.16 |
| LSD (P = 0.05) | 0.95 | - | 0.8 | - | - | 1.6 | 2.67 |
| Significance: | | | | | | | |
| Double v V-System | ** | NS | * | NS | NS | * 8% | ** |
| High v Low density | ** | NS | NS | NS | NS | NS | NS |
| Early v Late planting | * | NS | NS | NS | NS | * | NS |

Table 7b: Percentage Grade E

| | Total to End May | Total |
|---|---|---|
| Standard double | 2.8 | 2.3 |
| V-System: | | |
| High Early | 3.2 | 3.0 |
| High Late | 3.9 | 3.2 |
| Low Early | 2.6 | 3.1 |
| Low Late | 3.0 | 2.7 |
| SED (8 df) | 0.42 | 0.39 |
| LSD (P = 0.05) | 0.96 | - |
| Significance: | | |
| Double v V-System | NS | NS |
| High v Low density | * | NS |
| Early v Late planting | NS | NS |

Table 8 shows expected monetary returns from the treatments, calculated using average UK market prices (MAFF figures).

Overall, the V-System did not perform as well as the double row, mainly due to reduced early production and loss of quality in May.

Of the V-System treatments the high density early season treatments were better than the low density but planting stage did not have a significant effect.

**Table 8: Monetary Analysis (£/m²)**

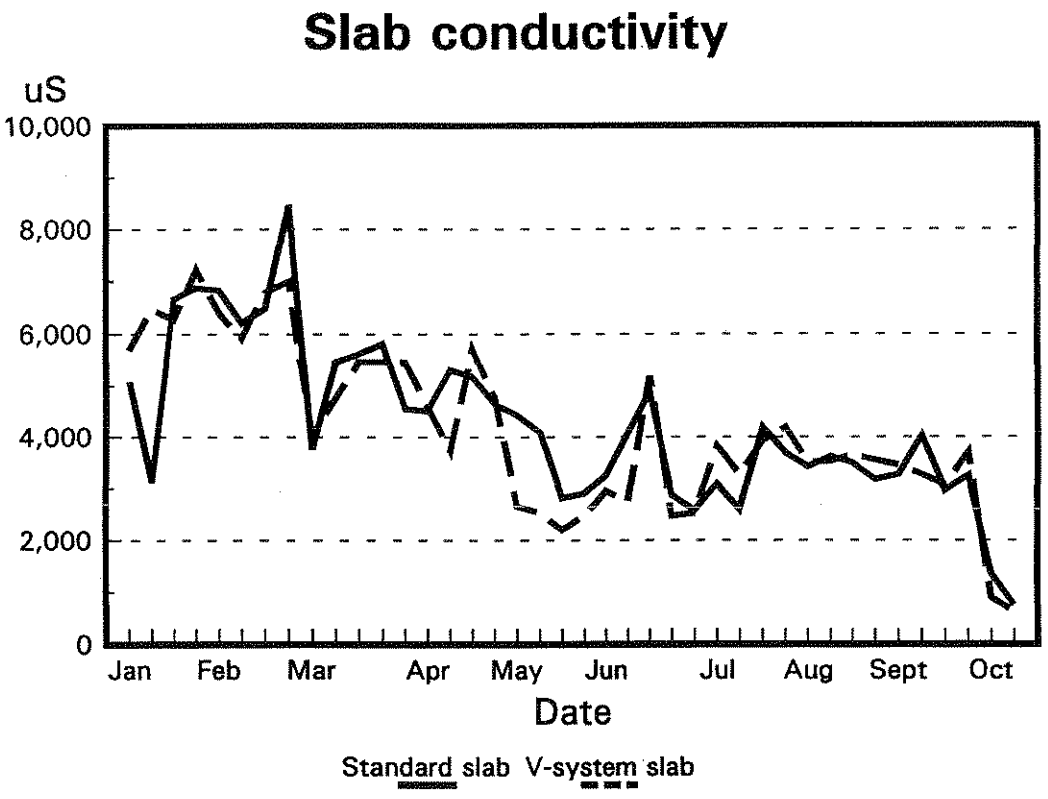
| | **To End May** | **All Season** |
|---|---|---|
| Standard double | 11.56 | 26.06 |
| V-System: | | |
| High Early | 10.26 | 25.04 |
| High Late | 10.36 | 24.60 |
| Low Early | 9.84 | 23.70 |
| Low Late | 9.77 | 23.84 |
| SED (8 df) | 0.352 | 0.64 |
| LSD (P = 0.05) | 0.81 | 1.48 |
| Significance: | | |
| Double v V-System | *** | ** |
| High v Low density | * 7% | * |
| Early v Late planting | NS | NS |

## Irrigation and Nutrition

Figure 2 shows the slab conductivities maintained in the double row and V-System treatments throughout the season. The aim was to keep two systems as near as possible to eliminate any conductivity effect on fruit size or quality.

This was achieved reasonably well. Differences occasionally occurred if more irrigation than necessary was applied to the V-System, when conductivity temporarily fell. This happened in May when attempts were made to resolve the Blossom-end rot problems seen at that time.

Figure 2



## Detailed Fruit Quality

### Firmness

Growing system and planting stage treatments did not have any significant effect on fruit firmness (Figure 3) although there was an indication that fruit from the high density V-System was firmest in May.

### Fine Net Cracking (Russetting)

There was an indication that fine net cracking was less severe on the V-System than the double row. Early in the season the low density treatment was more susceptible to cracking (Figure 4).

### Gold Spot

Gold Spot was worse in September than in May. The 11,000 plants/acre (higher density) treatments had less gold speckle early in the season and at this density the V-System was less affected than the double row. Results were variable in September (Figure 5).

### Flecking

In September there was more flecking on the double row than the V-System. In May differences were small but on the V-System the high density was slightly less affected (Figure 6).

Figure 3

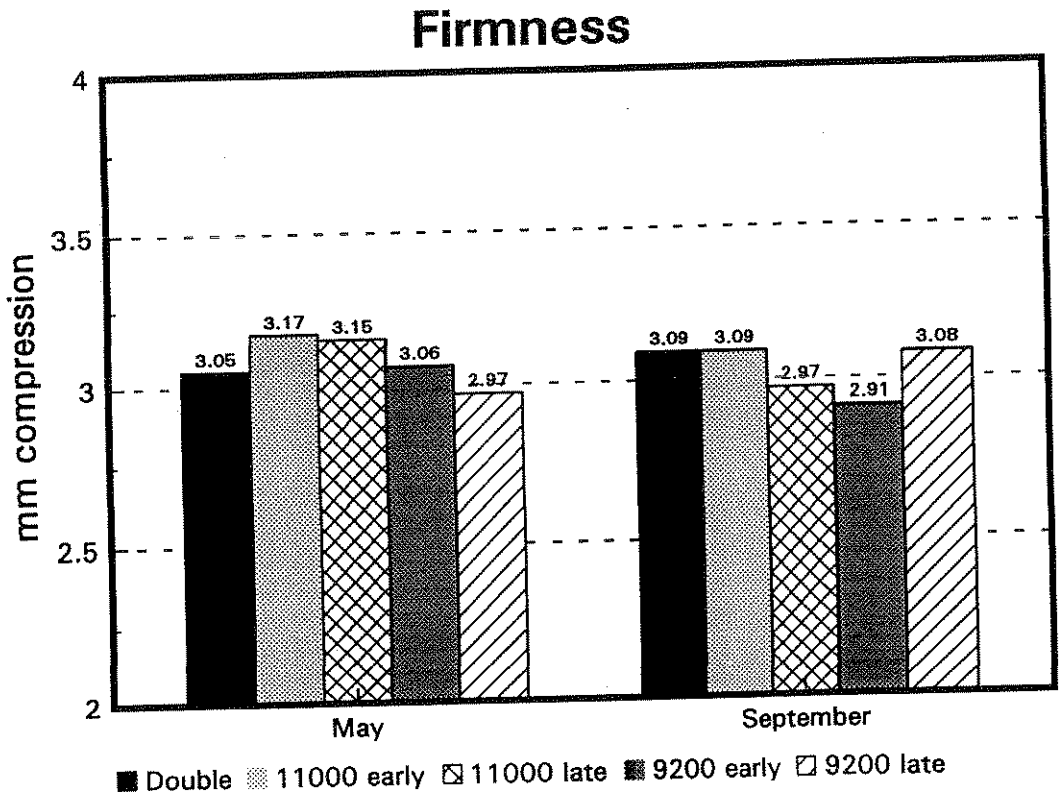



Figure 4

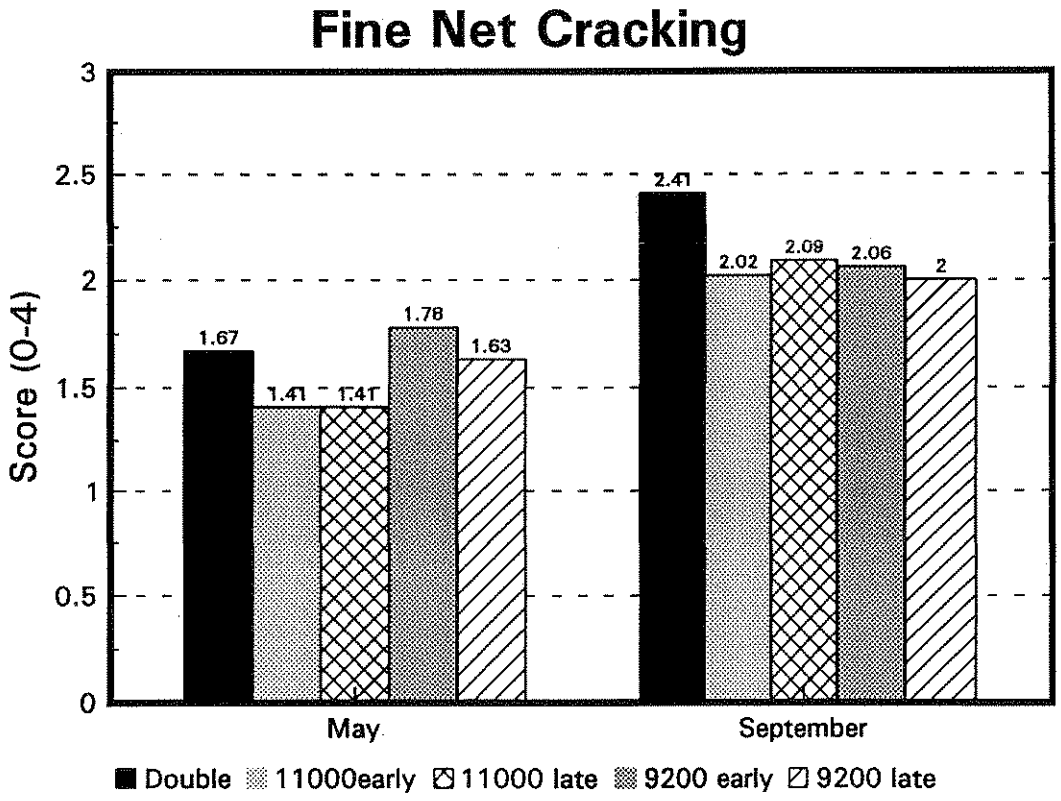


Figure 5

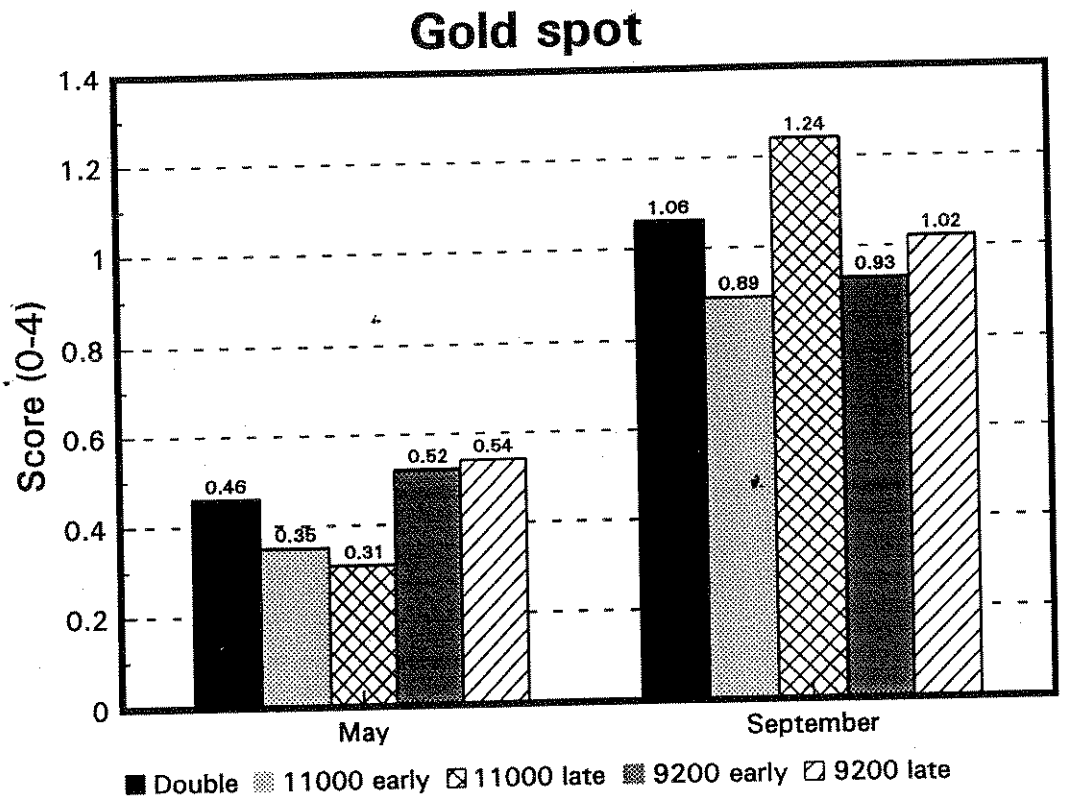
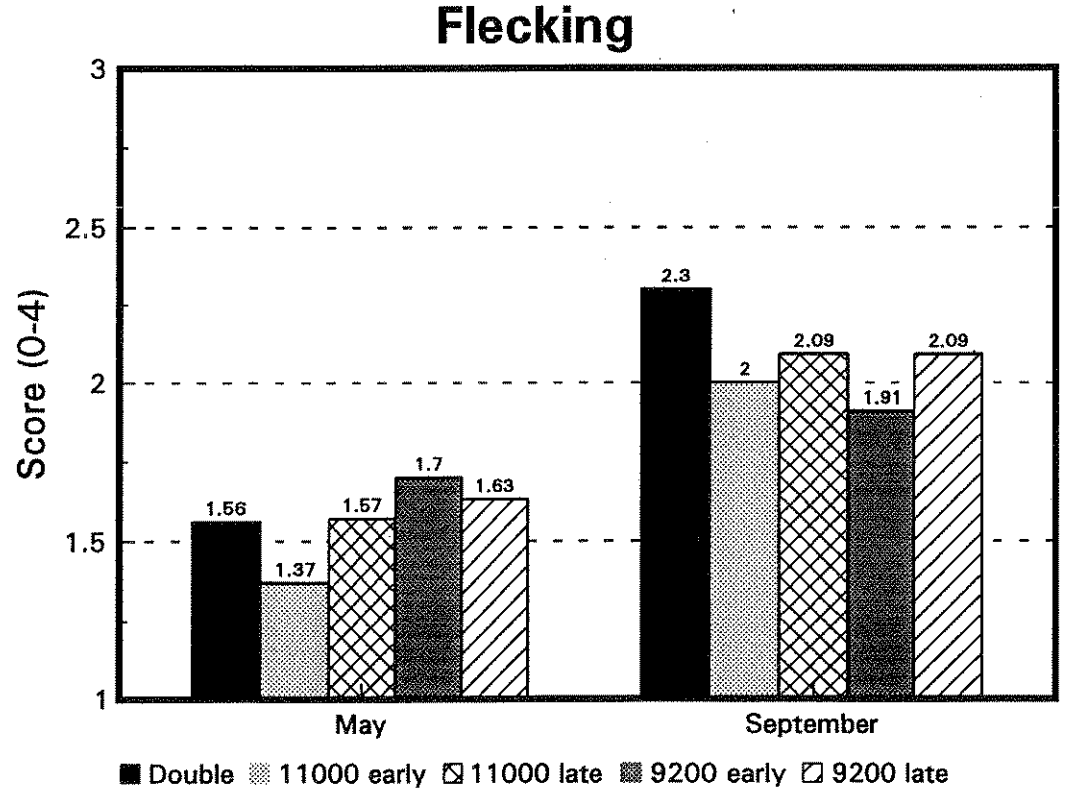



Figure 6



Red Noses

In May the low density V-System treatment was much more severely affected than the high density. The double row was better than the V-System at this time, but was much more severely affected in September (Figure 7).

Blotchy Ripening

Blotchy ripening was slightly more severe in May than in September (Figure 8). The low density treatment was the most severely affected.

Laddering

Differences in laddering between treatments were inconsistent (Figure 9).

Ribbing

Levels of ribbiness were generally low. In May the V-System was slightly more affected than the double row, but in September the opposite was true (Figure 10).

All fruit quality data is presented in the Appendix.

Figure 7

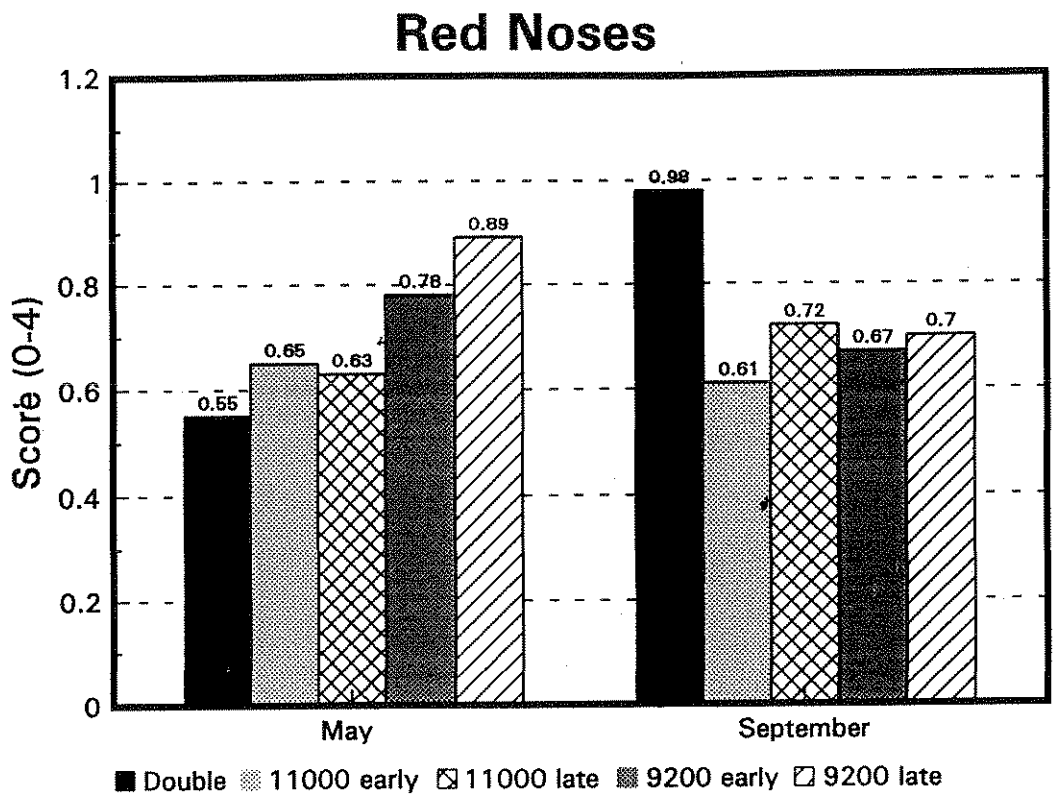



Figure 8

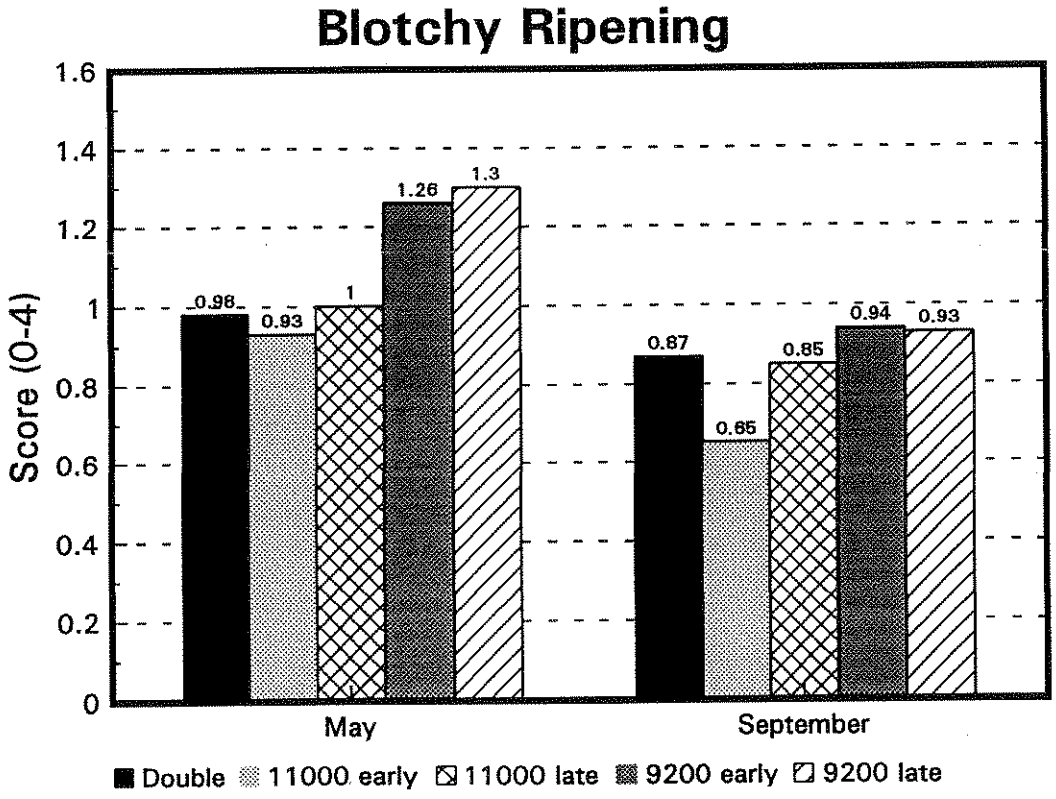


Figure 9

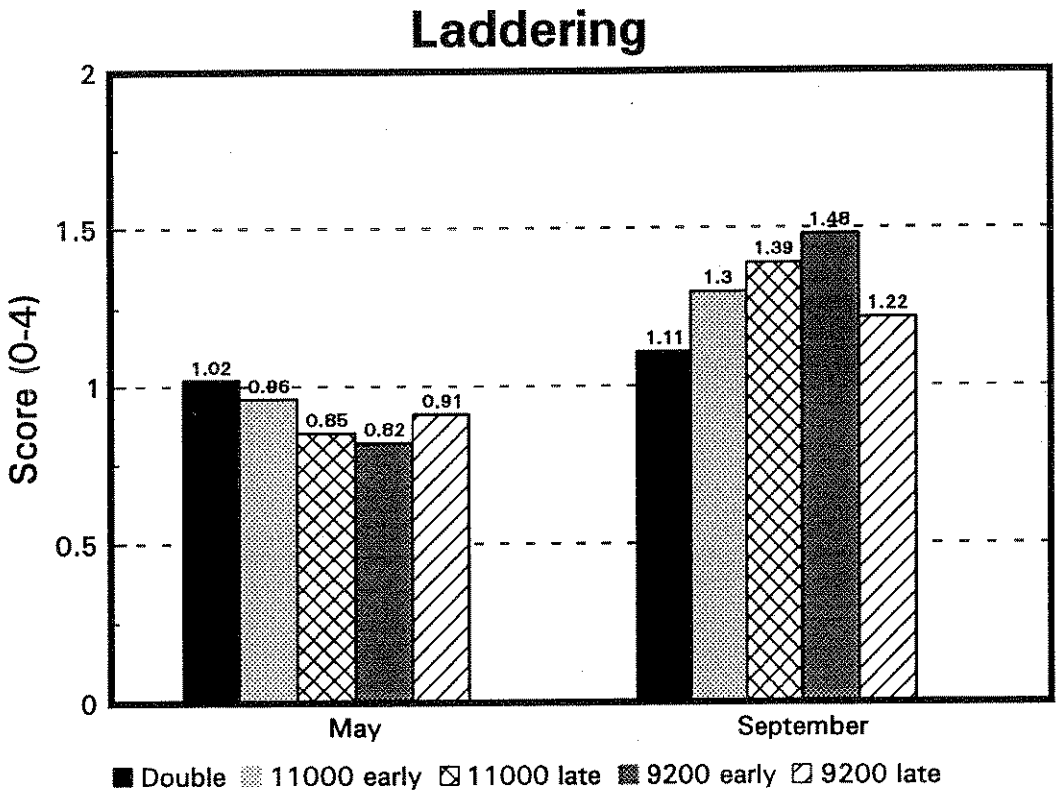
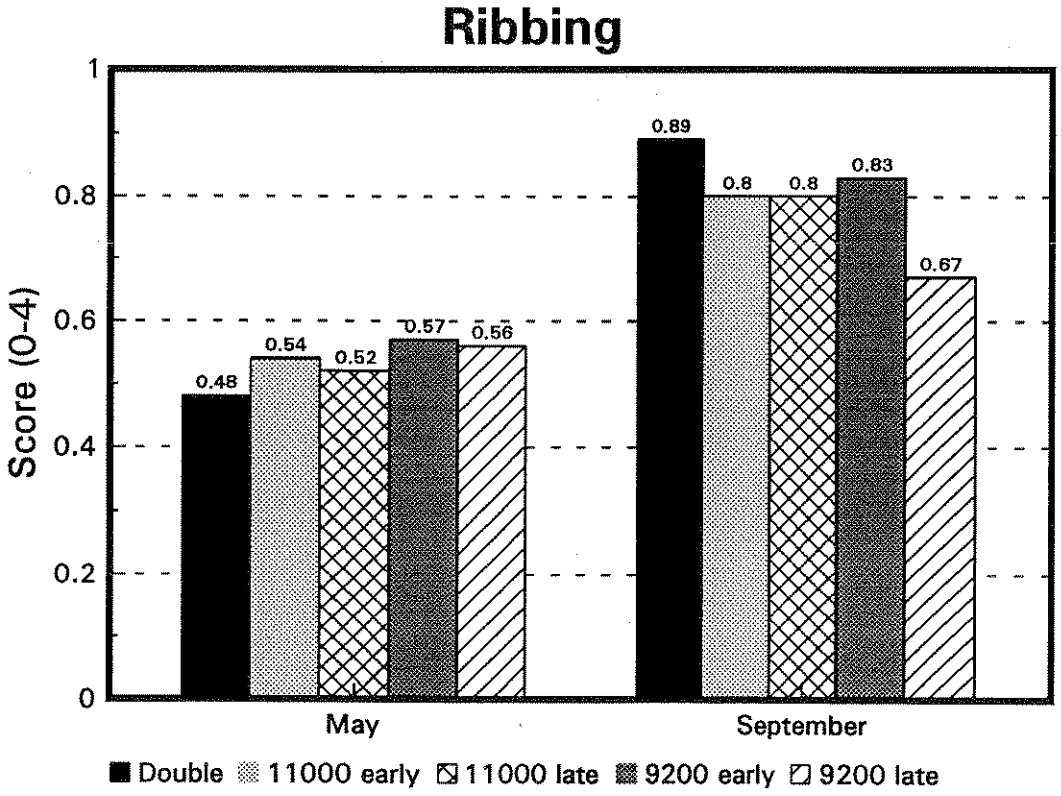



Figure 10



## Discussion

Overall, although the V-System did not perform as well as the traditional double row system in this trial, differences were small and much was learnt about the best way to manage a tomato crop grown on the V-System.

### Planting Stage

There were practical difficulties in holding planting until the second truss was in flower before making slab contact, such as lack of stability and an increased potential to dry out. These plants were slightly taller than the early planted treatment for the first two months but had the same number of leaves. The early planted treatment was more vigorous, having a larger stem diameter until the end of March.

Planting stage did not affect total yield but there was slight evidence that delayed planting improved fruit quality, possibly due to the increased vigour from the early planting. There was clearly less Blossom-end rot where planting had been delayed.

Planting stage did not influence fruit size.

### Plant Density

The results of this trial suggest that it is better to use the same early plant density as the double row, in this case 11,000 plants/acre.

Reducing the density to 9,200 plants/acre significantly reduced early yield and hence monetary returns were lower.

Plants tended to grow taller in the first three months at the high density although vigour and leaf number were not affected by density. For all treatments the number of flowers on the first ten trusses was similar (average 9.6) and fruit set was 99-100%.

Plant density did not affect the percentage Class I fruit production but detailed quality assessments clearly showed that fruit from the low density treatment was more susceptible to fine net cracking, gold speckle, blotchy ripening and red noses.

Blossom-end rot was, however, more severe at the high density.

Fruit size was the main factor to be affected by early plant density. To the end of May the high density (11,000 plants/acre) produced 23.9% Class I fruit in Grade C and the low density produced 32.5% in Grade C. There was a similar difference in Grade D (47-57 mm) production, with 73.9% from the high density and 66.4% from the low density.

Double Row v. V-System

Plants in the double row yielded more than those in the V-System until May There was no difference for the rest of the season except for a low yield from the V-System again in October/November.

The early season difference was probably caused by increased fruit losses due to BER in May. For the remainder of the season there was no significant difference in fruit quality between the treatments but a trend towards better fruit from the V-System from July onwards. Fine net cracking and gold spot were less severe from the V-System.

Where the double row and V-System were grown at the same density there was no difference in fruit size, except in October/November when the V-System produced a lot of small fruit.

## Conclusions

1. Yield from all the V-system treatments was lower than the double row system to the end of May.

2. Final yield from the high density treatment equalled the double row but yield from the low density was lower.

3. Overall fruit quality from the V-System equalled that from the double row.

4. Fruit quality from the high density V-System was better than the low density.

5. There was no difference in fruit size between the V-System and double row when both were planted at 11,000 plants/acre.

6. The low density V-System treatment produced more large fruit.

7. The V-System was more severely affected by Blossom-end rot than the double row system.

**APPENDIX: FRUIT QUALITY**

**Scores 0-4, where 4 is severe.**

| | April | May | September |
|---|---|---|---|
| Fruit Length | | | |
| Double | 2.52 | 2.80 | 2.61 |
| 11,000 | 2.44 | 2.85 | 2.68 |
| 11,000 | 2.44 | 2.94 | 2.59 |
| 9,200 | 2.67 | 2.74 | 2.57 |
| 9,200 | 2.69 | 2.94 | 2.67 |
| Ribbing | | | |
| Double | 1.37 | 0.48 | 0.89 |
| 11,000 | 1.82 | 0.54 | 0.80 |
| 11,000 | 1.37 | 0.52 | 0.80 |
| 9,200 | 1.48 | 0.57 | 0.83 |
| 9,200 | 1.54 | 0.56 | 0.67 |
| Slab Sided | | | |
| Double | 0.66 | 0.52 | 1.17 |
| 11,000 | 0.72 | 0.70 | 1.35 |
| 11,000 | 0.57 | 0.43 | 1.37 |
| 9,200 | 0.80 | 0.41 | 1.43 |
| 9,200 | 0.85 | 0.48 | 1.04 |
| Nipples | | | |
| Double | 0.17 | 0.19 | 0.31 |
| 11,000 | 0.13 | 0.11 | 0.31 |
| 11,000 | 0.11 | 0.15 | 0.50 |
| 9,200 | 0.22 | 0.15 | 0.37 |
| 9,200 | 0.20 | 0.20 | 0.32 |
| Fine Net Cracking | | | |
| Double | 2.09 | 1.67 | 2.41 |
| 11,000 | 1.72 | 1.41 | 2.02 |
| 11,000 | 2.09 | 1.41 | 2.09 |
| 9,200 | 1.87 | 1.78 | 2.06 |
| 9,200 | 1.72 | 1.63 | 2.00 |
| Radial Cracking | | | |
| Double | 0.07 | 0.59 | 1.57 |
| 11,000 | 0.04 | 0.54 | 1.18 |
| 11,000 | 0.04 | 0.46 | 1.32 |
| 9,200 | 0.02 | 0.82 | 1.13 |
| 9,200 | 0.06 | 0.54 | 1.26 |

| | April | May | September |
|---|---|---|---|
| Gold Spot | | | |
| Double | 0.13 | 0.46 | 1.06 |
| 11,000 | 0.26 | 0.35 | 0.89 |
| 11,000 | 0.20 | 0.31 | 1.24 |
| 9,200 | 0.09 | 0.52 | 0.93 |
| 9,200 | 0.31 | 0.54 | 1.02 |
| Blotchy Ripening | | | |
| Double | 0.07 | 0.98 | 0.87 |
| 11,000 | 0.02 | 0.93 | 0.65 |
| 11,000 | 0.07 | 1.00 | 0.85 |
| 9,200 | 0.11 | 1.26 | 0.94 |
| 9,200 | 0.02 | 1.30 | 0.93 |
| Red Noses | | | |
| Double | 0.02 | 0.55 | 0.98 |
| 11,000 | 0.02 | 0.65 | 0.61 |
| 11,000 | 0.00 | 0.63 | 0.72 |
| 9,200 | 0.09 | 0.78 | 0.67 |
| 9,200 | 0.02 | 0.89 | 0.70 |
| Flecking | | | |
| Double | 1.13 | 1.56 | 2.30 |
| 11,000 | 1.29 | 1.37 | 2.00 |
| 11,000 | 1.02 | 1.57 | 2.09 |
| 9,200 | 1.19 | 1.70 | 1.91 |
| 9,200 | 1.15 | 1.63 | 2.09 |
| Laddering | | | |
| Double | 0.69 | 1.02 | 1.11 |
| 11,000 | 0.87 | 0.96 | 1.30 |
| 11,000 | 0.83 | 0.85 | 1.39 |
| 9,200 | 0.95 | 0.82 | 1.48 |
| 9,200 | 0.96 | 0.91 | 1.22 |
| Boxiness | | | |
| Double | 0.02 | 0.00 | 0.00 |
| 11,000 | 0.00 | 0.07 | 0.00 |
| 11,000 | 0.04 | 0.07 | 0.02 |
| 9,200 | 0.04 | 0.00 | 0.00 |
| 9,200 | 0.00 | 0.04 | 0.00 |
| Compression (mm) | | | |
| Double | 3.04 | 3.05 | 3.09 |
| 11,000 | 3.17 | 3.17 | 3.09 |
| 11,000 | 2.85 | 3.15 | 2.97 |
| 9,200 | 2.93 | 3.06 | 2.91 |
| 9,200 | 3.08 | 2.97 | 3.08 |

| | April | May | September |
|---|---|---|---|
| pH | | | |
| Double | 7.43 | 7.90 | 7.22 |
| 11,000 | 7.29 | 8.29 | 7.37 |
| 11,000 | 7.28 | 8.04 | 6.67 |
| 9,200 | 7.46 | 8.20 | 7.07 |
| 9,200 | 7.31 | 8.26 | 6.95 |
| Sugar (%) | | | |
| Double | 4.80 | 4.71 | 4.23 |
| 11,000 | 4.70 | 4.57 | 4.34 |
| 11,000 | 5.00 | 4.60 | 4.37 |
| 9,200 | 4.80 | 4.61 | 4.36 |
| 9,200 | 5.03 | 4.50 | 4.44 |
| % Weight Loss (over 6 days) | | | |
| Double | 6.98 | 3.54 | 4.52 |
| 11,000 | 7.71 | 3.75 | 3.96 |
| 11,000 | 6.41 | 3.74 | 3.83 |
| 9,200 | 7.20 | 3.88 | 3.46 |
| 9,200 | 7.02 | 3.41 | 3.92 |
| % Dry Weight | | | |
| Double | 5.15 | 4.99 | 5.10 |
| 11,000 | 5.17 | 4.86 | 5.24 |
| 11,000 | 5.15 | 4.94 | 5.20 |
| 9,200 | 5.10 | 4.90 | 5.39 |
| 9,200 | 5.18 | 4.99 | 5.26 |