A REPORT TO THE HORTICULTURAL DEVELOPMENT COUNCIL
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SWEET PEPPERS: THE EFFECT OF IRRIGATION AND TRIMMING ON FRUIT QUALITY

FINAL REPORT

Project Number:	PC35b
Project Title:	Sweet Peppers: The effect of irrigation and trimming on fruit quality.
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Report Date:	1993
Date Project Commenced:	November 1990
Date Completed:	November 1992
Key Words:	sweet peppers, capsicums, fruit quality, blossom end rot, irrigation, trimming, root zone warming

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 .....

Mary Hardgrave
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Relevance to Growers and Practical Application

Application

This project aimed to determine the effect of irrigation, root zone warming, extra leaf area and cultivar on sweet pepper fruit quality, particularly Blossom-end rot.

Increased irrigation improved quality if applied at the right time and both root zone warming and extra leaf area also gave beneficial effects.

Optimum regimes are suggested.

Summary

Objective

Fruit quality defects, particularly Blossom-end rot can lead to severe losses in marketable yield for growers of long season sweet peppers in hydroponics.

The object of this project was to determine how irrigation could be best applied in order to reduce this problem. In a two year project four irrigation regimes, together with root zone warming, extra leaf area and a range of varieties were evaluated.

Year 1 Treatments

Irrigation:	*Standard day Day & night Extra day (0700-1000) Perlite reservoir
Varieties:	Cubico Lambada Mazurka
Root Zone Warming:	24°C

Year 2 Treatments

Irrigation:	*Standard day Day & night Extra day (1100-1400) Rockwool reservoir
Trimming:	Two leaves per sideshoot Three leaves per sideshoot
Varieties:	Valetta Lambada Mazurka

* Standard irrigation was applied as follows:

Time Interval:	2 hours
Light Limit:	100J
Target Run-off:	30%
Irrigation per Watering:	150 ml/plant
Daily Maximum:	5 l/plant

Results

Year 1

1. Extra day irrigation and the reservoir system increased yield compared with the standard.

2. Blossom-end rot was reduced slightly by the use of root zone warming. Of the irrigation systems night watering and the perlite reservoir were the most beneficial.

3. Fruit calcium levels were highest in the perlite reservoir treatment.

4. Fruit from the standard day irrigation treatment had the poorest shelf life.

5. Of the 3 varieties Cubico produced the highest yields. Fruit was very large and shelf life was the best. Mazurka produced the best fruit quality.

6. Fine net cracking was reduced by the use of root zone warming.

Year 2

1. Yield was lowest from the standard day irrigation regime and highest from the day and night regime.

2. Blossom-end rot was lower where extra leaves were left on each sideshoot. Flecking was also reduced but fine net cracking was slightly higher.

3. In May and June night watering and the reservoir system improved fruit quality but at the end of the season these treatments reduced fruit quality.

4. Extra day irrigation and the reservoir system increased fruit cracking and therefore decreased shelf life.

5. Night watering decreased fine net cracking.

6. Of the three varieties tested Mazurka produced the best yield and quality.

Action Points for Growers

1. Select a suitable variety. Of those tested Mazurka gave the best combination of yield and fruit quality.

2. The use of root zone or solution warming in the early season may advance yield and improve fruit quality.

3. Excessive leaf removal should be avoided as extra leaf on each sideshoot shades fruit and can help to reduce Blossom-end rot.

4. The standard irrigation regime as used in this trial was suitable for the beginning and end of the season but more irrigation applied when radiation was high and fruit were expanding rapidly (ie, when BER is likely to be a problem) helped to improve quality. Irrigation could be applied around mid-day but 4 waterings spaced throughout the night were more successful in this trial.

Objective

To evaluate the effects of four irrigation regimes and two trimming regimes on sweet pepper fruit quality, particularly Blossom-end rot and sun scorch.

Introduction

Production of long season sweet pepper crops in hydroponics has developed considerably in the UK over recent years. Although it is possible to produce high yields, fruit quality is often reduced by faults such as Blossom End Rot, Sun Scorch and Fine Net Cracking. These problems are equally serious for growers outside the UK. Blossom End Rot is influenced by variety but is also closely related to calcium movement in the plant. Factors influencing calcium movement are likely to affect Blossom End Rot occurrence. The growing environment and the availability of adequate water and nutrients together with the ability to translocate them to the fruit play an important role.

The causes of Sun Scorch are unproven but it is known to be influenced by direct sunlight which increases fruit temperature and causes structural breakdown. Therefore a dense crop canopy and a higher leaf area index should help to reduce this problem.

This project included 4 irrigation regimes and 2 levels of trimmings and aimed to determine the effect of water availability and shading on fruit quality and yield.

Materials and Methods

Varieties

Mazurka (RZ)
Lambada (RZ)
Valetta (RZ)

Cultural Details

Sowing:	22 November 1991
Blocked On:	10 December 1991
Planted:	13 January 1992 (plants moved to growing house and slab contact made)
Irrigation Treatments Started:	13 April
First Harvest:	9 April
Final Harvest:	13 October
Plant Population:	11,000 plants/acre (5.55 stems/m^2)
Training:	2 leaders per plant
Pollination:	Bumble Bees from March - May, August - October
Environment:	Temperature: 23°C day, 21°C night, 27°C vent until crown fruit aborted then gradually reduced to 21°C day, 19°C night, 24°C vent.
Carbon Dioxide:	1000 vpm until end of April, then 350 vpm.

Treatments

1. Standard rockwool
   Standard day irrigation, no night watering
   Standard trimming

2. Standard rockwool
   Standard day irrigation, with night watering
   Standard trimming

3. Standard rockwool
   Standard day irrigation plus supplementary watering during the day to provide the same 24 hour total as Treatment 2
   No night watering
   Standard trimming

4. Rockwool reservoir system
   Standard day irrigation, no night watering
   Standard trimming

5. Standard rockwool
   Standard day irrigation, no night watering
   With extra leaves

6. Standard rockwool
   Standard day irrigation, with night watering
   With extra leaves

7. Standard rockwool
   Standard day irrigation plus supplementary watering during the day to provide the same 24 hour total as Treatment 2
   No night watering
   With extra leaves

8. Rockwool reservoir system
   Standard day irrigation, no night watering
   With extra leaves

Irrigation Regimes

Standard Day:	Time Interval	2 hours
	Light Limit	100 J
	Target Run-Off	30%
	Irrigation per Watering	150 ml/plant
	Daily Maximum	5 l/plant
Night Watering:	4 irrigations of 100 ml equally spaced through the night.	
Supplementary Day Watering:	4 irrigation of 100 ml at 1100, 1200, 1300 and 1400 hrs.	

Trimming

Standard Trimming:	Sideshoots stopped at 1 fruit plus 2 leaves.
Extra Leaf:	1 additional leaf left on each sideshoot.

Achieved Irrigation Regimes

The volumes of irrigation applied are included in Appendix I. They demonstrate that the regimes were achieved reasonably well and show the differences between them, although there were occasional deviations from targets as would be experienced with any commercially available irrigation equipment.

Experimental Design

The trial consisted of 24 treatments in a 4 irrigations x 3 varieties x 2 trimmings factorial structure. Two blocks of 12 double rows were available, each divided into 4 plots with 16 plants per plot. Irrigation treatments and varieties were applied to whole rows on the basis of a block design and trimming treatments were applied to blocks of 12 plants, consisting of one plot in each row.

Records

Fruit was harvested once a week and graded for size and quality. The number and weight of fruit in each size grade was recorded. Fruit with Blossom End Rot and Sun Scorch was recorded separately.

Applied and slab pH and EC levels were monitored daily and a full nutrient analysis was carried out weekly. Applied irrigation volumes and run-off from each treatment were recorded daily, together with daily light levels.

Shelf Life and Fruit Quality

Samples of 6 fruit per treatment were tested for shelf life and detailed fruit quality on the following dates:

Fruit Harvested and First Assessments	**Final Assessments**
4 June	10 June
9 July	15 July
13 August	19 August
17 September	23 September

Shelf Life Room Conditions

20 °C, 50-60% RH
12 hours light per 24 hours

Fruit Quality

The following fruit quality factors were assessed.

Flecking	Score 0-9, where 9 is severe
Fine Net Cracking	"
Longitudinal Cracking	"
Blossom End Rot	"
Sun Scorch	"
Fruit Shine	"
Shrivelling	"
Internal Stip	Number of spots
Ears	Number
Sugar Content	% Sucrose. Juice squeezed from fresh fruit onto hand held refractometer at the beginning and end of the shelf life period.
Wall Thickness (mm)	Measured at the centre of the locule at the beginning and end of the shelf life period.
Crispness	Pressure (Newtons) required to slice a piece of flesh with a blade at the beginning and end of the shelf life period. A high figure denotes softer flesh.
Weight Loss (%)	During the shelf life period.
% Dry Weight:	Of fresh samples.

Fruit was harvested and placed under shelf life conditions immediately after grading. Fruit quality assessments were carried out first on the day of harvest and again after 7 days.

Results

Fruit Yield and Quality

Neither the irrigation or trimming treatments gave any significant effect on final fruit yield although in May and June the Day and Night watering treatment gave an increased yield compared with the Reservoir and Day Only treatments (Table 1).

Mazurka gave a significantly higher marketable yield than both Lambada and Valetta. Trimming treatments had no effect on marketable yield.

Table 1: Marketable yield (kg/m^2).

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	2.57	2.60	2.47	3.14	3.18	2.03	2.48	18.48
Day & night	2.48	2.76	2.75	3.05	3.36	2.15	2.56	19.12
Extra day	2.52	2.68	2.65	3.24	3.12	2.29	2.46	18.98
Reservoir	2.67	2.41	2.66	2.93	3.33	2.08	2.63	18.72
SED (6 df)	0.141	0.105	0.096	0.210	0.108	0.106	0.126	0.272
LSD (P = 0.05)	-	0.26	0.23	-	-	-	-	-
Significance	NS	*	* 7%	NS	NS	NS	NS	NS
Trimming								
Normal	2.58	2.53	2.65	3.01	3.24	2.18	2.54	18.72
Extra leaf	2.55	2.70	2.62	3.17	3.26	2.10	2.53	18.93
SED (5 df)	0.055	0.208	0.136	0.119	0.106	0.190	0.141	0.429
LSD (P = 0.05)	-	-	-	-	-	-	-	-
Significance	NS	NS	NS	NS	NS	NS	NS	NS
Varieties								
Lambada	2.51	2.86	2.46	2.96	3.02	2.01	2.61	18.43
Mazurka	2.59	2.64	2.68	3.34	3.32	2.29	2.41	19.29
Valetta	2.59	2.33	2.77	2.97	3.41	2.11	2.58	18.76
SED (6 df)	0.122	0.091	0.083	0.182	0.093	0.092	0.109	0.236
LSD (P = 0.05)	-	0.22	0.20	-	0.22	0.22	-	0.52
Significance	NS	***	**	NS	**	*	NS	*

Percentage Class I fruit was generally good except in June (Table 2) when Blossom-end rot and Sun scorch were prevalent.

In June both the day and night irrigation treatment and the reservoir treatment gave significant improvements in fruit quality compared with the day only treatment. This trend was also apparent in May although differences were not statistically significant.

In September and October poor fruit shape and BER were the main reasons for downgrading. In September the day only irrigation system gave significantly more Class I fruit. Averaged over the season as a whole the irrigation treatments did not have any significant effect on percentage Class I fruit.

There were three main periods during the season when the trimming regimes affected fruit quality significantly. In June there was significantly less Class I fruit where extra leaf had been left on the plant but in July and September extra leaf improved fruit quality.

Fruit quality from varieties Mazurka and Valetta were similar but Lambada was consistently worse.

Table 2: Percentage Class I Fruit

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	96.2	81.9	60.0	72.7	80.9	75.6	66.0	76.7
Day & night	95.2	84.2	64.8	71.9	80.1	69.0	66.6	76.2
Extra day	95.9	82.0	61.7	71.5	79.1	69.2	65.7	75.2
Reservoir	96.9	86.1	64.1	71.7	79.3	67.6	63.9	76.1
SED (6 df)	0.79	1.84	1.67	1.77	1.72	2.18	2.45	0.82
LSD (P = 0.05)	-	-	4.1	-	-	5.3	-	-
Significance	NS	NS	*	NS	NS	**	NS	NS
Trimming								
Normal	96.1	83.5	64.7	70.0	79.5	68.5	64.8	75.6
Extra leaf	96.0	83.6	60.6	73.9	80.2	72.2	66.3	76.5
SED (5 df)	0.35	1.62	1.08	0.48	0.92	0.79	2.21	0.47
LSD (P = 0.05)	-	-	2.8	1.2	-	2.0	-	-
Significance	NS	NS	**	***	NS	**	NS	NS
Varieties								
Lambada	96.2	80.3	55.6	64.9	71.8	64.2	63.7	71.3
Mazurka	97.0	85.7	65.9	75.9	82.9	72.9	67.1	78.6
Valetta	95.0	84.7	66.4	74.9	84.8	74.0	65.8	78.2
SED (6 df)	0.69	1.59	1.45	1.53	1.49	1.89	2.12	0.71
LSD (P = 0.05)	1.7	3.9	3.5	3.7	3.6	4.6	-	1.6
Significance	*	**	***	***	***	***	NS	***

Irrigation regimes had no significant effect on production of large fruit over 75 mm diameter (Table 4) but there was evidence that both the day and night and extra day treatments reduced the percentage of medium and small fruit.

Over the season as a whole there was a significant reduction in production of very large fruit (over 90 mm diameter) where extra leaves were left on each shoot. This effect was particularly marked in April, May and July. The percentage of large and medium fruit was higher from this treatment. Small fruit was not affected by trimming treatments.

Fruit size was similar for varieties Lambada and Mazurka but Valetta produced less very large fruit and more medium fruit.

Table 3: Percentage Very Large Fruit (over 90 mm)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	24.3	64.1	74.9	61.2	41.9	46.1	34.5	48.6
Day & night	25.1	68.8	78.9	67.9	47.6	50.1	35.3	53.4
Extra day	22.0	67.1	79.1	66.2	48.1	51.7	41.8	53.1
Reservoir	21.0	67.7	72.5	64.2	44.6	48.1	38.0	49.4
SED (6 df)	2.46	2.94	3.24	3.55	3.86	3.59	3.05	2.25
LSD (P = 0.05)	-	-	-	-	-	-	-	-
Significance	NS	NS	NS	NS	NS	NS	NS	NS
Trimming								
Normal	25.2	69.4	77.3	67.1	46.1	50.3	37.6	52.5
Extra leaf	21.0	64.4	75.4	62.7	45.0	47.7	37.2	49.7
SED (5 df)	1.50	1.70	1.37	1.49	1.98	2.19	3.48	0.97
LSD (P = 0.05)	3.9	4.4	-	3.8	-	-	-	2.5
Significance	*	*	NS	*	NS	NS	NS	*
Varieties								
Lambada	32.1	71.9	82.5	60.6	42.5	46.9	35.9	52.1
Mazurka	20.4	65.5	76.0	69.6	50.2	54.6	40.1	53.3
Valetta	16.7	63.4	70.6	64.5	43.9	45.6	36.1	47.9
SED (6 df)	2.13	2.54	2.81	3.08	3.35	3.11	2.64	1.95
LSD (P = 0.05)	5.2	6.2	6.9	7.5	8.2	7.6	-	4.3
Significance	***	*	**	*	* 9%	*	NS	*

Table 4: Percentage Large Fruit (75-90 mm)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	54.3	25.3	22.3	33.5	46.1	42.3	49.2	39.7
Day & night	55.2	22.1	18.8	28.3	43.2	39.7	51.0	36.9
Extra day	56.9	24.4	19.0	29.6	44.5	40.3	44.6	37.6
Reservoir	54.6	24.3	24.5	31.7	45.1	42.6	47.4	39.4
SED (6 df)	1.47	2.14	2.98	3.16	2.62	2.89	2.24	1.57
LSD (P = 0.05)	-	-	-	-	-	-	-	-
Significance	NS	NS	NS	NS	NS	NS	NS	NS
Trimming								
Normal	54.7	21.8	20.2	29.0	44.3	40.7	48.5	37.6
Extra leaf	55.8	26.2	22.2	32.5	45.2	41.8	47.6	39.2
SED (5 df)	1.01	1.56	1.19	1.30	1.96	2.15	2.02	0.75
LSD (P = 0.05)	-	4.0	-	3.3	-	-	-	-
Significance	NS	*	NS	*	NS	NS	NS	NS
Varieties								
Lambada	51.6	20.0	15.9	33.9	45.9	41.8	48.0	37.4
Mazurka	58.6	26.4	21.4	26.9	41.3	37.7	47.5	37.3
Valetta	55.5	25.6	26.2	31.5	46.9	44.1	48.7	40.4
SED (6 df)	1.28	1.85	2.58	2.74	2.27	2.50	1.94	1.36
LSD (P = 0.05)	3.1	4.5	6.3	6.0	5.5	6.1	-	-
Significance	***	**	**	* 7%	* 7%	* 7%	NS	NS

Table 5: Percentage Medium Fruit (65-75 mm)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	19.1	8.3	2.1	5.0	10.4	9.5	14.5	10.2
Day & night	17.4	7.1	2.0	3.5	7.9	8.9	12.5	8.6
Extra day	18.7	6.1	1.7	4.0	6.4	6.6	12.3	8.1
Reservoir	20.7	5.7	2.8	3.8	8.9	8.2	13.2	9.5
SED (6 df)	1.28	0.96	0.73	0.91	1.39	1.64	1.46	0.66
LSD (P = 0.05)	-	2.3	-	-	3.4	-	-	1.5
Significance	NS	* 8%	NS	NS	* 8%	NS	NS	*
Trimming								
Normal	17.8	6.5	2.1	3.7	8.3	7.7	12.7	8.6
Extra leaf	20.2	7.1	2.2	4.5	8.5	8.9	13.6	9.5
SED (5 df)	0.93	0.44	0.41	0.55	0.56	0.79	1.56	0.28
LSD (P = 0.05)	2.4	-	-	-	-	-	-	0.7
Significance	*	NS	NS	NS	NS	NS	NS	*
Varieties								
Lambada	14.4	6.3	1.4	5.2	10.0	9.5	14.6	9.1
Mazurka	18.7	5.9	2.1	3.2	7.4	6.5	11.2	8.1
Valetta	23.8	8.2	3.0	3.8	7.9	8.8	13.6	10.1
SED (6 df)	1.11	0.83	0.64	0.79	1.20	1.42	1.26	0.57
LSD (P = 0.05)	2.7	2.0	1.6	1.9	-	-	-	1.3
Significance	***	*	* 7%	* 8%	NS	NS	NS	*

Table 6: Percentage Small Fruit (50-65 mm)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	2.3	2.3	0.6	0.2	1.7	2.0	1.8	1.5
Day & night	2.3	2.0	0.3	0.2	1.2	1.2	1.2	1.2
Extra day	2.3	2.3	0.2	0.3	0.9	1.4	1.2	1.3
Reservoir	3.7	2.3	0.2	0.4	1.4	1.1	1.3	1.6
SED (6 df)	0.51	0.41	0.24	0.14	0.34	0.46	0.36	0.13
LSD (P = 0.05)	1.2	-	-	-	-	-	-	0.3
Significance	*	NS	NS	NS	NS	NS	NS	*
Trimming								
Normal	2.3	2.2	0.4	0.2	1.3	1.3	1.9	1.3
Extra leaf	3.0	2.3	0.2	0.3	1.3	1.6	1.6	1.5
SED (5 df)	0.13	0.41	0.21	0.11	0.16	0.37	0.17	0.09
LSD (P = 0.05)	0.3	-	-	-	-	-	0.43	-
Significance	*	NS	NS	NS	NS	NS	*	NS
Varieties								
Lambada	1.8	1.8	0.3	0.3	1.5	1.8	1.5	1.3
Mazurka	2.2	2.2	0.5	0.3	1.1	1.1	1.2	1.2
Valetta	3.9	2.7	0.2	0.2	1.3	1.4	1.6	1.7
SED (6 df)	0.44	0.35	0.20	0.12	0.29	0.40	0.31	0.11
LSD (P = 0.05)	1.1	0.9	-	-	-	-	-	0.2
Significance	***	* 7%	NS	NS	NS	NS	NS	**

Overall production of Class II fruit was not affected by the irrigation or trimming regimes although there was some reduction in fruit quality from the reservoir treatment in September and October, when mis-shapen fruit was a problem.

Lambada consistently produced more Class II fruit than Mazurka and Valetta.

Table 7: Percentage Class II Fruit

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	3.2	10.6	15.5	13.3	10.5	13.7	23.8	12.7
Day & night	3.3	10.3	15.6	13.0	10.0	15.7	21.6	12.7
Extra day	3.2	11.4	15.8	14.0	12.5	17.1	22.9	13.7
Reservoir	2.2	9.5	17.7	15.8	12.0	18.9	25.4	14.2
SED (6 df)	0.71	0.90	2.06	1.09	1.68	1.50	1.76	0.75
LSD (P = 0.05)	-	-	-	-	-	3.7	-	-
Significance	NS	NS	NS	NS	NS	*	NS	NS
Trimming								
Normal	3.1	9.7	14.7	14.2	11.5	17.3	23.2	13.2
Extra leaf	2.9	11.2	17.6	13.8	11.0	15.4	23.6	13.4
SED (5 df)	0.19	0.67	1.53	0.24	0.52	1.01	2.48	0.41
LSD (P = 0.05)	-	1.7	-	-	-	-	-	-
Significance	NS	* 7%	NS	NS	NS	NS	NS	NS
Varieties								
Lambada	2.9	13.5	21.1	18.6	16.1	21.0	24.8	16.7
Mazurka	2.2	9.8	15.1	11.6	9.1	13.9	21.9	11.6
Valetta	3.8	8.0	12.2	11.9	8.5	14.2	23.5	11.6
SED (6 df)	0.62	0.78	1.78	0.94	1.45	1.30	1.52	0.65
LSD (P = 0.05)	1.5	1.9	4.4	2.3	3.5	3.2	-	1.4
Significance	* 8%	***	***	***	***	***	NS	***

Waste fruit production was approximately 10% of total yield when averaged over the whole season but in June when Blossom-end rot was severe losses reached around 20%. At this time both the day and night irrigation and the reservoir treatments significantly reduced the amount of waste fruit.

Differences in waste fruit production between trimming treatments were small; only in July was there a significant reduction in waste where extra leaves had been left. Sun scorch was at its highest level in this month and the extra leaf therefore probably gave some protection.

Of the three varieties Lambada produced more waste fruit than Mazurka and Valetta on average. In June, when BER was severe Mazurka produced the lowest level of waste fruit.

Table 8: Percentage Waste Fruit

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	0.6	7.5	24.5	14.0	8.6	10.7	10.9	10.6
Day & night	1.5	5.5	19.6	15.1	10.0	15.3	11.8	11.1
Extra day	0.9	6.6	22.4	14.6	8.4	13.6	11.4	11.1
Reservoir	0.9	4.4	18.2	12.5	8.7	13.5	10.7	9.7
SED (6 df)	0.33	1.59	1.38	1.59	1.43	1.58	1.37	0.56
LSD (P = 0.05)	-	-	3.4	-	-	-	-	-
Significance	NS	NS	**	NS	NS	NS	NS	NS
Trimming								
Normal	0.8	6.8	20.6	15.8	9.0	14.2	11.9	11.2
Extra leaf	1.1	5.1	21.8	12.3	8.8	12.4	10.1	10.1
SED (5 df)	0.32	1.38	1.82	0.48	0.78	1.30	1.10	0.71
LSD (P = 0.05)	-	-	-	1.2	-	-	-	-
Significance	NS	NS	NS	***	NS	NS	NS	NS
Varieties								
Lambada	0.8	6.2	23.2	16.5	12.1	14.9	11.4	12.0
Mazurka	0.8	4.5	18.9	12.4	7.9	13.2	11.0	9.8
Valetta	1.3	7.3	21.4	13.2	6.7	11.8	10.6	10.2
SED (6 df)	0.29	1.38	1.19	1.38	1.24	1.36	1.18	0.49
LSD (P = 0.05)	-	-	2.9	3.4	3.0	-	-	1.1
Significance	NS	NS	**	*	**	NS	NS	**

Blossom-end rot was recorded as both weight and number of fruit affected (Tables 9a and 9b). Results were similar for both methods.

Levels were highest in June and July when radiation levels were high and fruit were expanding rapidly. During this period the results show the highest incidence of BER where irrigation was applied during the day only. In June applying extra irrigation during the night gave benefits compared with extra day irrigation. The reservoir system also produced significantly less fruit with BER.

In September BER levels were again relatively high. At this time fruit expansion was slower, plants had been stopped and fruit was being picked from secondary growth. During this period the irrigation effect seen early in the season was reversed and the day and night and reservoir irrigation systems produced more fruit with BER symptoms.

Less fruit were developing and light levels were lower. This period is less representative than the earlier period but the significance of this result should not be ignored.

There was a consistent reduction in BER from July onwards where extra leaf had been left on the plant but no difference in June.

Of the three varieties Mazurka was less susceptible to BER.

Table 9a: Percentage Blossom-end Rot (by weight)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	0	2.5	19.8	10.8	4.6	6.8	5.7	7.0
Day & night	0.3	1.5	15.2	10.9	5.4	11.2	7.7	7.4
Extra day	0	2.2	17.7	11.0	4.4	9.3	5.2	7.1
Reservoir	0.1	1.0	15.2	8.9	4.5	10.2	5.7	6.4
SED (6 df)	0.14	0.94	1.73	1.54	0.88	1.30	1.18	0.54
LSD (P = 0.05)	-	-	4.2	-	-	3.2	-	-
Significance	NS	NS	* 6%	NS	NS	*	NS	NS
Trimming								
Normal	0.1	2.5	17.2	12.0	5.0	10.5	7.3	7.7
Extra leaf	0.1	1.2	16.8	8.8	4.5	8.3	4.9	6.2
SED (5 df)	0.06	1.01	1.62	0.69	0.40	0.83	0.81	0.56
LSD (P = 0.05)	-	-	-	1.8	-	2.1	2.1	1.4
Significance	NS	NS	NS	**	NS	*	*	*
Varieties								
Lambada	0.1	0.7	17.2	12.0	6.5	11.1	7.2	7.6
Mazurka	0.1	0.6	14.9	9.1	4.2	8.5	5.9	6.2
Valetta	0.1	4.2	18.8	10.1	3.5	8.6	5.1	7.1
SED (6 df)	0.12	0.81	1.49	1.33	0.76	1.13	1.03	0.47
LSD (P = 0.05)	-	2.0	3.7	-	0.6	2.8	-	1.0
Significance	NS	***	* 6%	NS	**	* 7%	NS	*

Table 9b: Percentage Blossom-end Rot (by number)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	0	2.3	26.7	13.4	5.2	8.1	6.5	8.8
Day & night	0.3	1.6	19.9	12.7	6.2	13.2	7.7	8.8
Extra day	0.1	2.0	23.4	12.3	4.9	11.0	5.5	8.4
Reservoir	0.1	0.9	20.1	10.6	4.9	12.5	6.0	7.7
SED (6 df)	0.13	0.85	2.2	1.57	1.21	1.51	1.33	0.73
LSD (P = 0.05)	-	-	5.4	-	-	3.7	-	-
Significance	NS	NS	*	NS	NS	*	NS	NS
Trimming								
Normal	0.1	2.3	22.5	14.6	5.8	12.6	7.9	9.4
Extra leaf	0.1	1.1	22.6	9.9	4.9	9.8	5.0	7.5
SED (5 df)	0.07	0.82	1.84	1.04	0.38	0.88	0.95	0.67
LSD (P = 0.05)	-	-	-	2.7	1.0	2.3	2.4	1.7
Significance	NS	NS	NS	**	* 6%	*	*	*
Varieties								
Lambada	0.1	0.6	24.1	14.2	7.2	13.3	7.5	9.5
Mazurka	0.1	0.5	20.3	11.1	4.9	10.3	6.3	7.7
Valetta	0.1	4.0	23.1	11.4	3.8	10.0	5.4	8.1
SED (6 df)	0.11	0.74	1.93	1.36	1.05	1.30	1.15	0.63
LSD (P = 0.05)	-	1.8	-	3.3	2.6	3.2	-	1.4
Significance	NS	***	NS	* 8%	*	*	NS	*

The percentage of fruit affected by Sun scorch was low and the results therefore do not show any significant treatment effects.

Table 10a: Percentage Sun Scorch (by weight)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	0	0	0.1	0.6	0.5	0	0	0.2
Day & night	0.03	0.06	0.4	0.6	0.5	0.1	0.1	0.3
Extra day	0	0	0.3	0.4	0.7	0	0	0.2
Reservoir	0	0	0.1	0.5	0.3	0.2	0.2	0.2
SED (6 df)	0.024	0.039	0.13	0.23	0.24	0.09	0.09	0.05
LSD (P = 0.05)	-	-	-	-	-	-	-	-
Significance	NS	NS	NS	NS	NS	NS	NS	NS
Trimming								
Normal	0	0.03	0.3	0.5	0.4	0.1	0.1	0.2
Extra leaf	0.02	0	0.2	0.6	0.5	0.1	0.1	0.2
SED (5 df)	0.017	0.028	0.13	0.17	0.23	0.07	0.1	0.02
LSD (P = 0.05)	-	-	-	-	-	-	-	-
Significance	NS	NS	NS	NS	NS	NS	NS	NS
Varieties								
Lambada	0	0.04	0	0.6	0.6	0	0.1	0.2
Mazurka	0	0	0.5	0.5	0.4	0.1	0.1	0.3
Valetta	0.03	0	0.1	0.4	0.4	0.1	0.1	0.2
SED (6 df)	0.021	0.034	0.12	0.20	0.21	0.07	0.1	0.04
LSD (P = 0.05)	-	-	0.3	-	-	-	-	-
Significance	NS	NS	**	NS	NS	NS	NS	NS

Table 10b: Percentage Sun Scorch (by number)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Irrigation								
Day only	0	0	0.1	0.7	0.5	0	0	0.2
Day & night	0.04	0.06	0.5	0.5	0.5	0.1	0.1	0.3
Extra day	0	0	0.3	0.4	0.7	0	0	0.2
Reservoir	0	0	0.1	0.6	0.3	0.2	0.2	0.2
SED (6 df)	0.031	0.041	0.14	0.25	0.25	0.09	0.08	0.06
LSD (P = 0.05)	-	-	-	-	-	-	-	-
Significance	NS	NS	NS	NS	NS	NS	NS	NS
Trimming								
Normal	0	0.03	0.2	0.6	0.4	0.1	0.1	0.2
Extra leaf	0.02	0	0.2	0.5	0.5	0.1	0.1	0.2
SED (5 df)	0.022	0.029	0.11	0.23	0.22	0.06	0.08	0.02
LSD (P = 0.05)	-	-	-	-	-	-	-	-
Significance	NS	NS	NS	NS	NS	NS	NS	NS
Varieties								
Lambada	0	0.04	0	0.6	0.6	0	0.1	0.2
Mazurka	0	0	0.5	0.5	0.4	0.1	0.1	0.3
Valetta	0.03	0	0.1	0.5	0.3	0.1	0.1	0.2
SED (6 df)	0.027	0.036	0.12	0.22	0.21	0.08	0.07	0.05
LSD (P = 0.05)	-	-	0.3	-	-	-	-	-
Significance	NS	NS	***	NS	NS	NS	NS	NS

Fruit Quality

Flecking

Flecking was most common in September although it was never a severe problem. There was no evidence that the irrigation treatments affected the level of flecking and varietal differences were inconsistent (Figure 1).

Where extra leaves were left on each sideshoot the level of flecking was consistently reduced (Figure 1), possibly due to reduced fruit temperatures.

Fine Net Cracking

From July onwards the results suggest that the rockwool reservoir system and the extra day irrigation system exacerbated the problem of fine net cracking. Where standard irrigation only was applied during the day or extra irrigation was applied at night, fine net cracking levels were lower (Figure 2).

In June cracking was high on all treatments except the rockwool reservoir.

Fine net cracking was consistently worse where extra leaf had been left on each sideshoot.

Mazurka was affected less than Lambada and Valetta.

Longitudinal Cracking

Levels of longitudinal cracking were lower than those for fine net cracking but treatment effects were consistent.

The reservoir system and extra irrigation during the day generally increased cracking and extra leaf also increased the problem in all months except September (Figure 3).

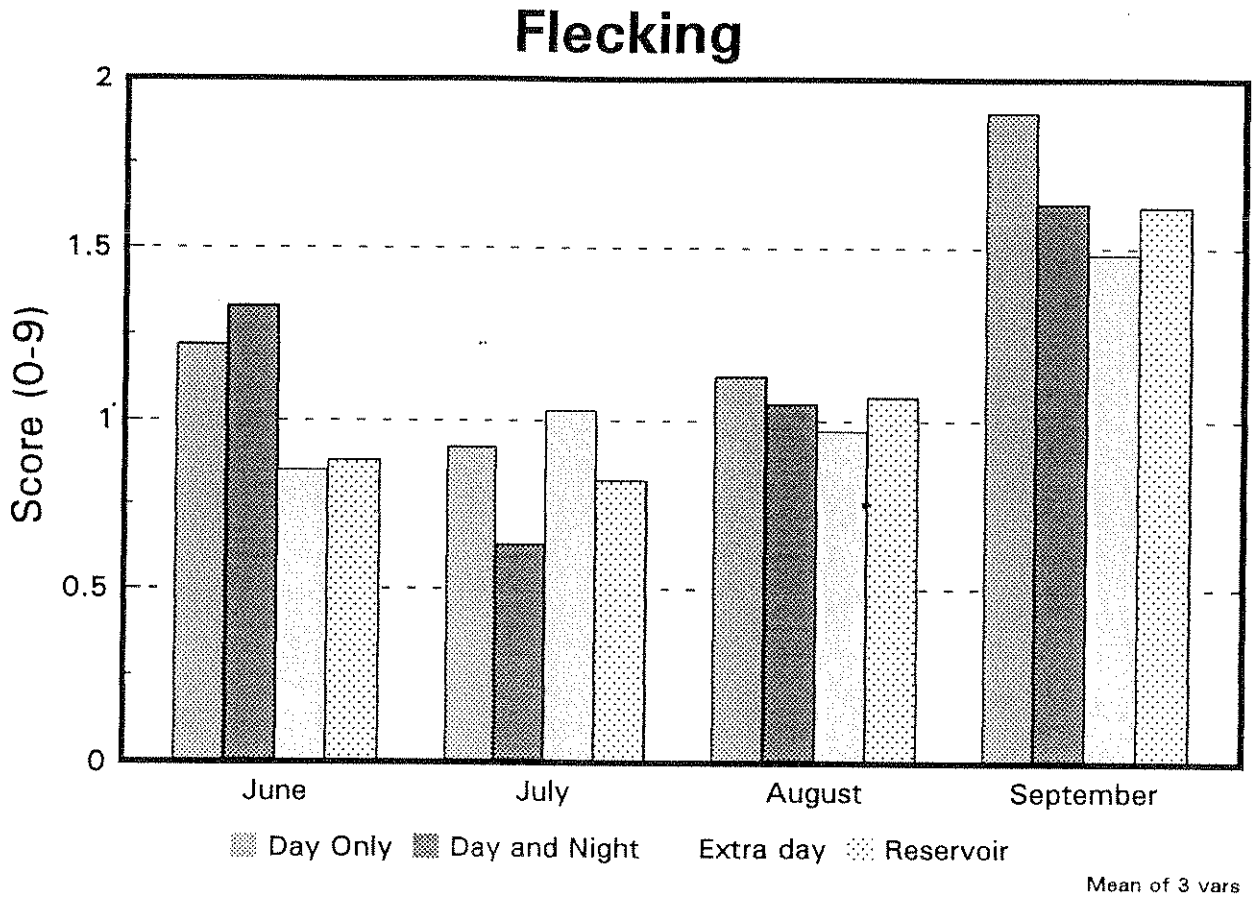
Lambada was most badly affected and Mazurka had the lowest levels.

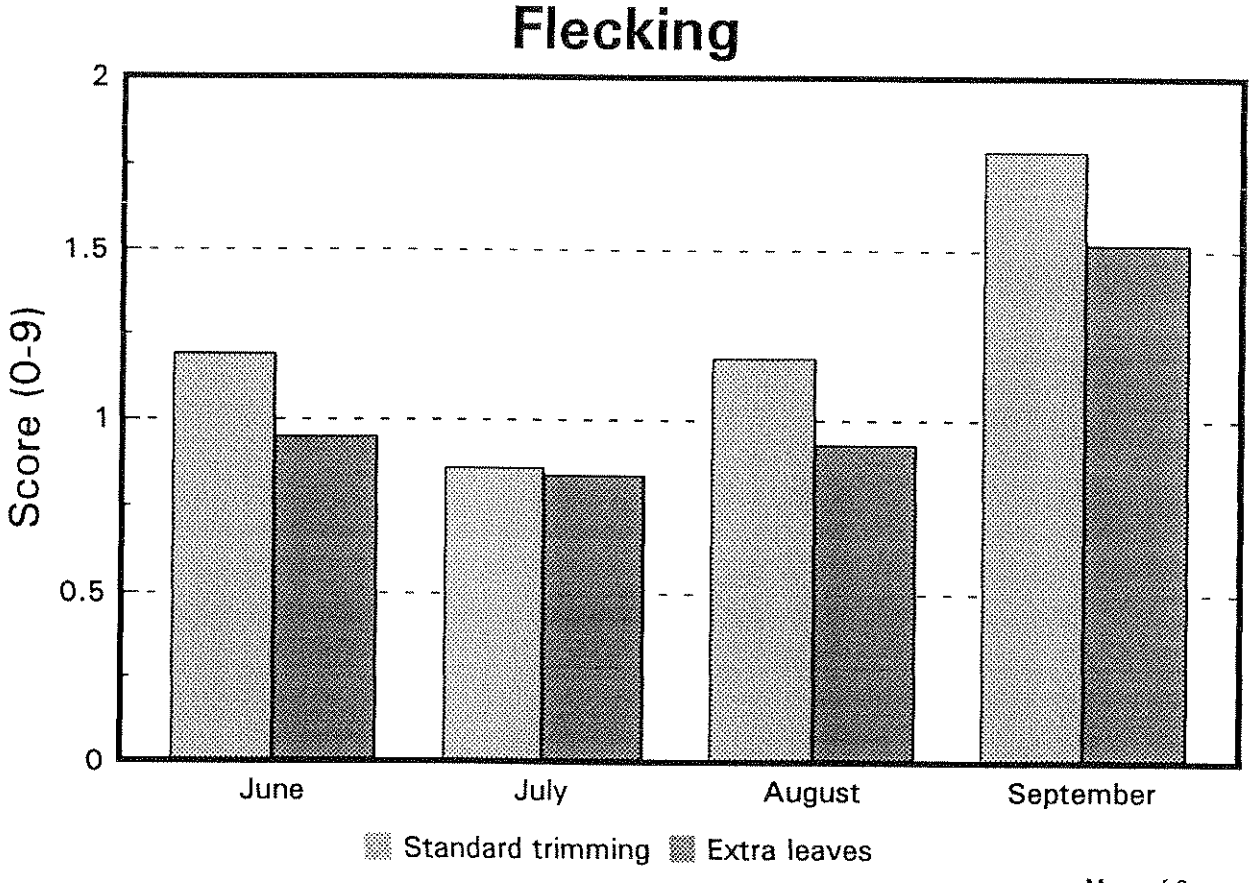
Ears

Small ears were found most frequently in July but there was no evidence that severity was influenced by the irrigation or trimming regimes (Figure 4).

Variety effects were variable but in general Valetta was affected most frequently.

Figure 1: Flecking





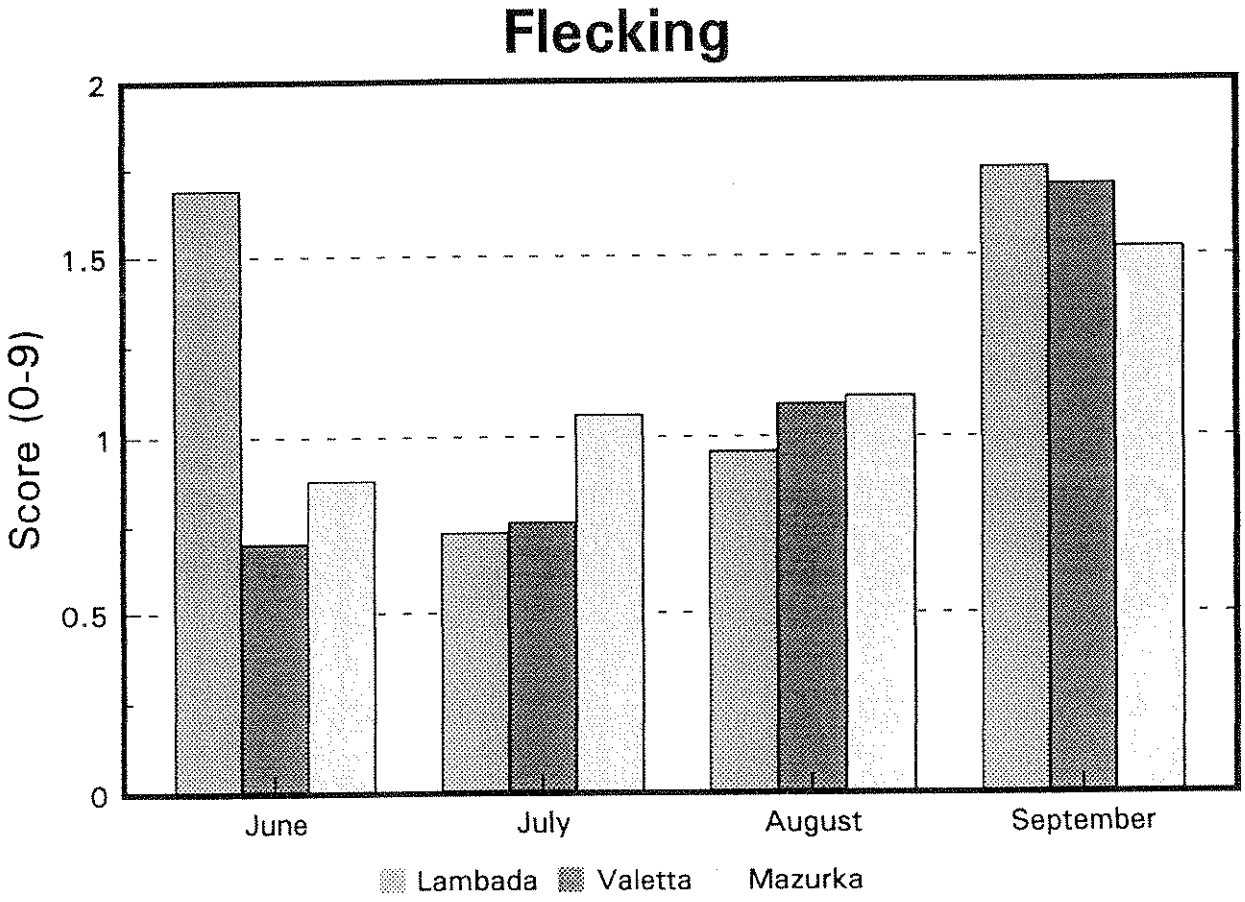
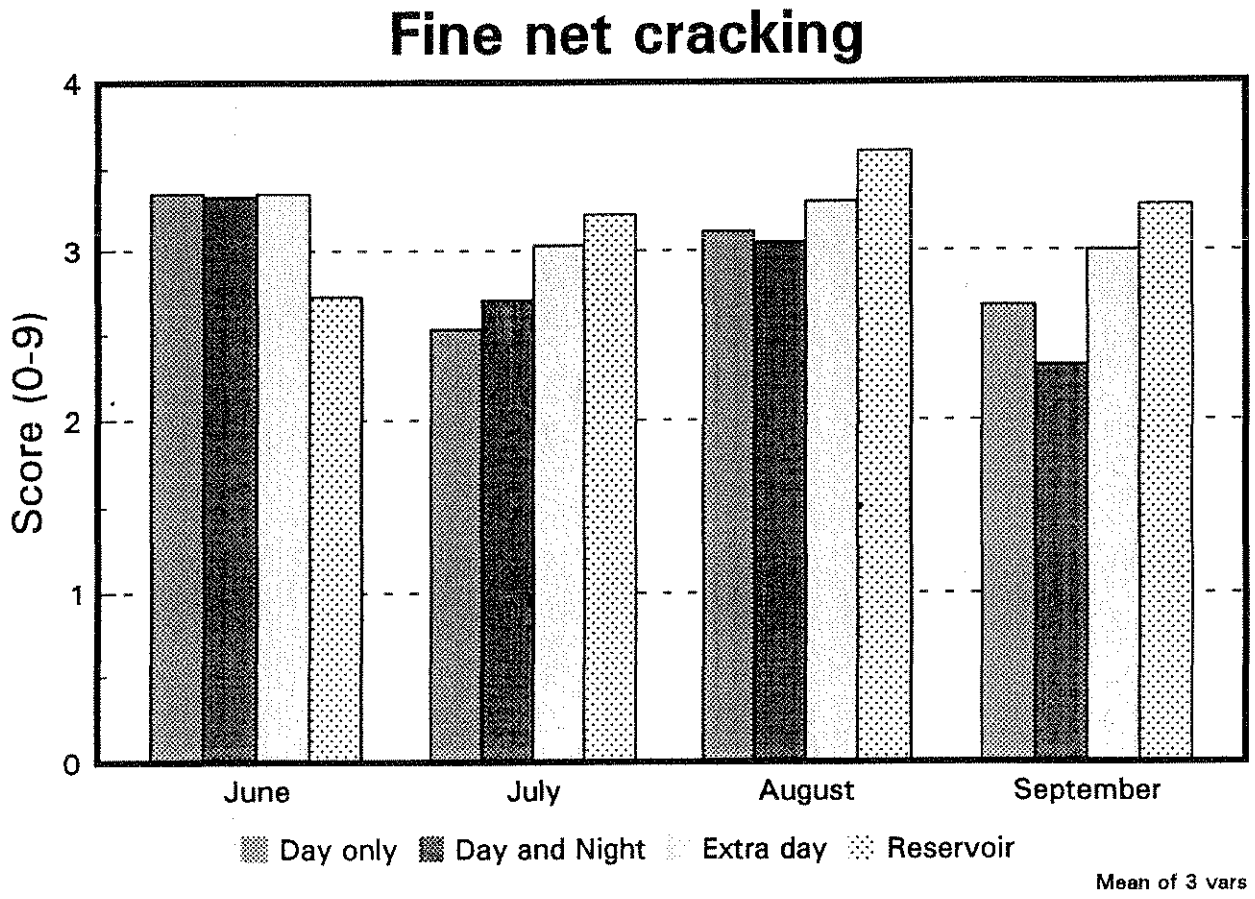
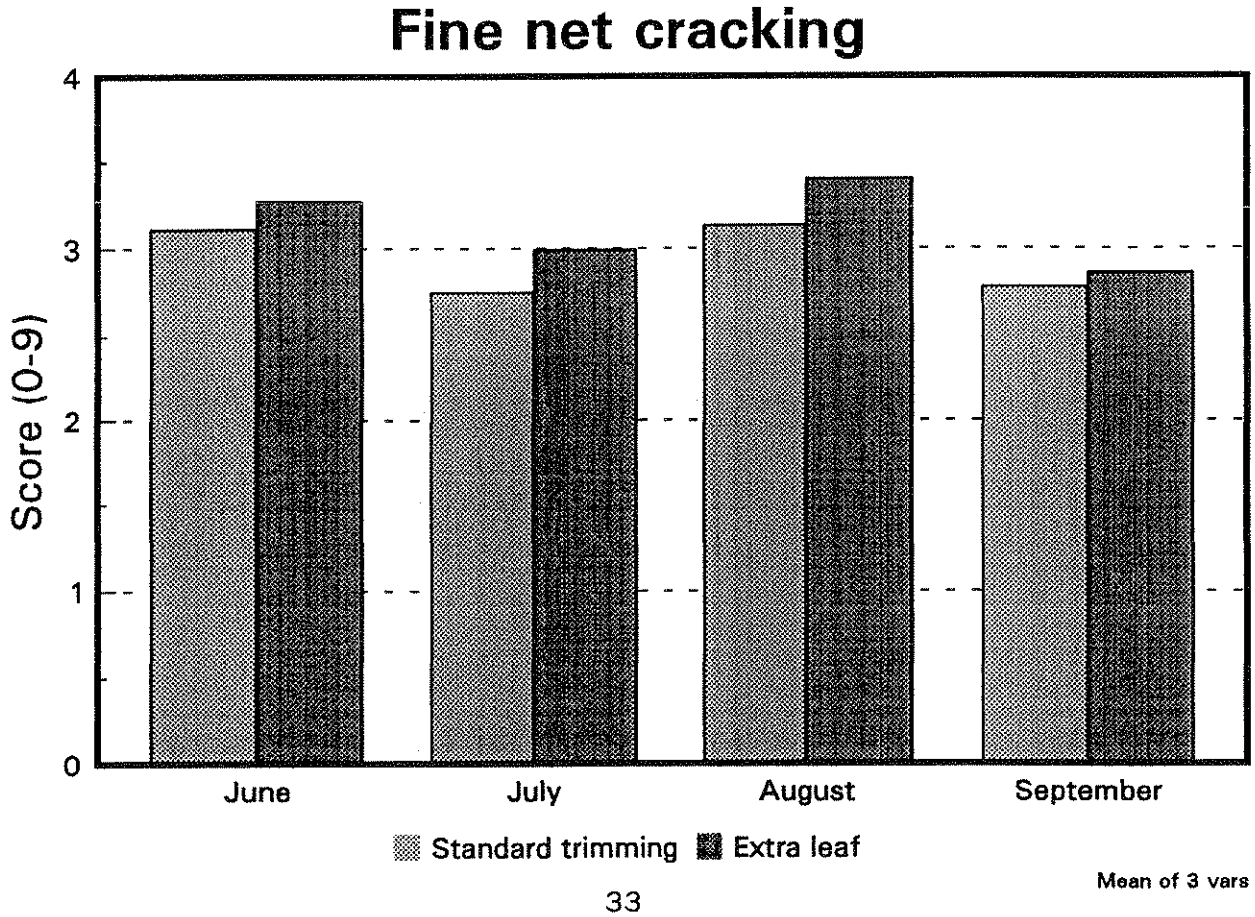

Flecking
Score (0-9)
2
1.5
1
0.5
0
June
July
August
September
Lambada
Valetta
Mazurka

Figure 2: Fine Net Cracking





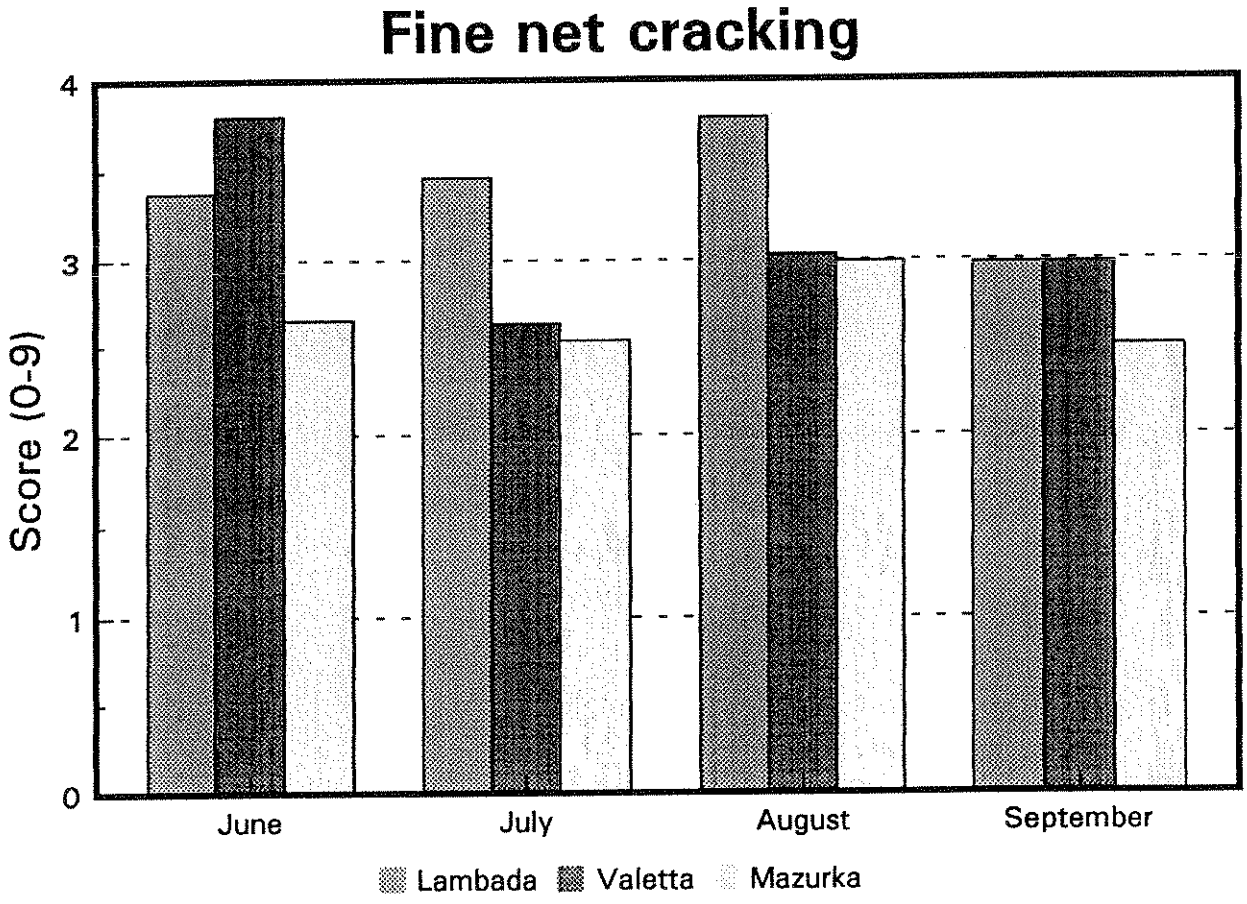
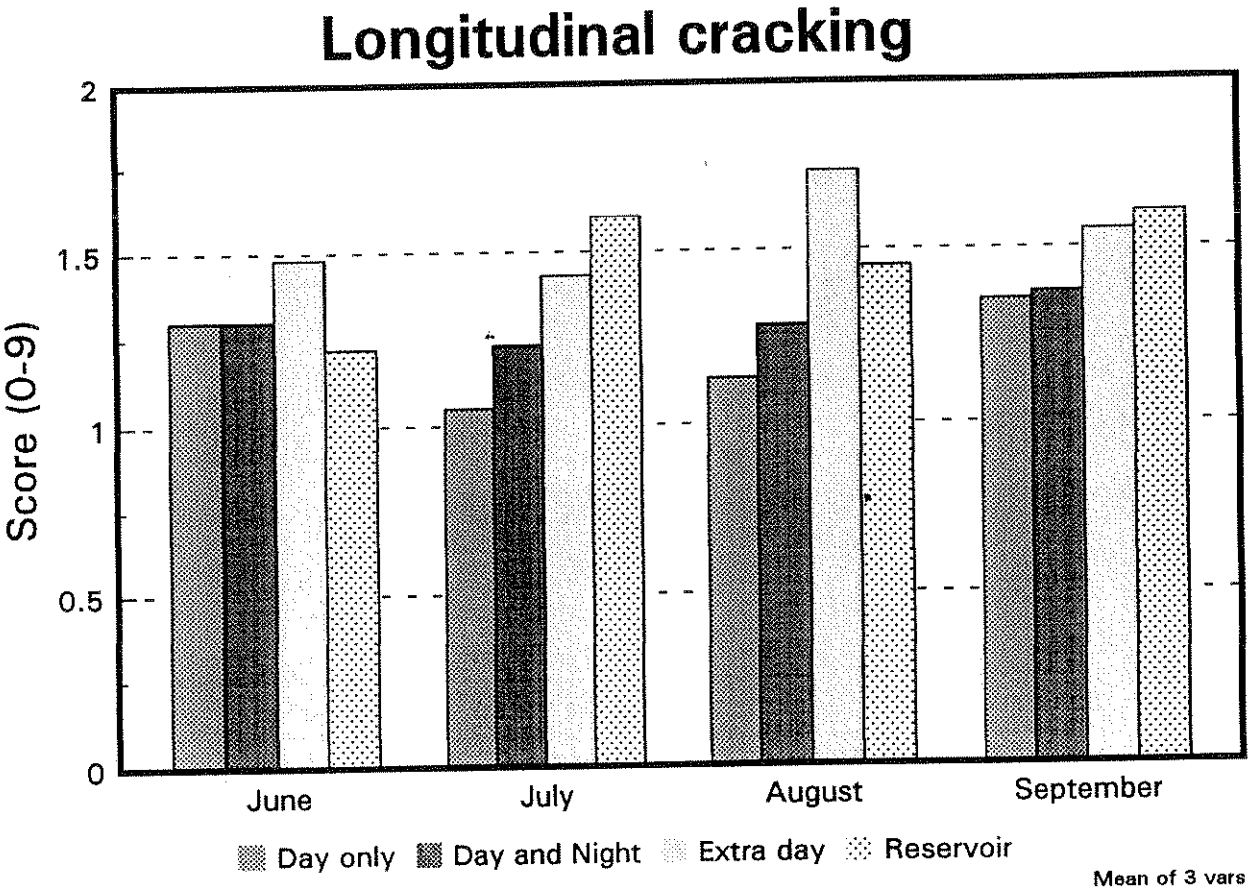
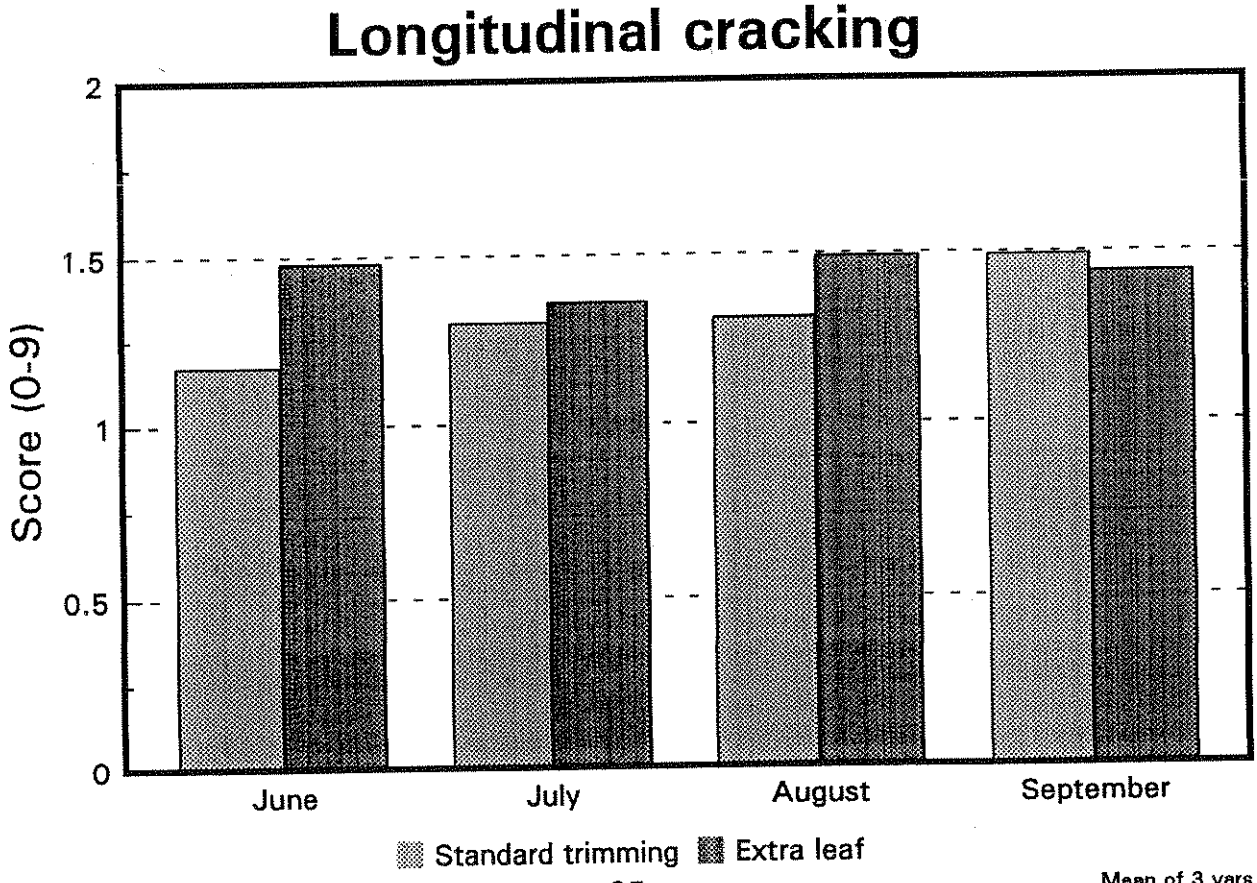

Fine net cracking
Score (0-9)
4
3
2
1
0
June
July
August
September
Lambada
Valetta
Mazurka

Figure 3: Longitudinal Cracking





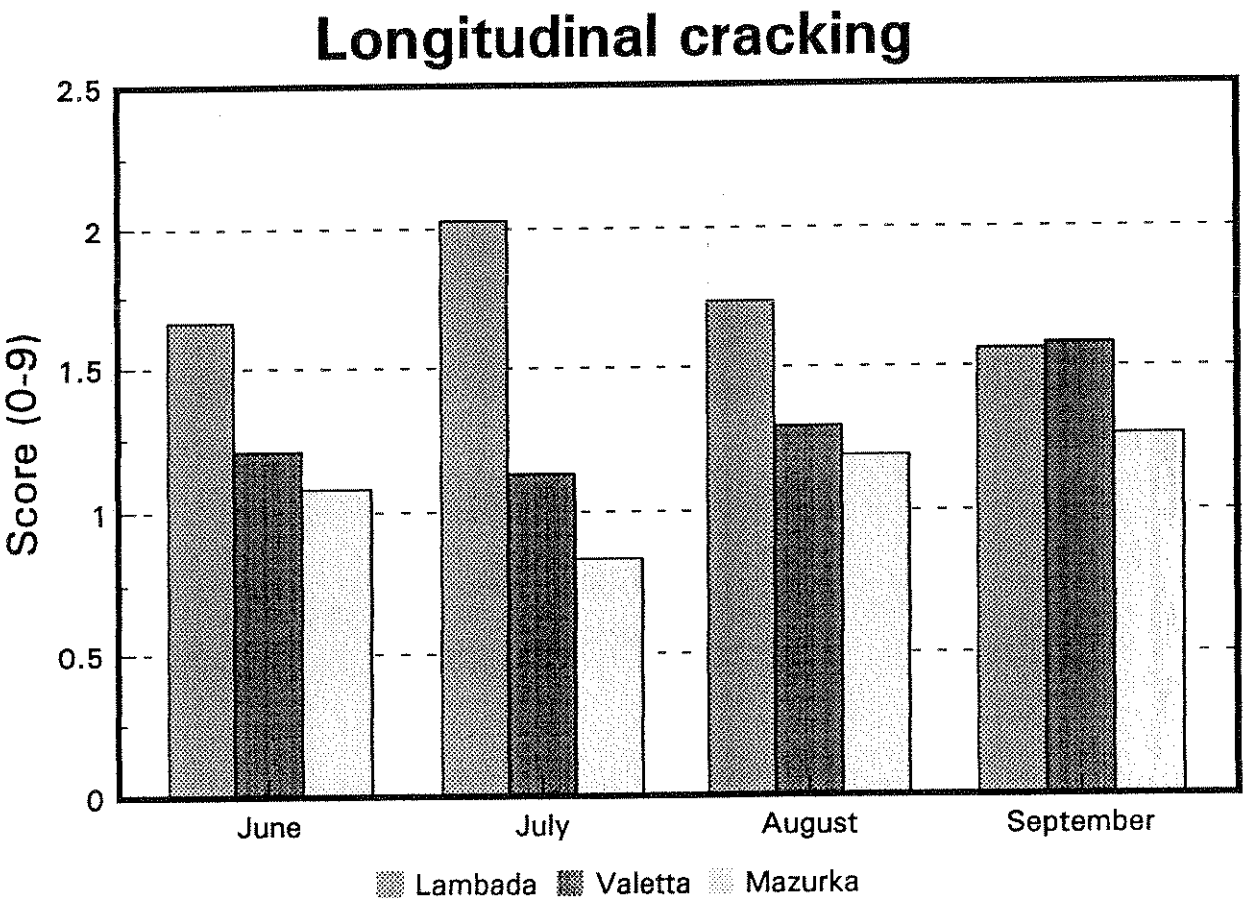
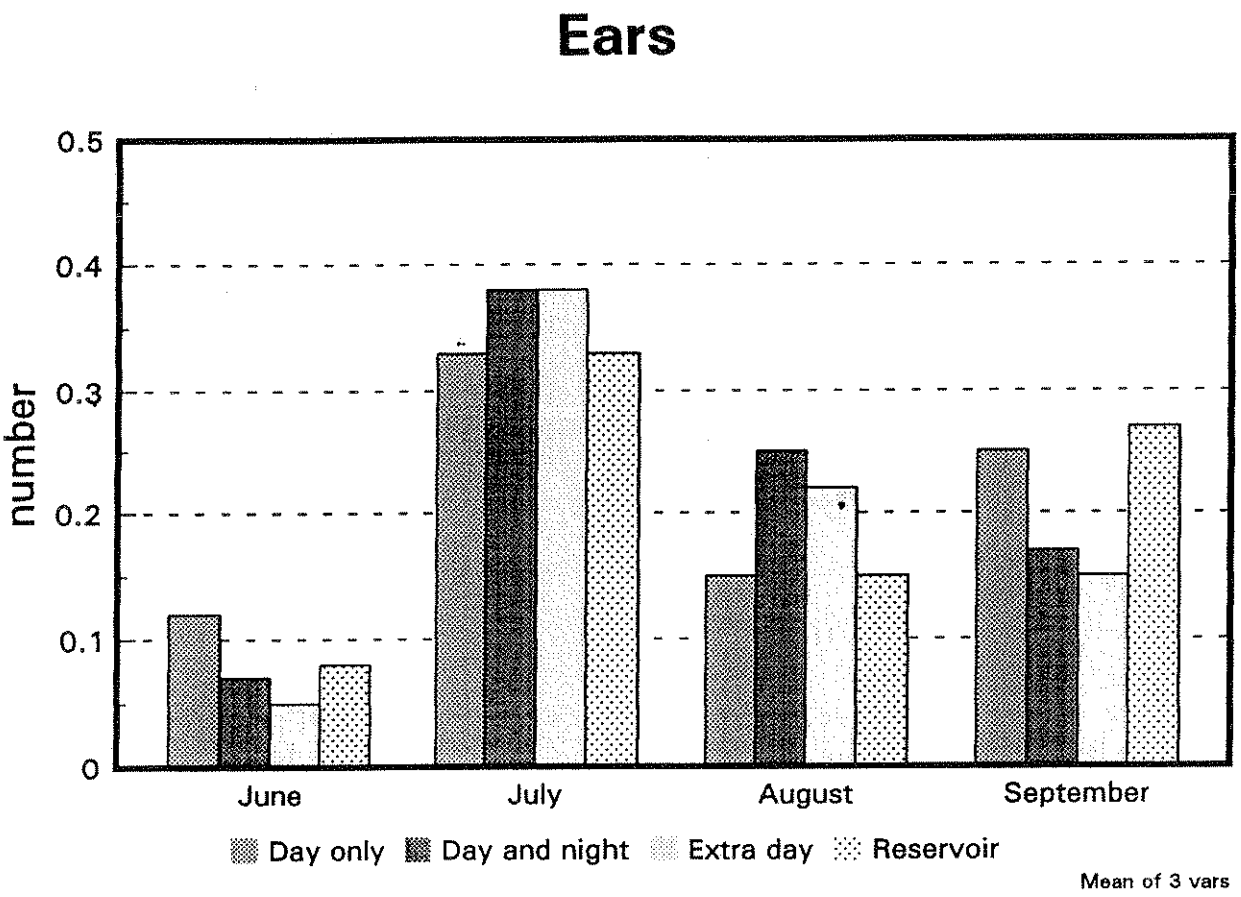
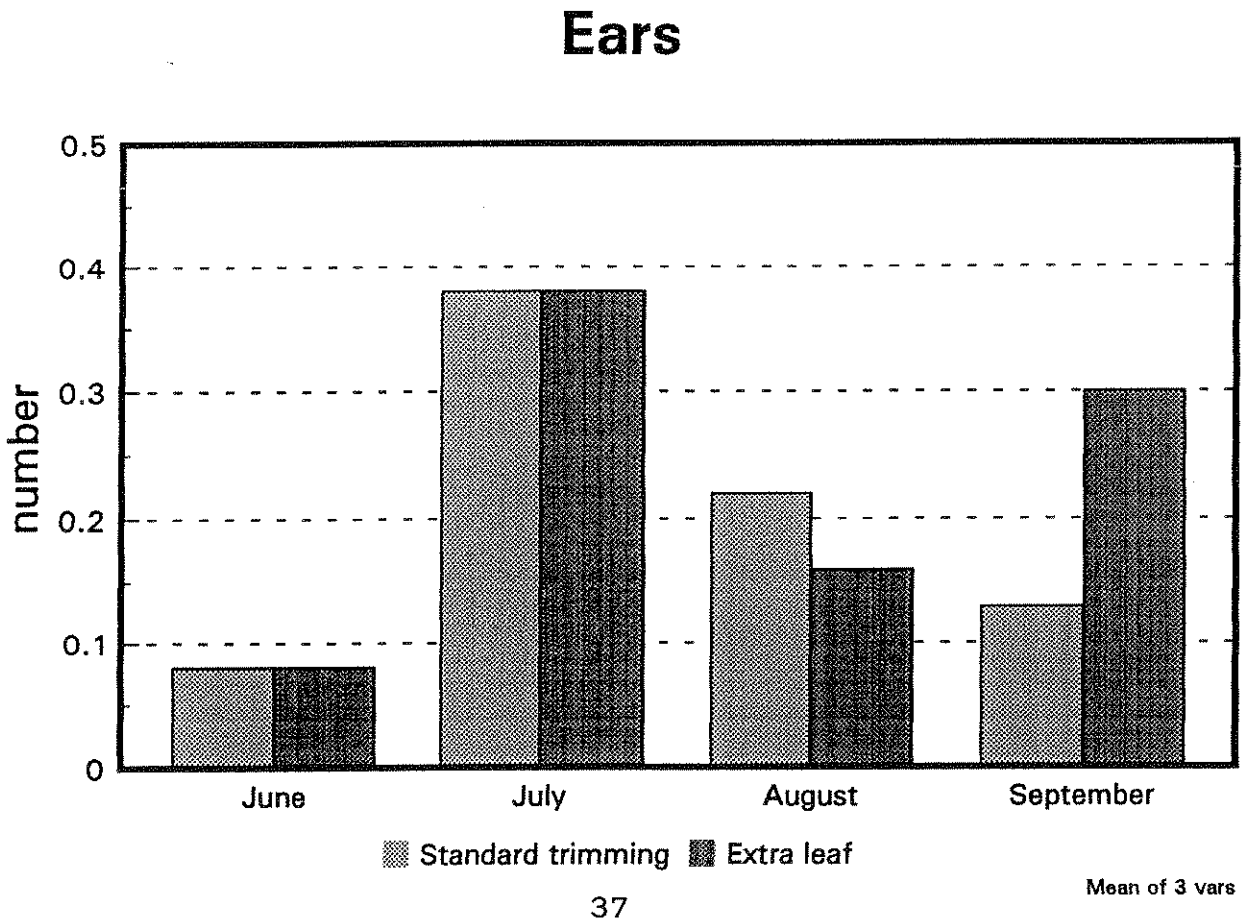
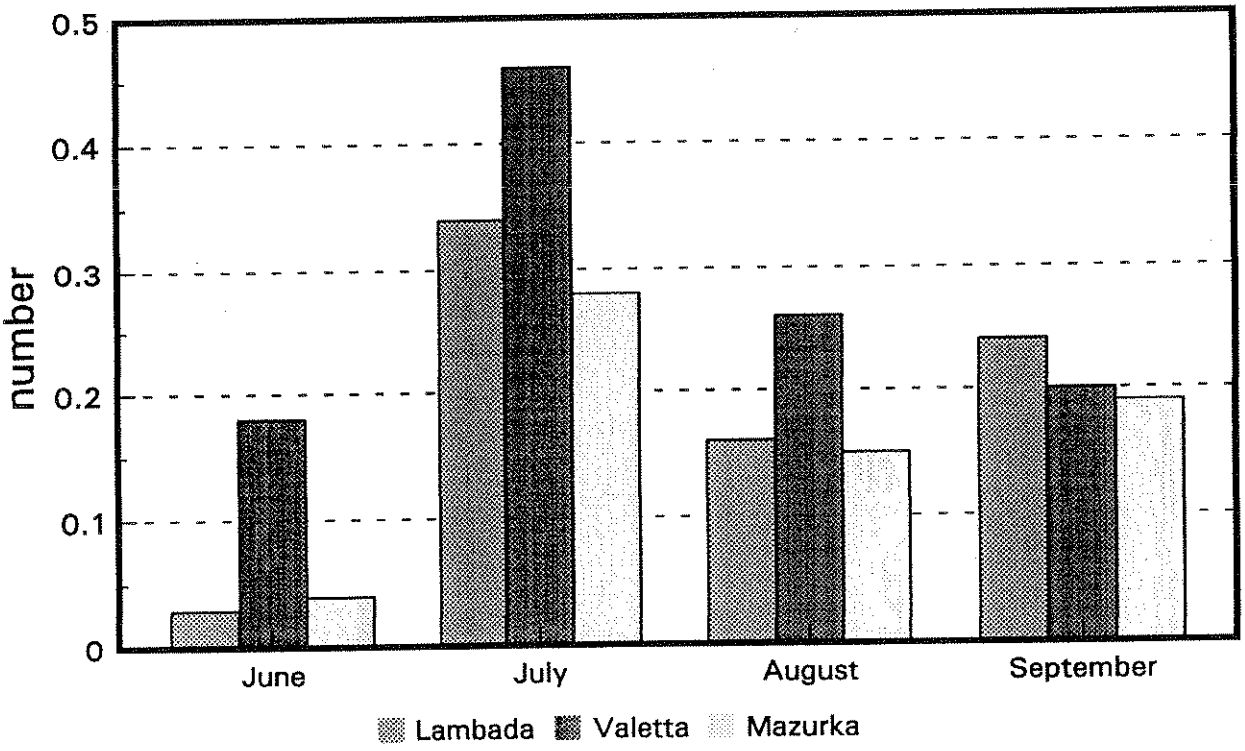

Longitudinal cracking
Score (0-9)
2.5
2
1.5
1
0.5
0
June
July
August
September
Lambada
Valetta
Mazurka

Figure 4: Ears





Ears


0.5
0.4
0.3
0.2
0.1
0
number
June
July
August
September
Lambada
Valetta
Mazurka

Shelf Life

Shrivelling

Treatment effects on shrivelling were inconsistent. In general the problem was worse where extra irrigation had been applied in the day or the reservoir system was used. This was related to the levels of fine net cracking in these treatments (Figure 5).

Trimming regime had very little effect on shrivelling and variety effects varied from month to month.

Crispness

At harvest there was very little difference in crispness between irrigation and trimming treatments but Lambada was consistently softer than Valetta and Mazurka (Figure 6c).

In July fruit became very soft after 7 days, particularly from the day and night watering treatment.

There were no differences between fruit from the two trimming treatments. After 7 days under shelf life conditions Valetta remained crispest.

Sugar Content

At harvest there were no significant differences in sugar content between irrigation or trimming treatments, but Lambada was sweeter than Valetta and Mazurka (Figure 7).

Sugar content increased during the 7 days under shelf life conditions but rate of sugar accumulation was not related to treatments.

Weight Loss

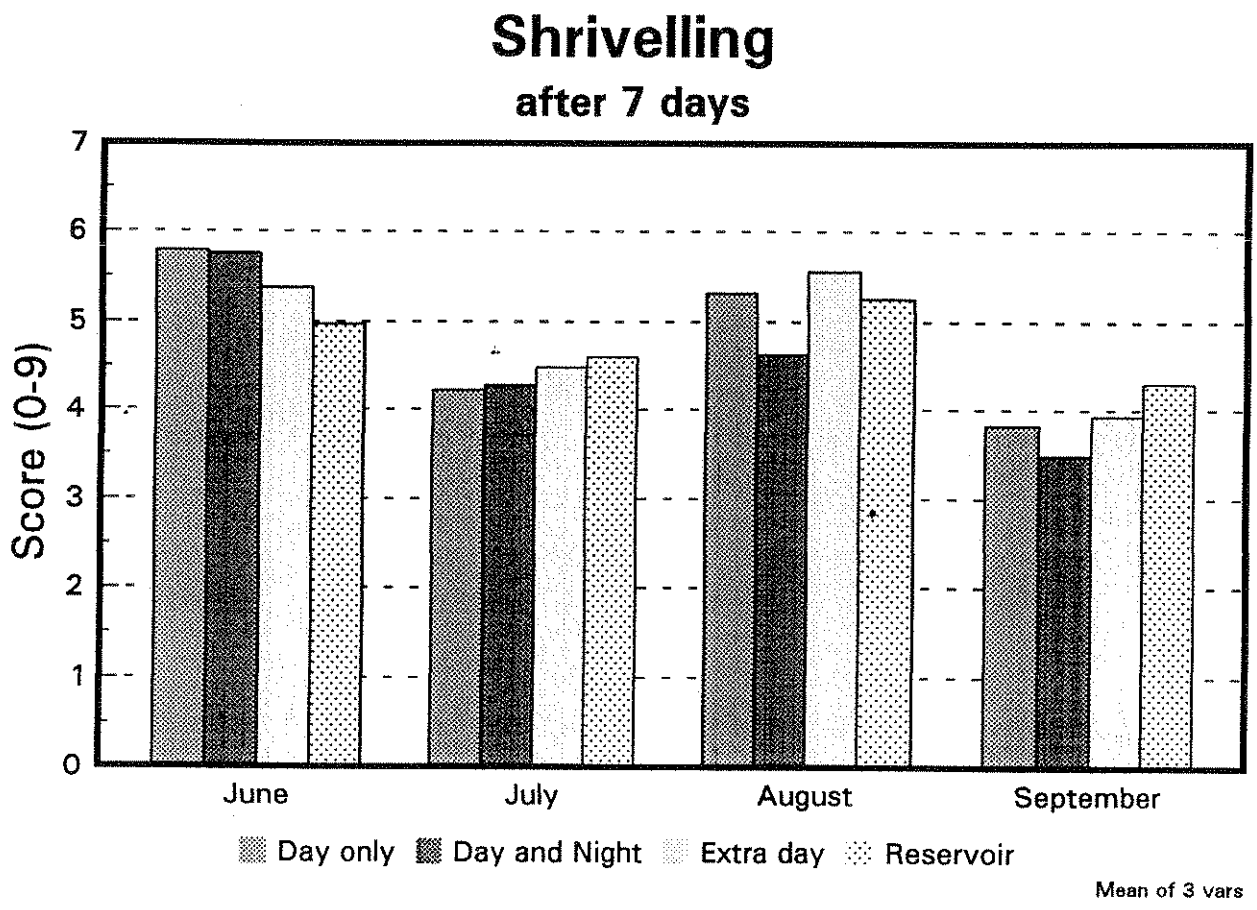
There was no clear indication that the irrigation treatments affected weight less during shelf life, but in June, August and September there was slightly more weight loss from plants with extra leaves (Figure 8). Lambada lost more weight than the other two varieties. These results correlate closely with levels of fine net cracking.

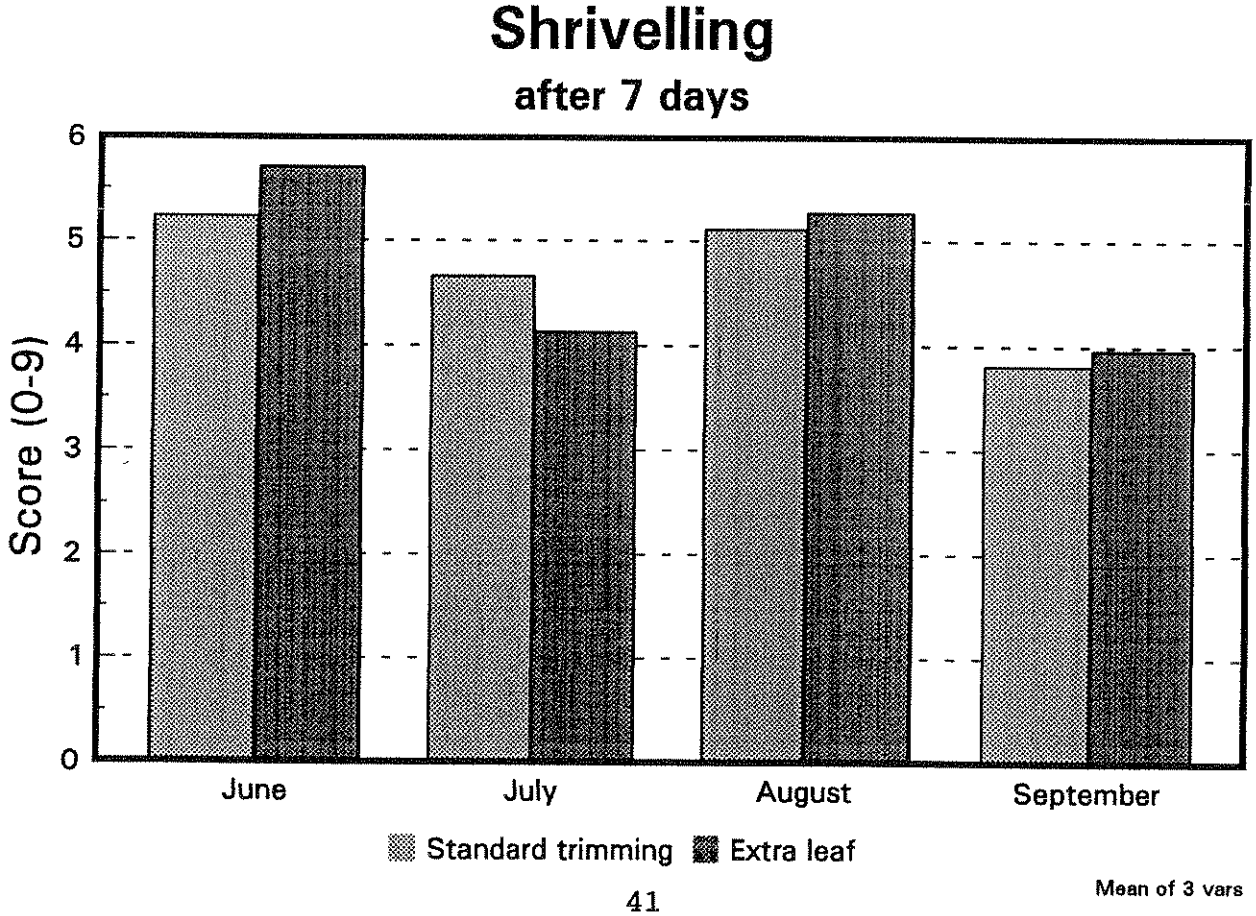
Fruit Shine

At harvest there was no irrigation effect on fruit shine but extra leaf tended to give some reduction. Valetta was the shiniest of the varieties (Figure 9).

After seven days under shelf life conditions fruit shine had decreased. Overall the day and night irrigation treatment tended to retain most shine and from June-August standard trimming was better than extra leaf. Variety differences were inconsistent after seven days.

Figure 5: Shrivelling





Shrivelling

after 7 days

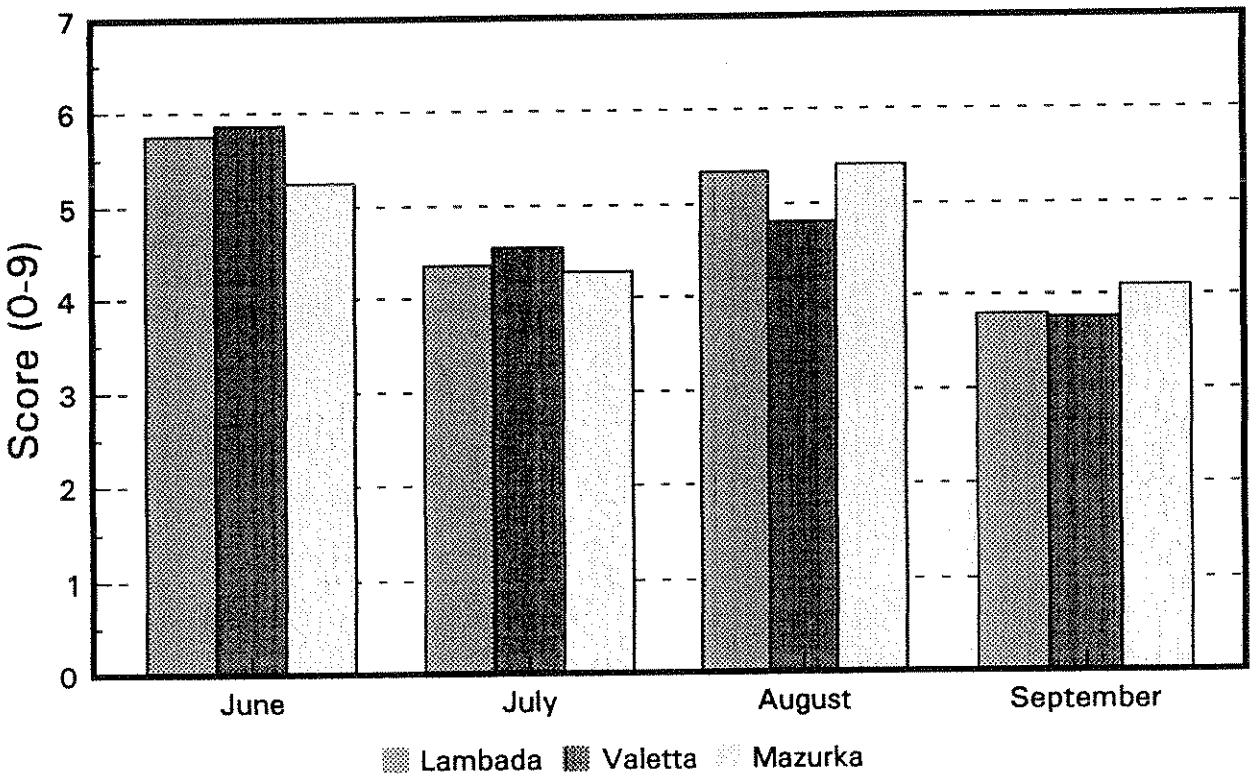
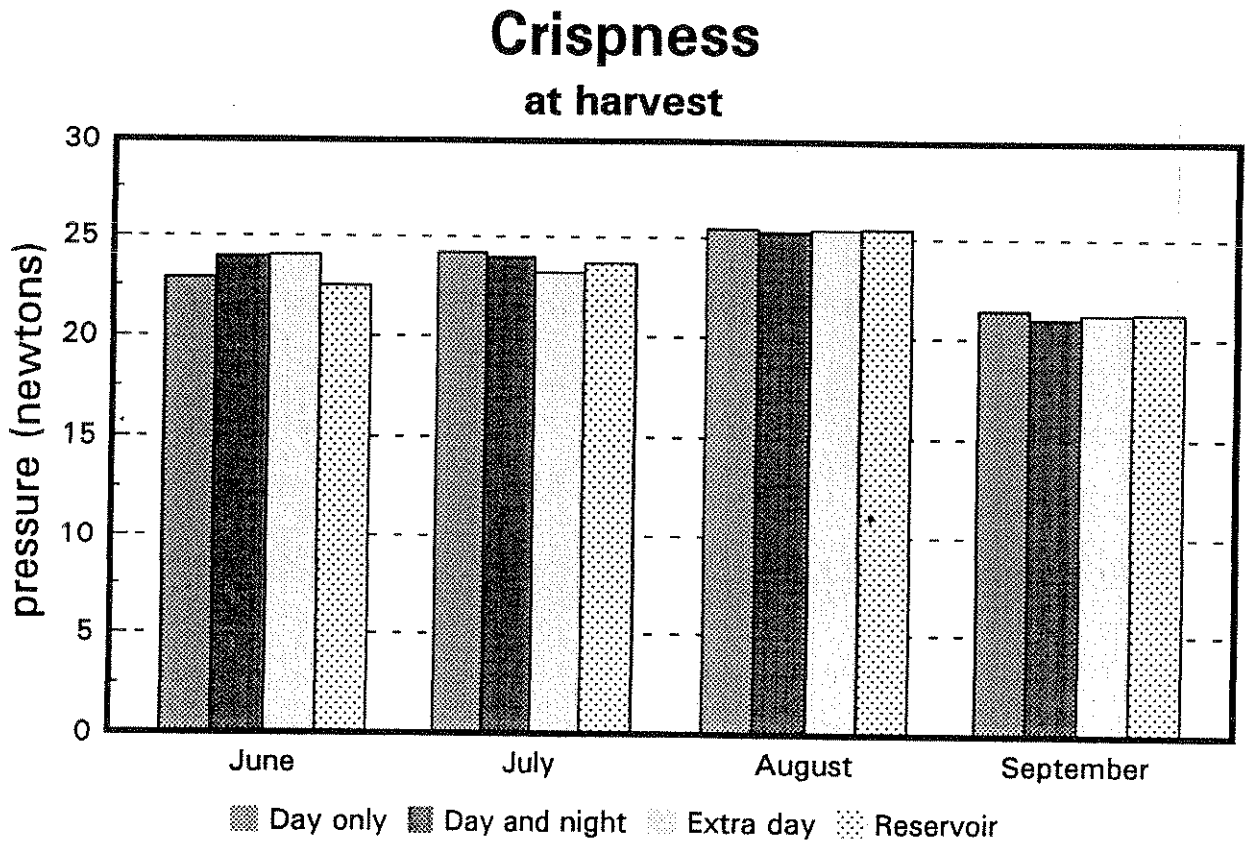
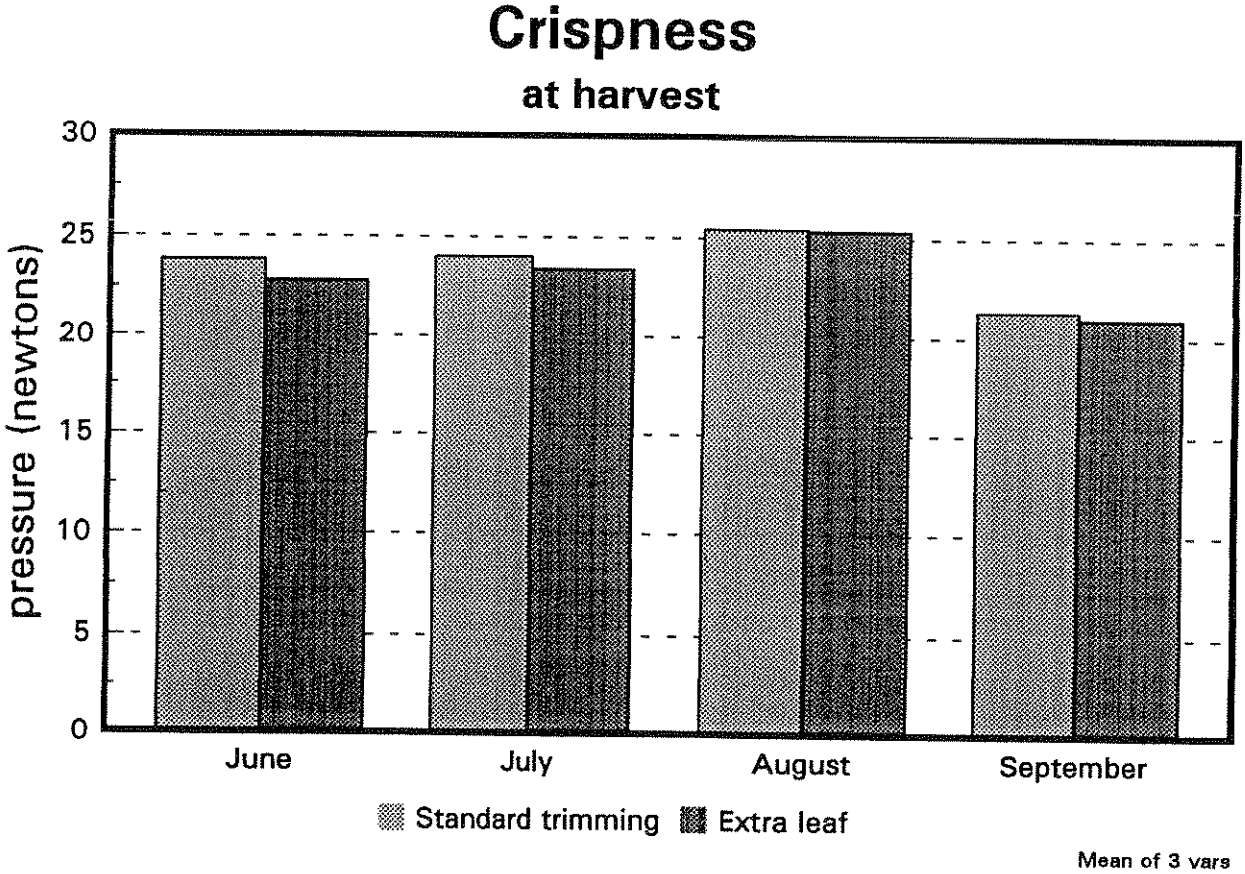


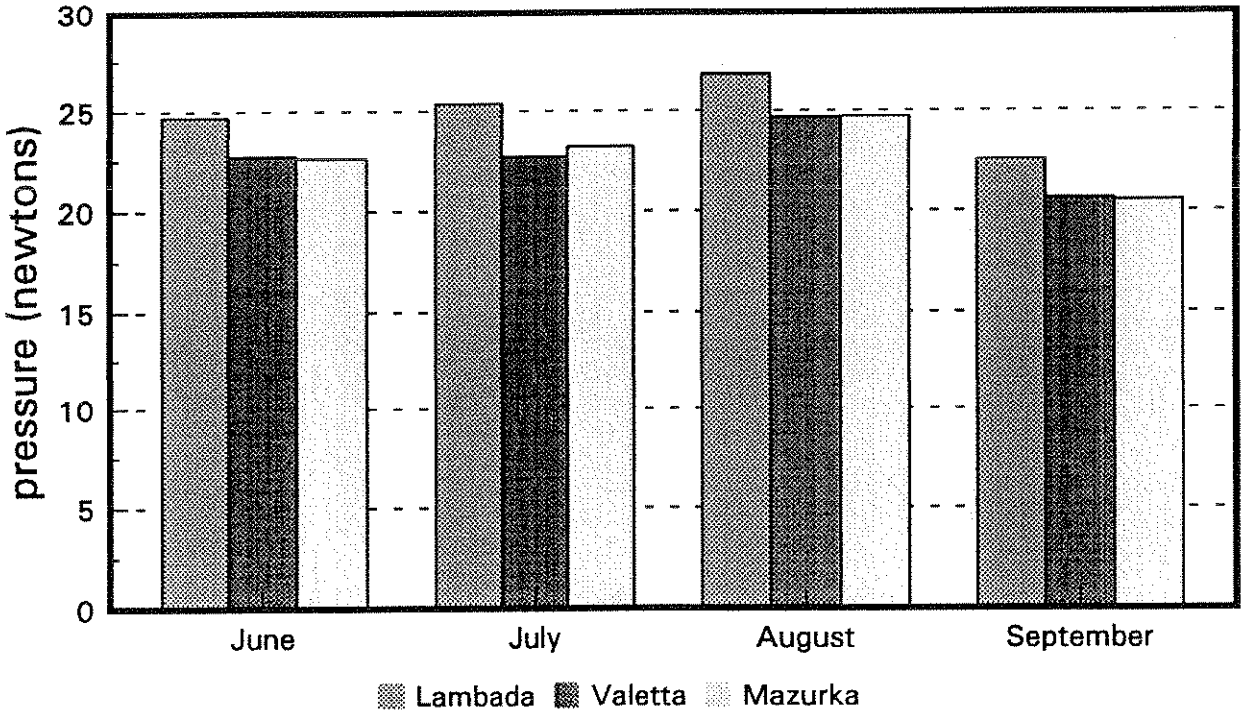
Figure 6: Crispness





Crispness

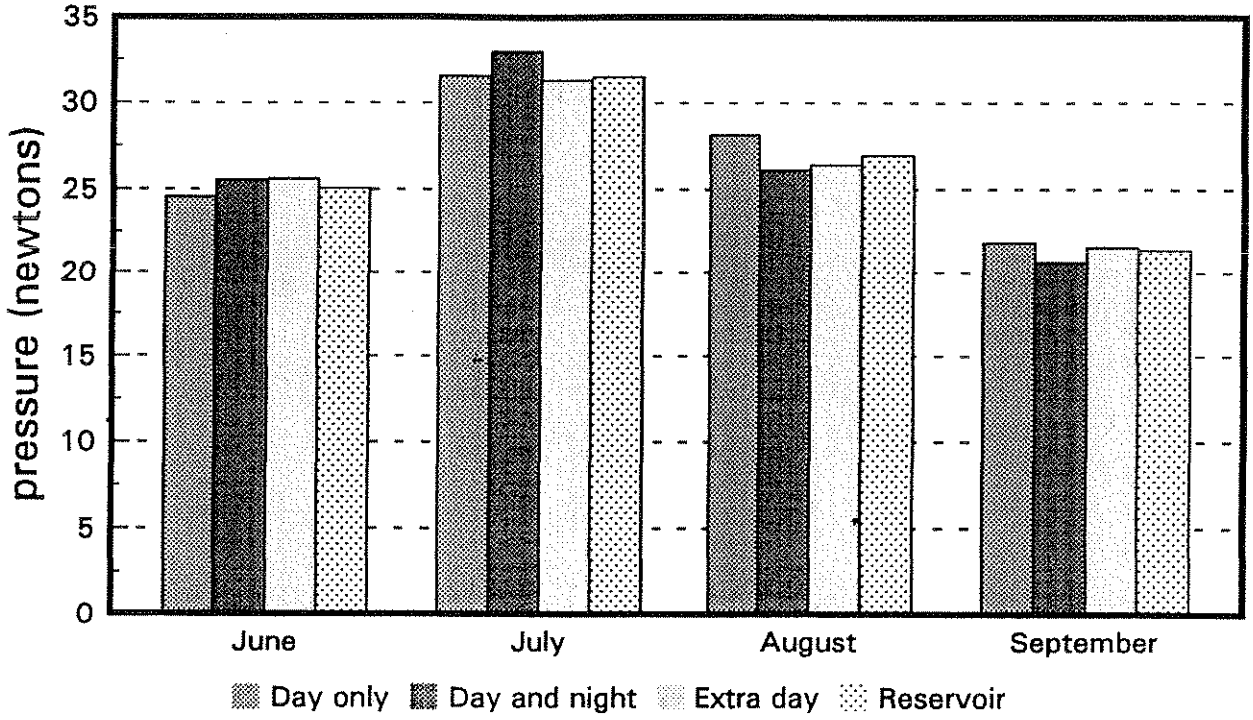
at harvest



Higher values denote softer flesh

Crispness

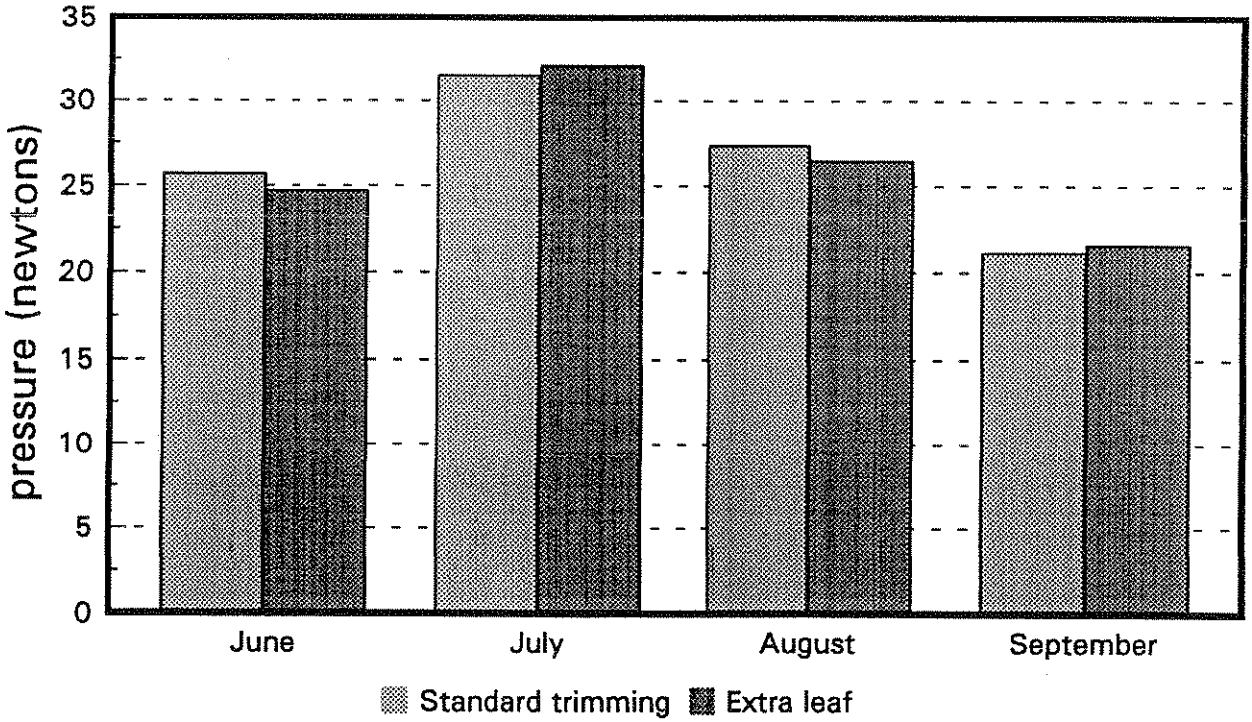
after 7 days



Mean of 3 vars
Higher values denote softer flesh

Crispness

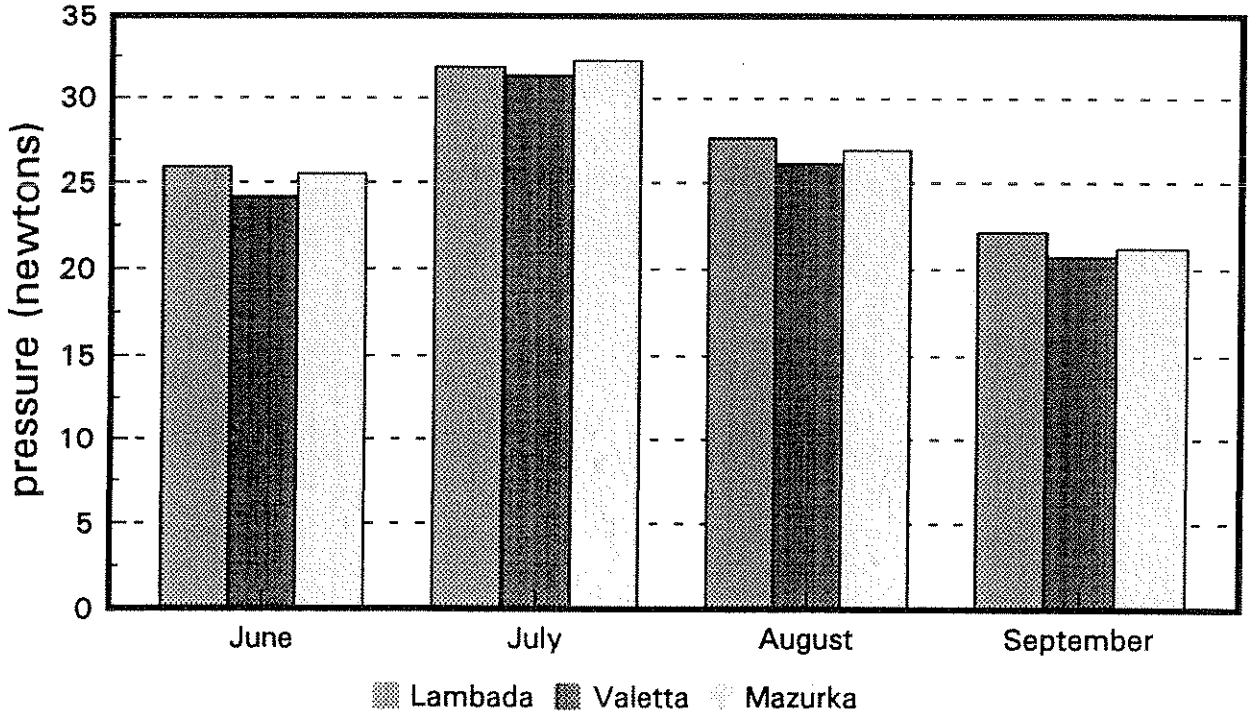
after 7 days



Mean of 3 vars
Higher values denote softer flesh

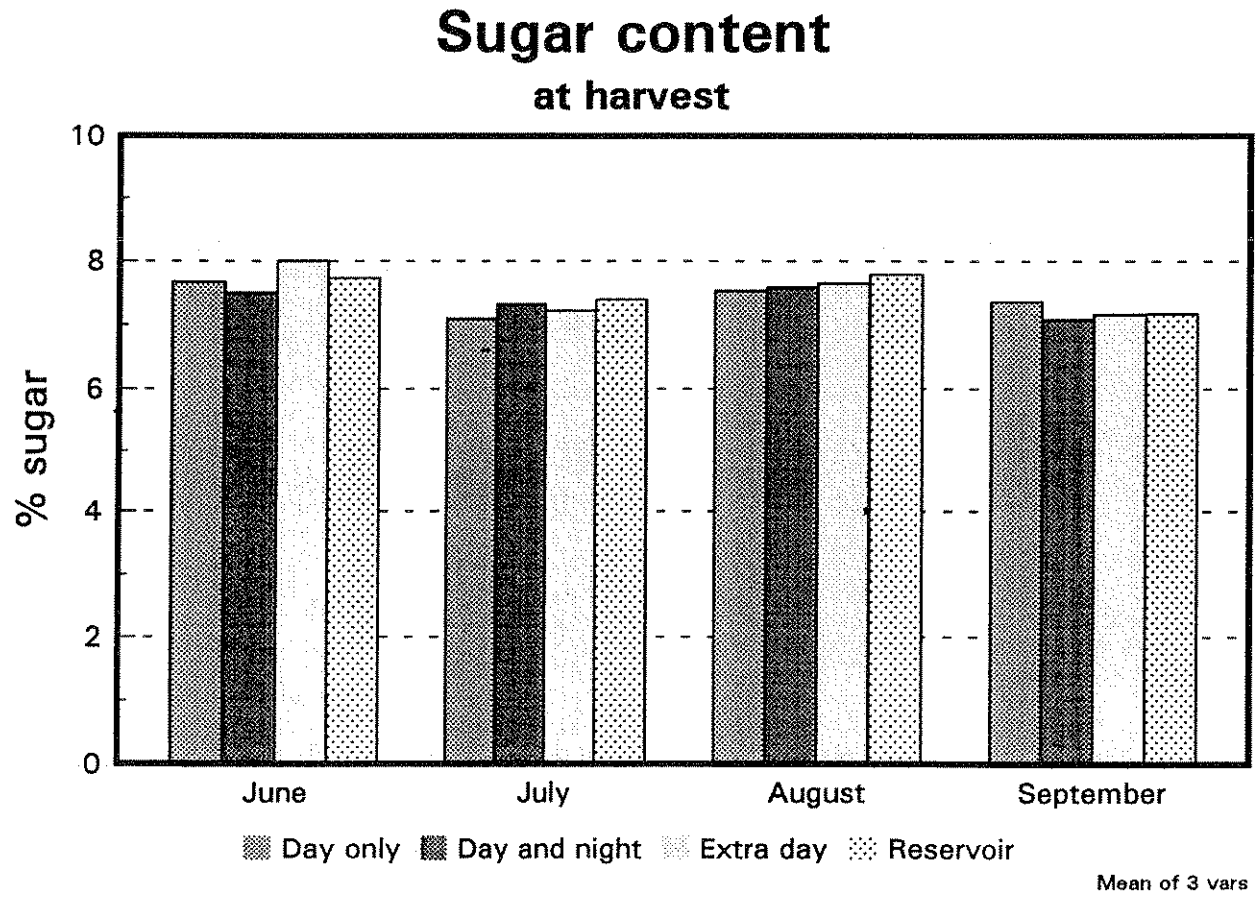
Crispness

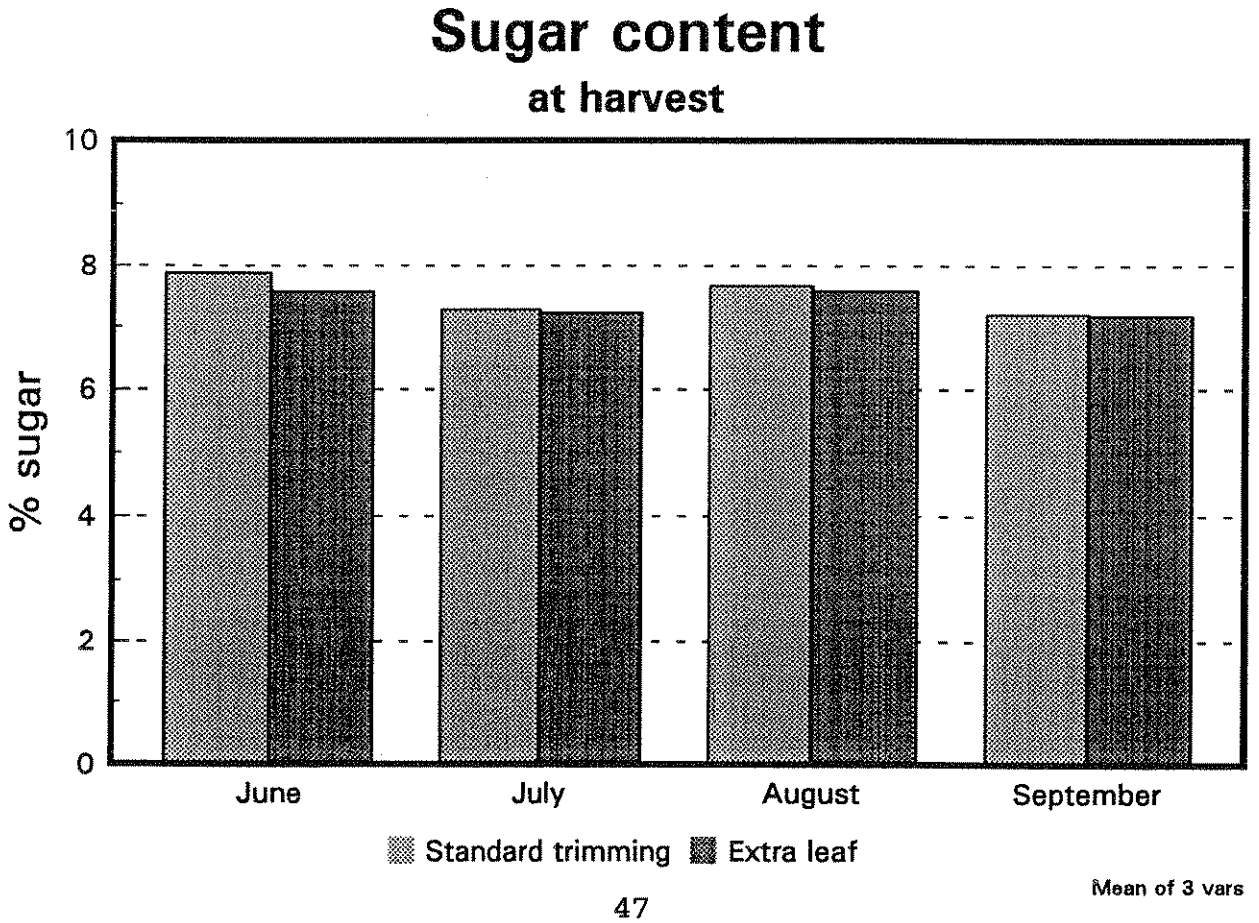
after 7 days



Higher values denote softer flesh

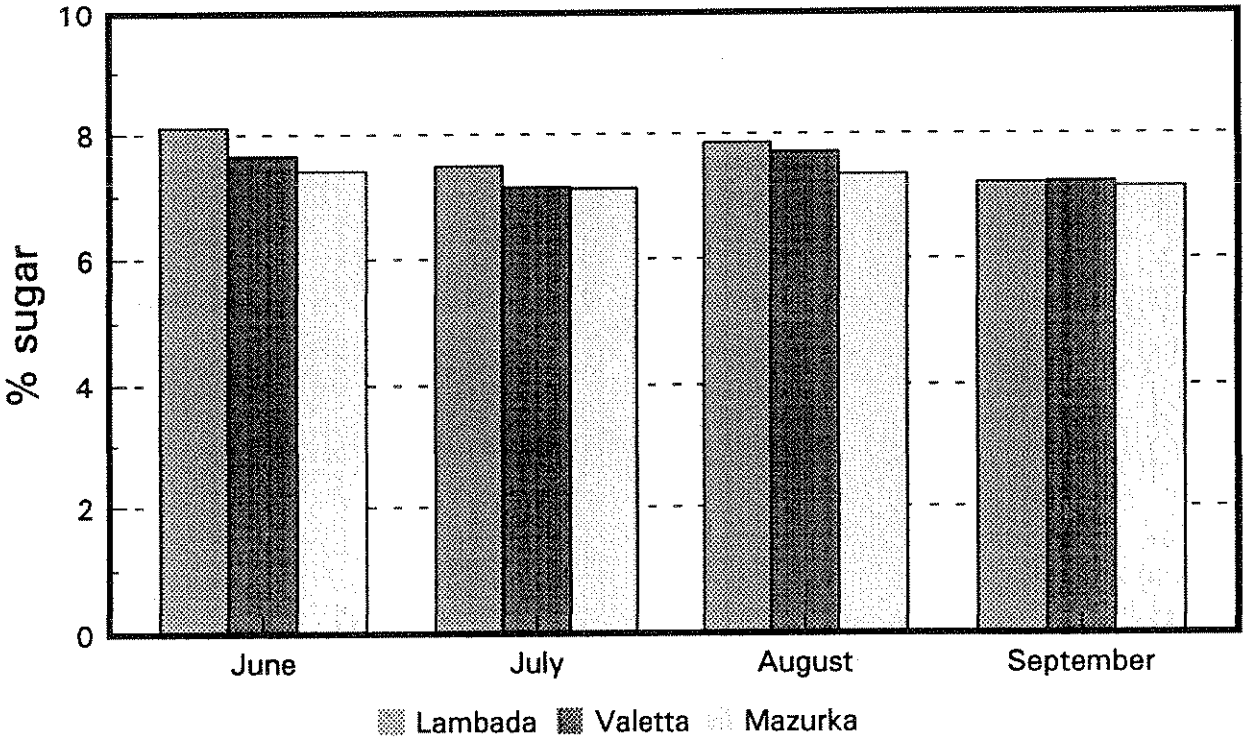
Figure 7: Sugar Content





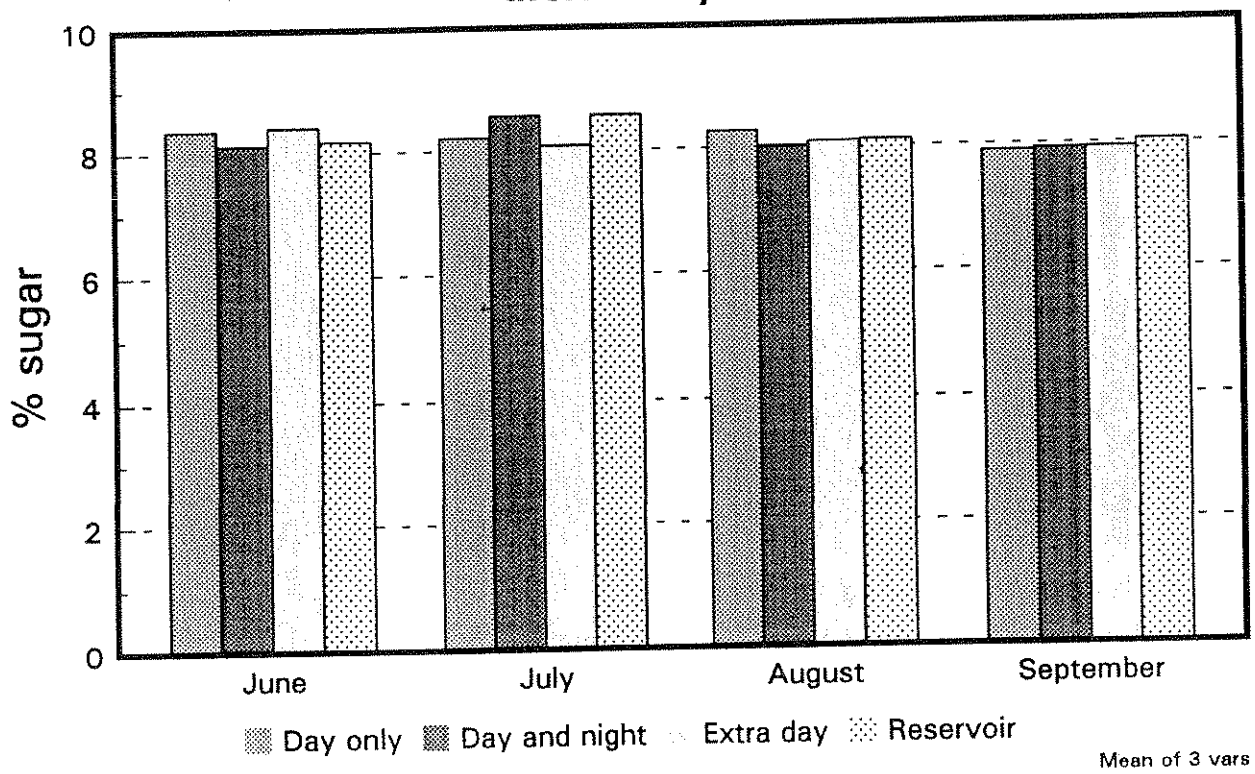
Sugar content

at harvest



Sugar content

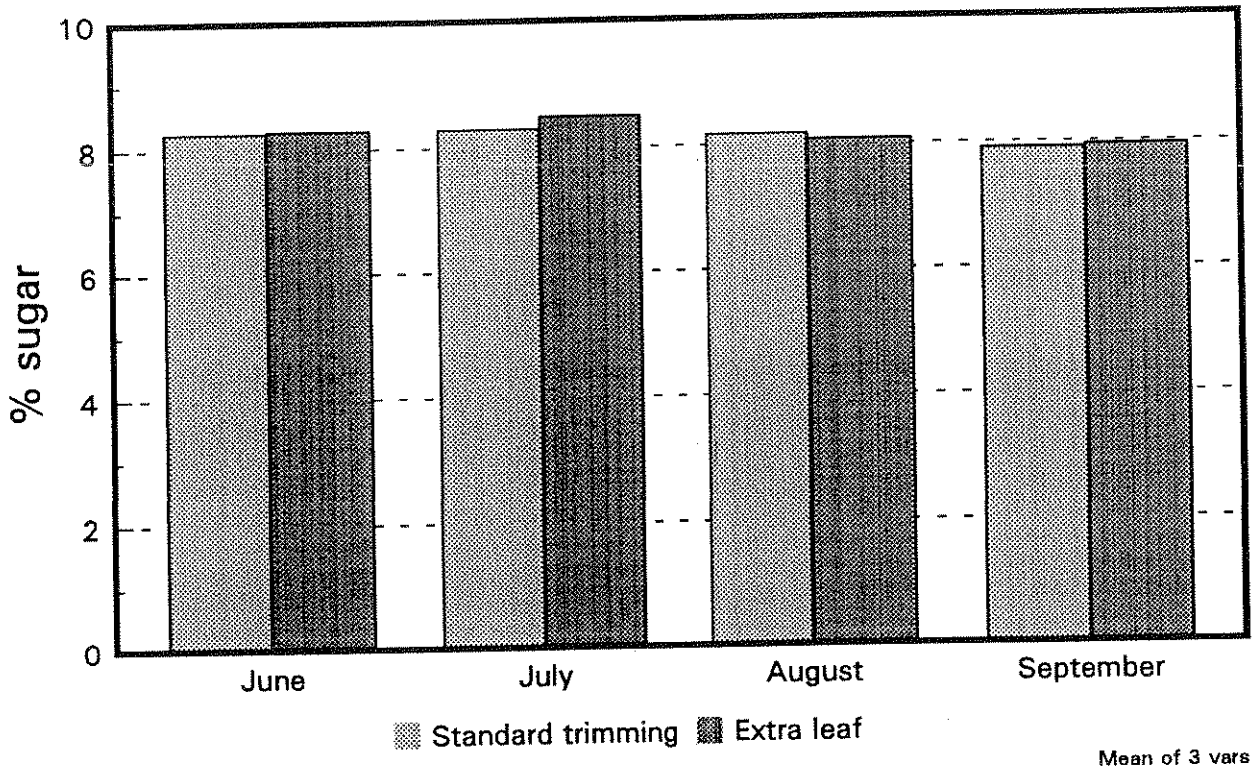
after 7 days



Mean of 3 vars

Sugar content

after 7 days



Mean of 3 vars

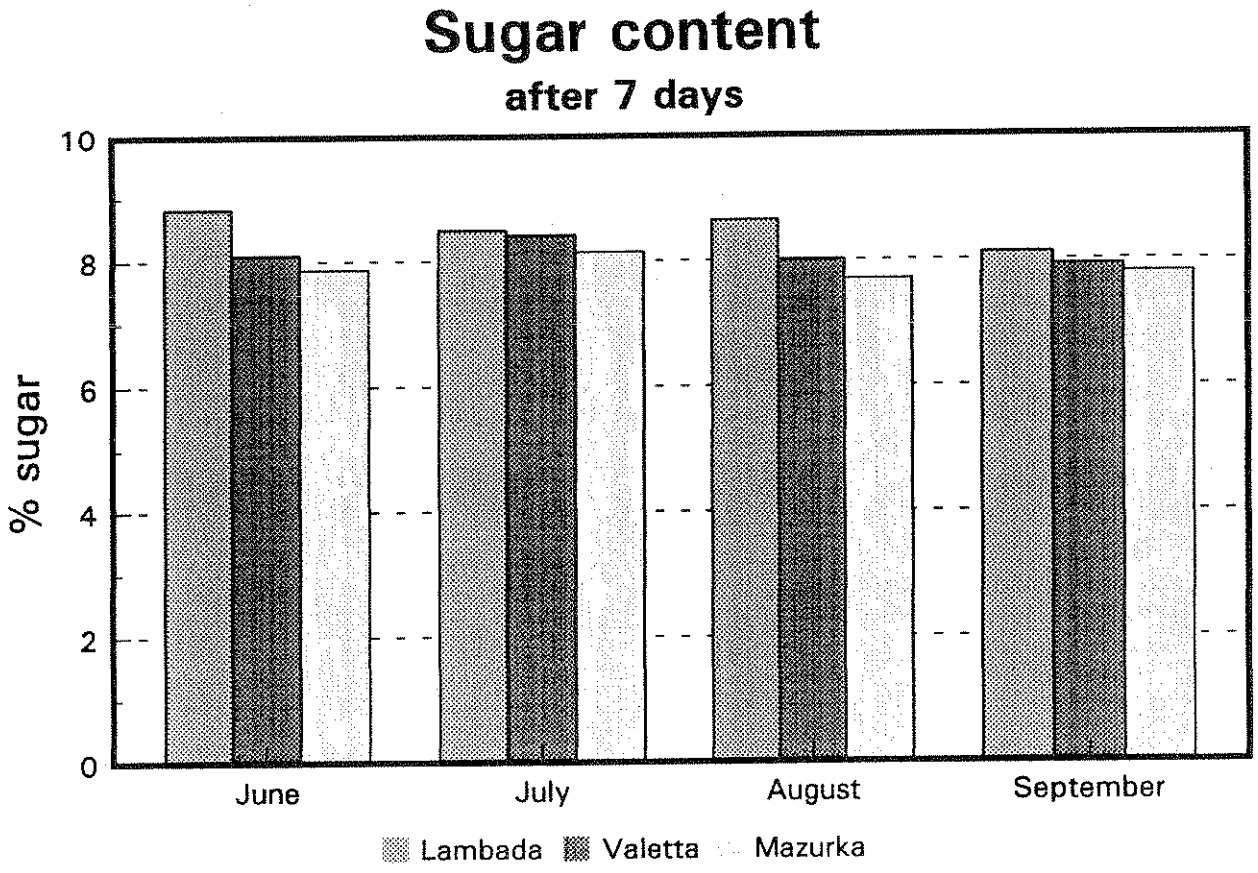
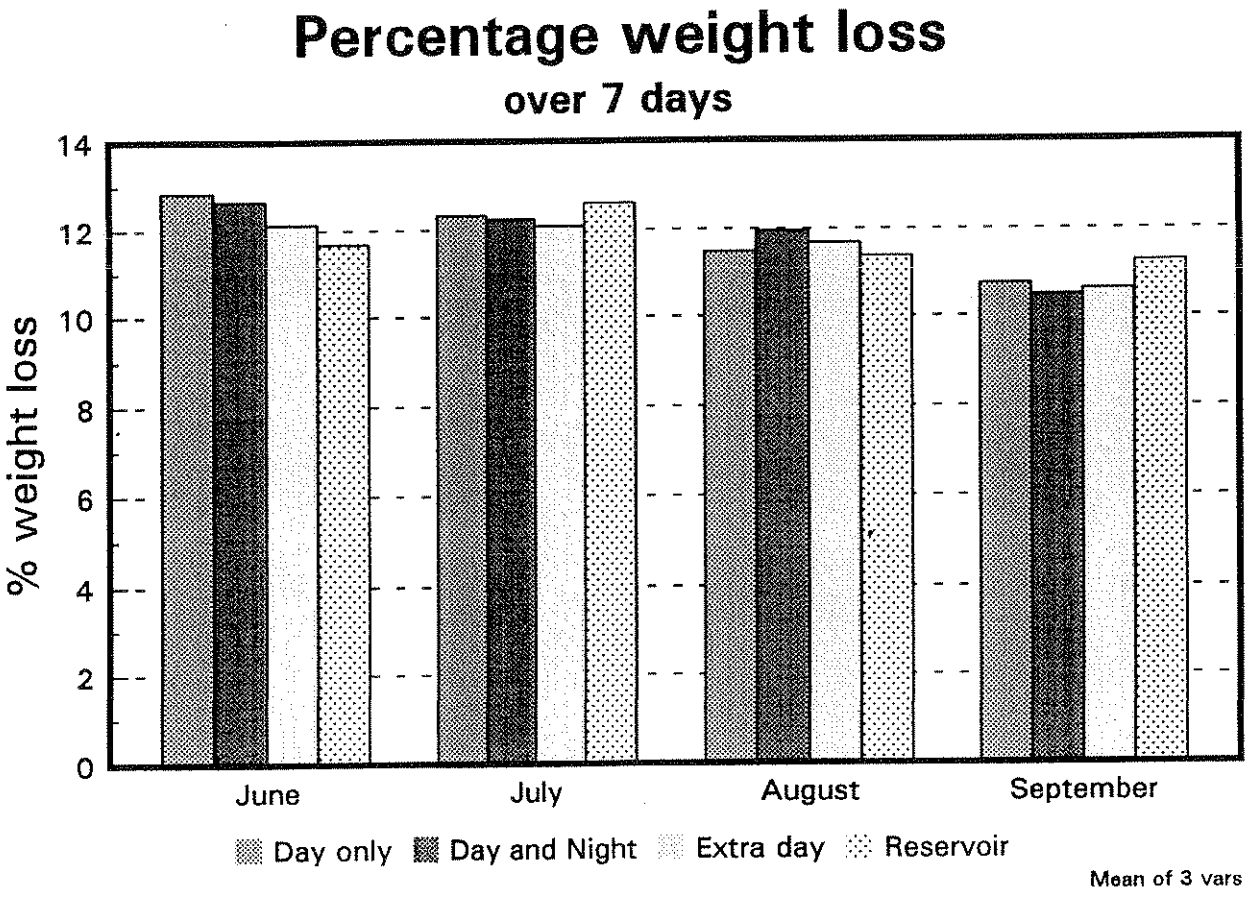
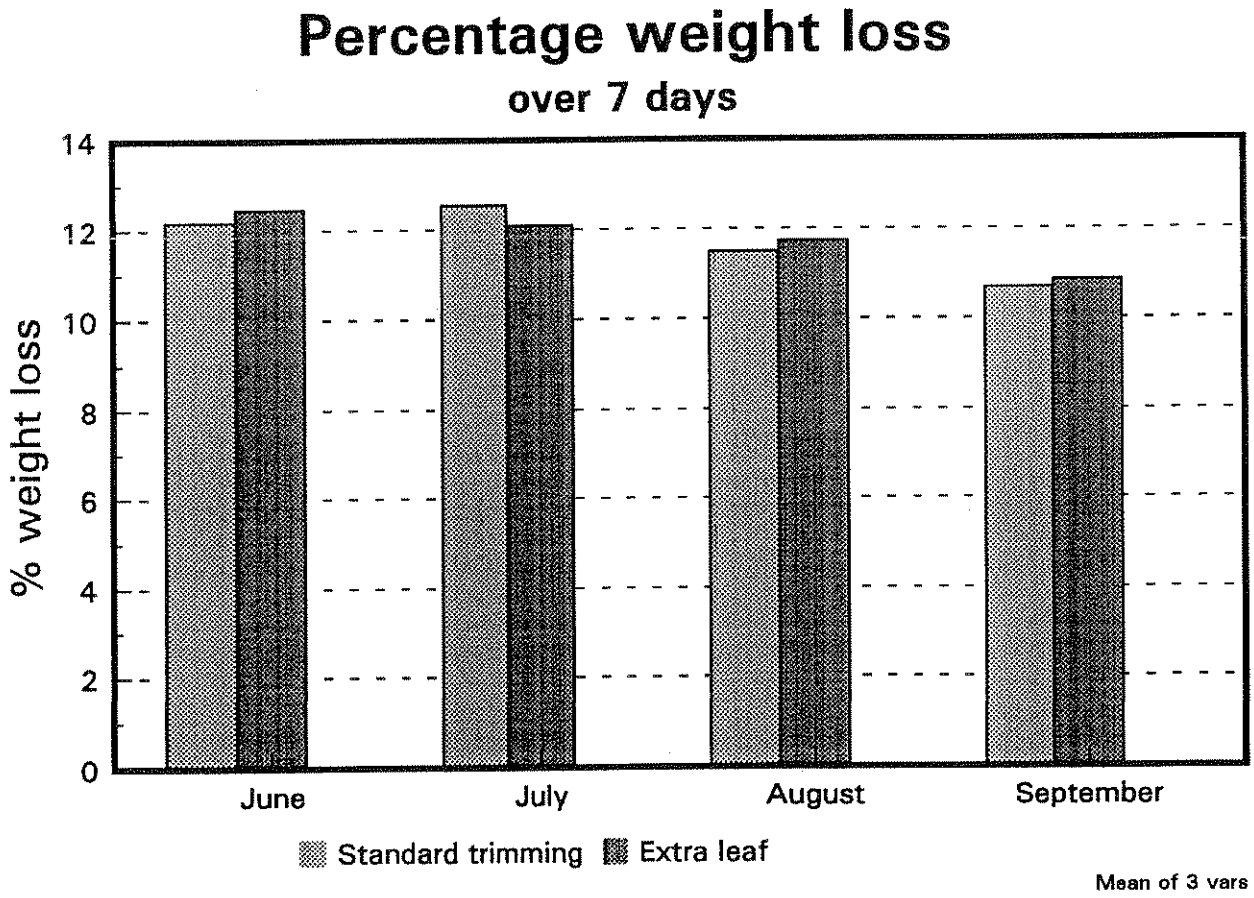

Sugar content
after 7 days
% sugar
10
8
6
4
2
0
June
July
August
September
Lambada
Valetta
Mazurka

Figure 8: Percentage Weight Loss





Percentage weight loss

over 7 days

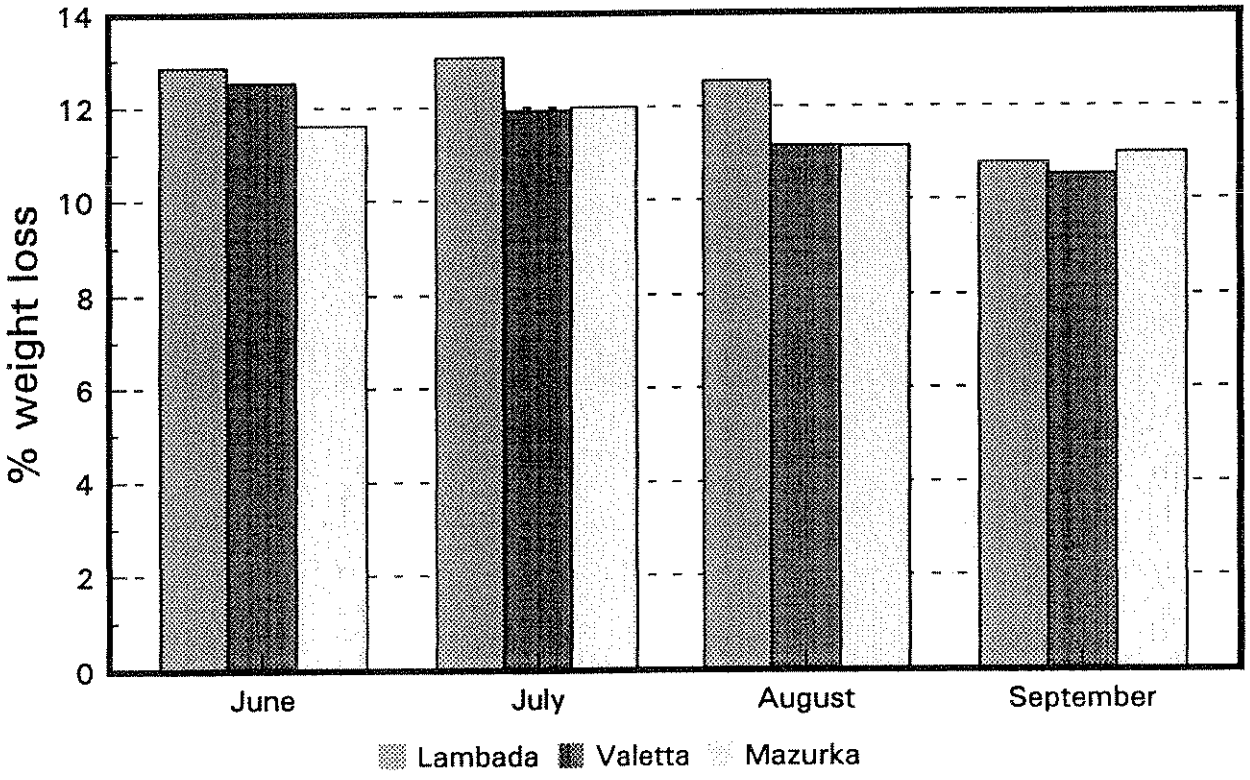
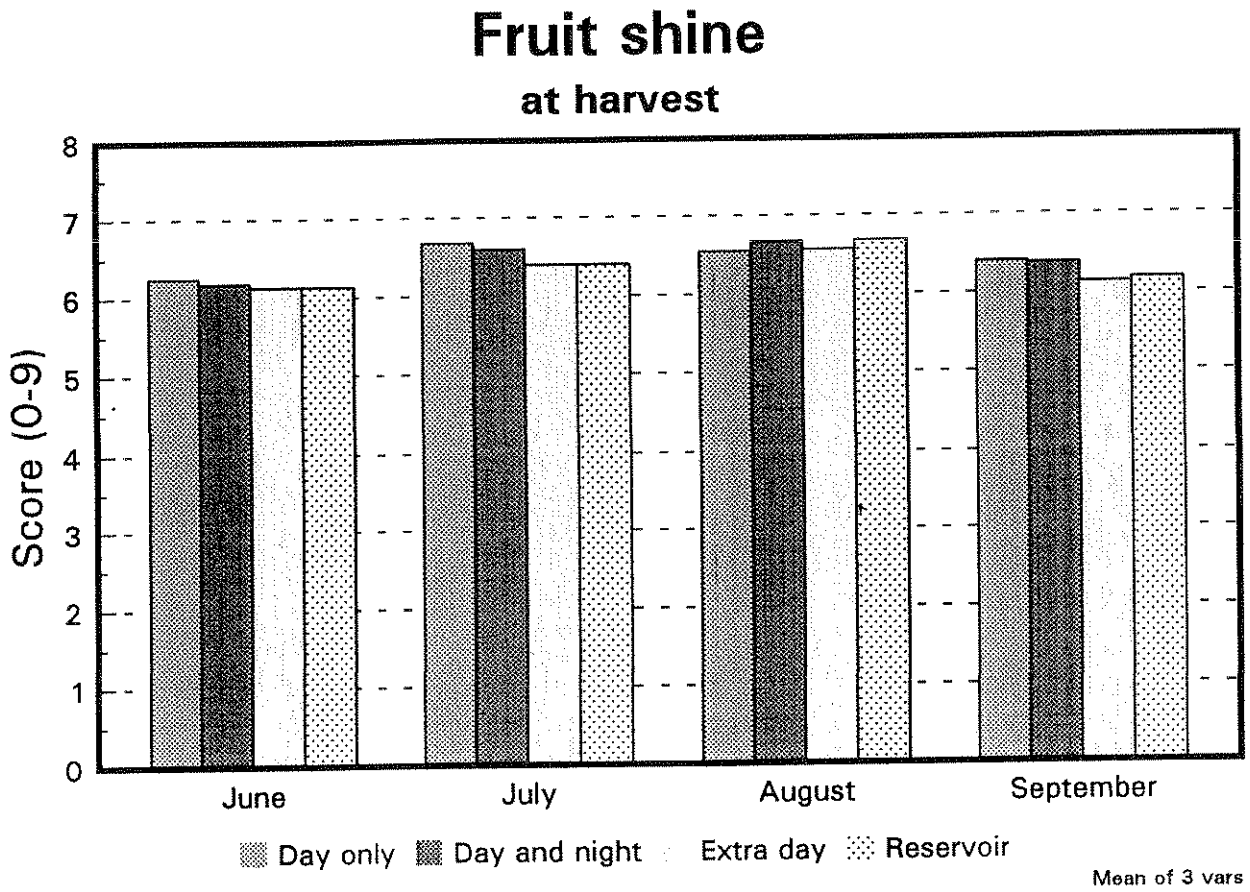
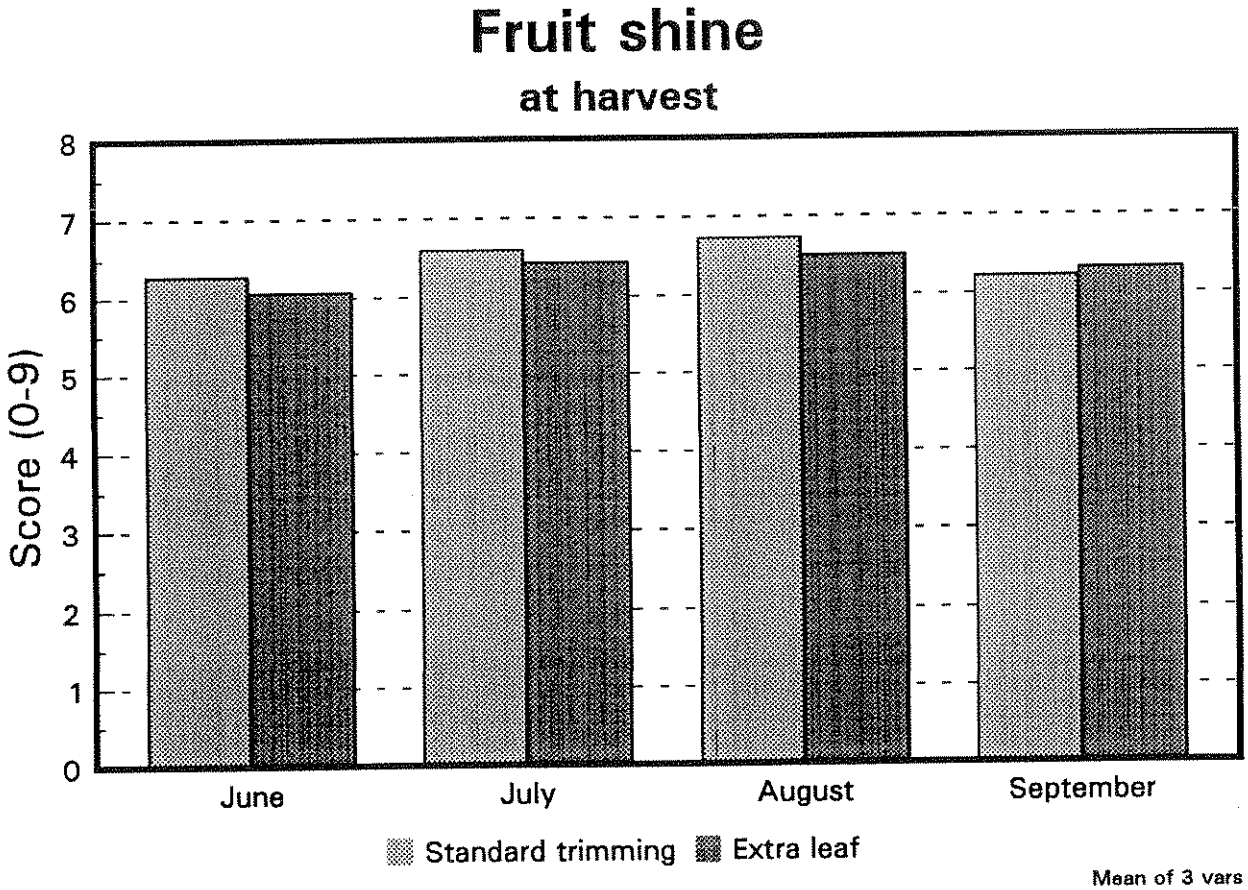
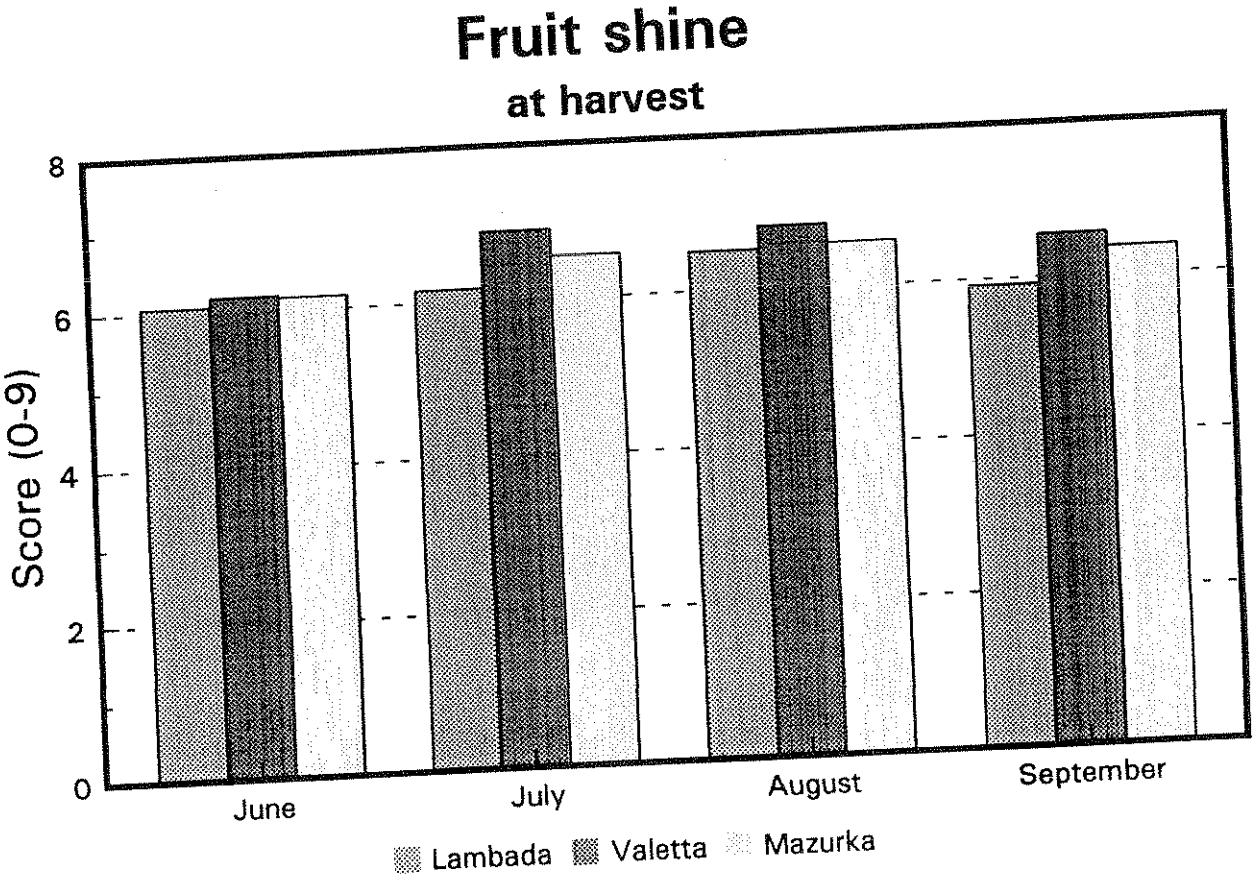


Figure 9: Fruit Shine

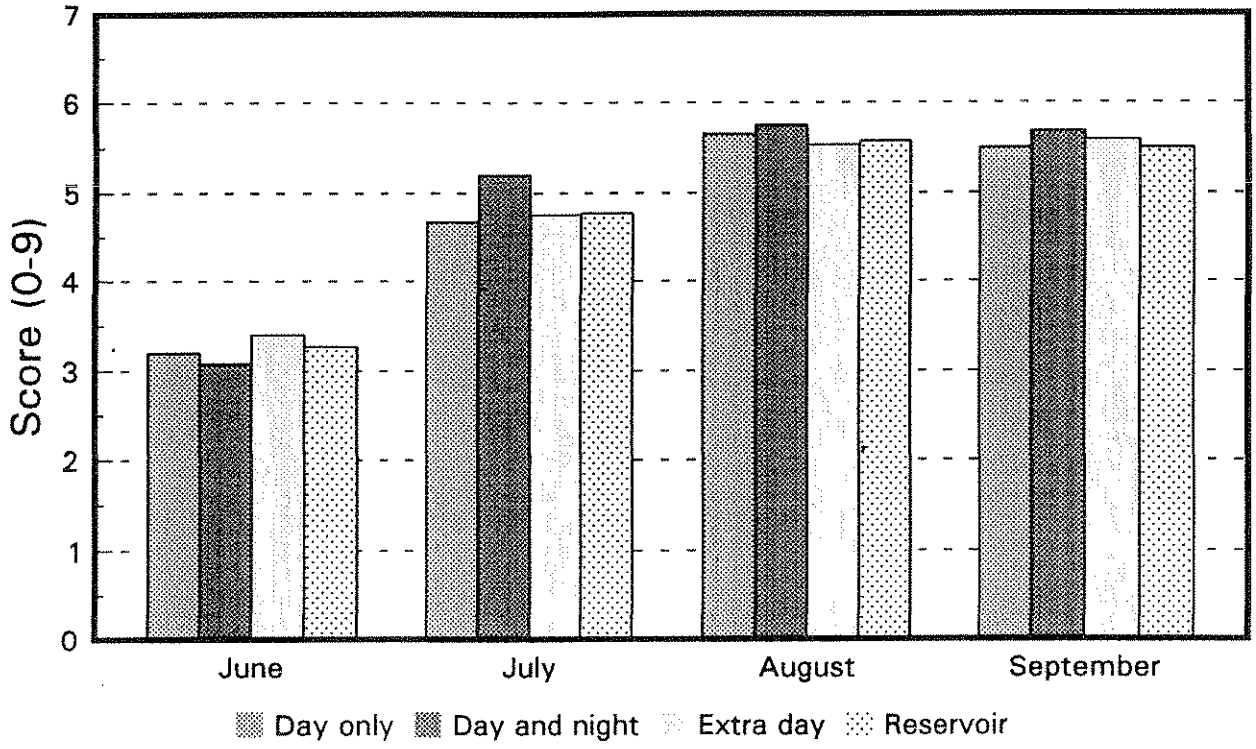





Fruit shine
at harvest
Score (0-9)
8
6
4
2
0
June
July
August
September
Lambada
Valetta
Mazurka

Fruit shine

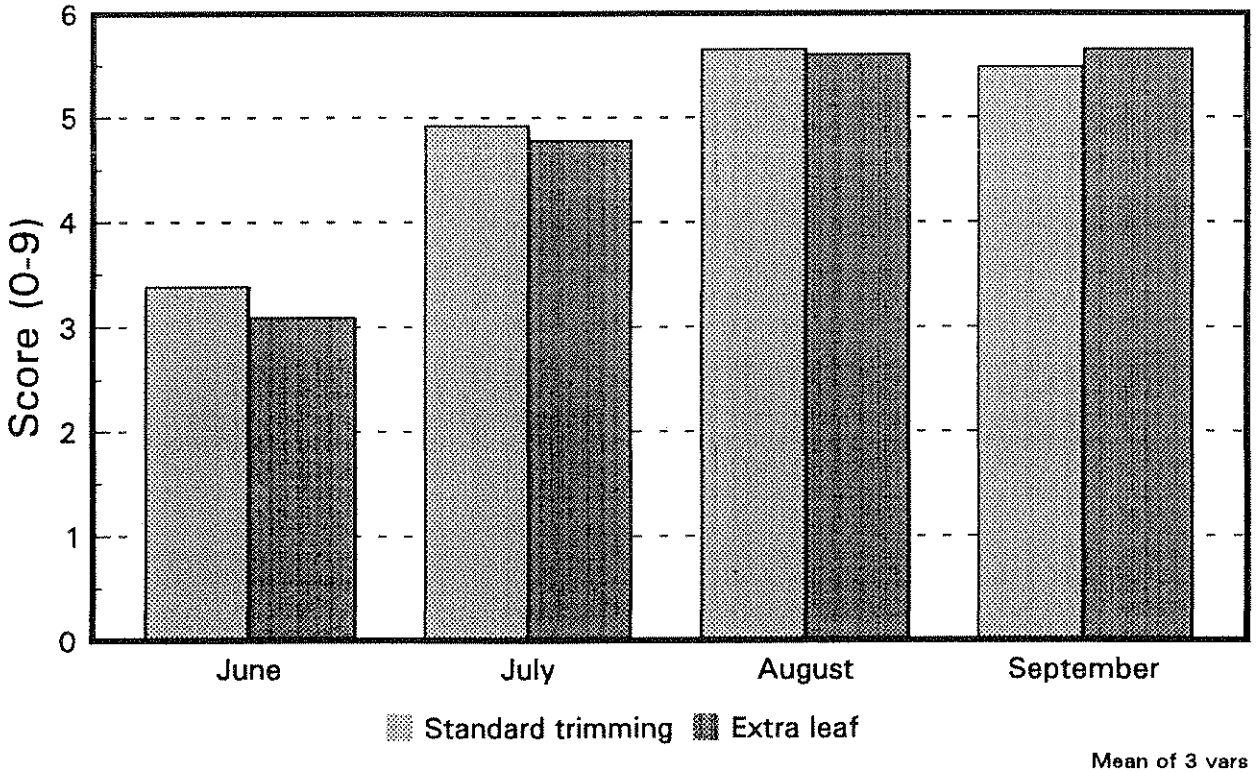
after 7 days



Mean of 3 vars

Fruit shine

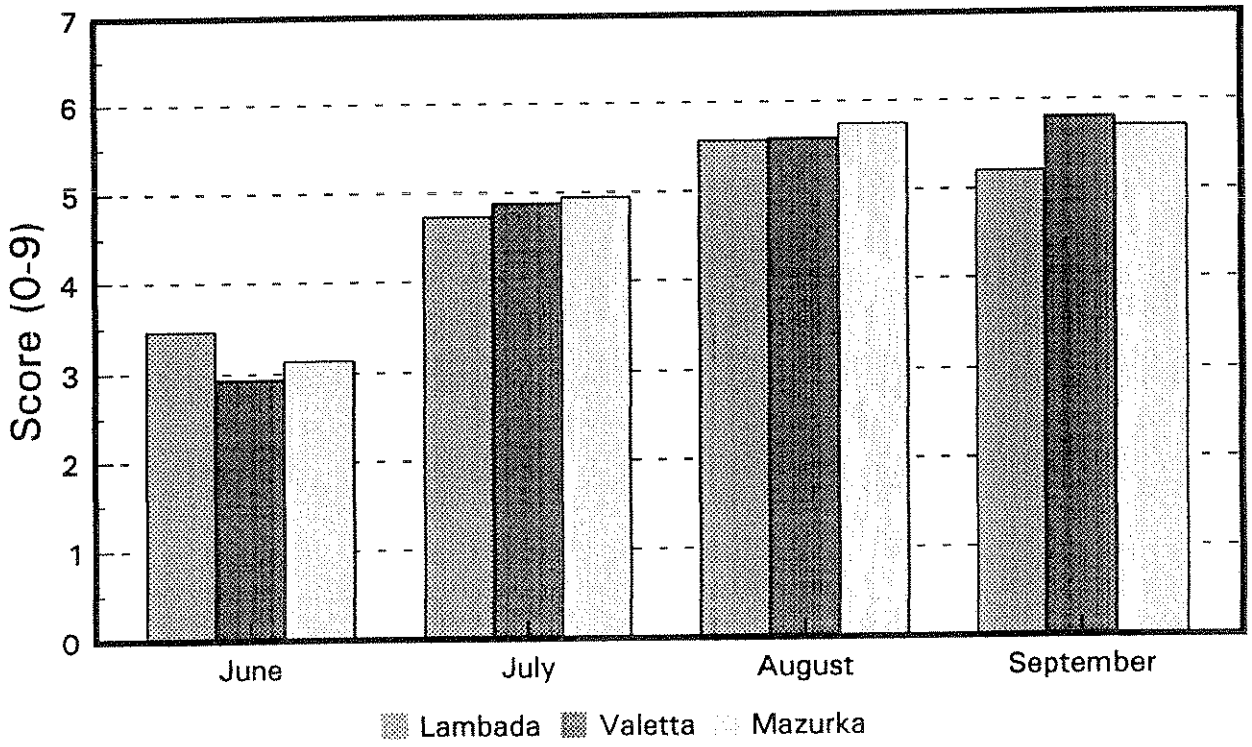
after 7 days



Mean of 3 vars

Fruit shine

after 7 days



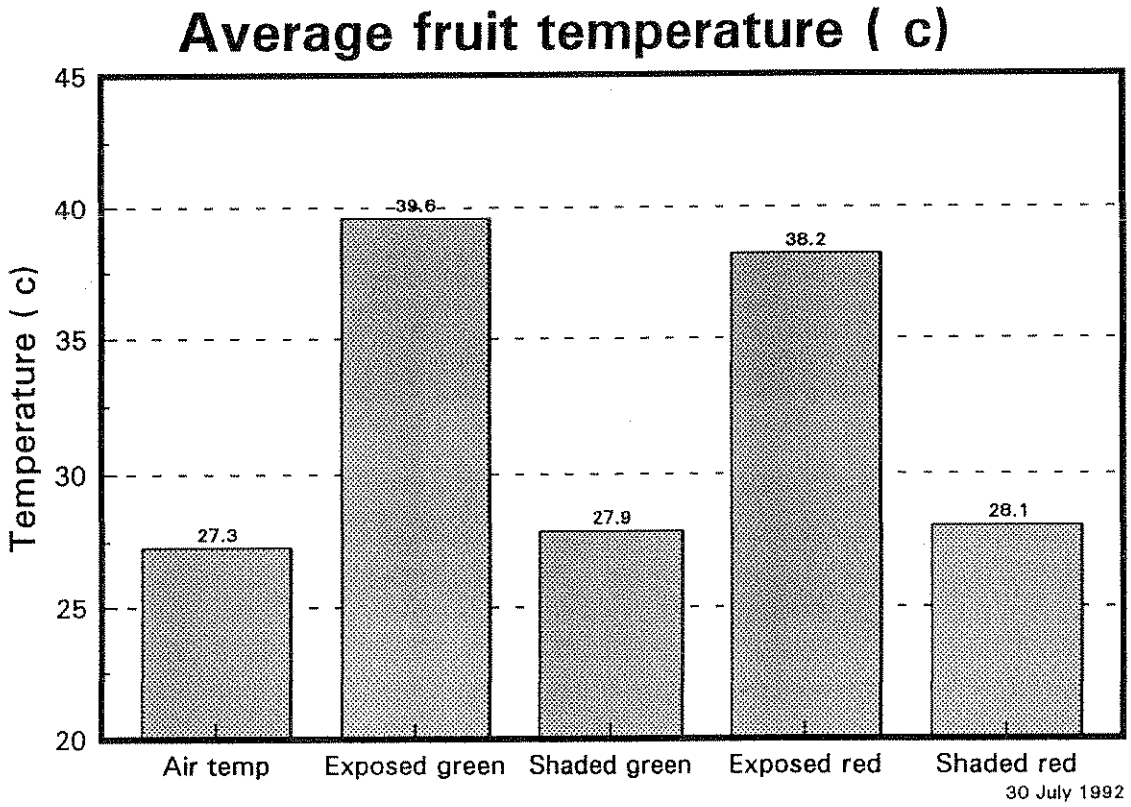
Fruit Temperature

Fruit temperatures were generally above air temperatures (Figure 10).

When irradiation was high the air temperature rose above 25°C. At this time measurements of fruit temperature showed that the temperature of shaded fruit was approximately 0.5-1°C above air temperature and exposed fruit could be more than 10°C above air temperature.

Green fruit tended to get warmer than red fruit. Fruit temperatures in excess of 40°C were recorded.

Figure 10: Average Fruit Temperature (°C)



Discussion

Irrigation Treatments

The effect of irrigation regime on total marketable yield was small, but as in 1991 the 'standard' day only irrigation regime gave the lowest yield. The application of extra water either during the day or at night gave some benefits but the rockwool reservoir system did not perform as well as the perlite reservoir that was used in 1991.

In June, when Blossom-end rot was severe and fruit expansion was rapid, the day and night regime and the reservoir system gave significantly more Class I fruit. In September however quality was reduced by the addition of extra water. This effect was also seen in the first year of the trial and suggests that additional irrigation should only be supplied when fruit is expanding rapidly and there is a high demand.

The addition of extra water either during the day or night tended to increase fruit size. Over the season as a whole these two treatments produced significantly less fruit under 75 mm diameter.

When BER was severe the standard day only irrigation regime produced most waste fruit. There was some reduction by applying extra irrigation in the day but night irrigation and the reservoir system had the biggest effect. Towards the end of the season the treatments with extra water produced more waste fruit.

Extra day irrigation and the reservoir system seemed to increase fine net cracking and this had other effects, such as extra weight loss and increased shrivelling during shelf life. Night watering generally decreased fine net cracking. Longitudinal cracking was also increased in these treatments.

Trimming

The trimming regimes aimed to improve fruit quality by shading fruit. Figure 10 shows effect of extra leaf on fruit temperature. The standard regime was not as severe as used by some growers in the early part of the season, so larger differences could be expected in those situations.

Leaving extra leaves had no significant effect on overall marketable yield but it did reduce production of very large fruit (>90 mm diameter). There was some evidence that leaving extra leaf reduced BER, possibly by shading and slowing fruit expansion rates. Not enough sun scorch was recorded in the trial, to fully evaluate the effect of extra leaf.

Extra leaf also reduced flecking on the fruit but seemed to have some detrimental effect on fine net cracking although levels were generally low.

These results suggest that benefits can definitely be gained by leaving extra leaf to shade the fruit during periods of high irradiance.

Varieties

Variety selection obviously plays a very important part in determining crop yield and quality.

In this trial Mazurka gave the highest yield and the highest percentage of Class I fruit. It tended to produce large fruit.

Waste fruit production was also lowest from Mazurka due to slightly lower levels of BER. Lambada and Valetta were similar in their susceptibility to BER.

Mazurka was less susceptible to fine net cracking than the other two varieties. Valetta produced most ears. Lambada was the sweetest variety but tended to be softest at harvest. There was more Class II fruit from Lambada.

Conclusions

1. Yield was lowest from the standard day irrigation regime and highest from the day and night regime.

2. Blossom-end rot was lower where extra leaves were left on each sideshoot. Flecking was also reduced but fine net cracking was slightly higher.

3. In May and June night watering and the reservoir system improved fruit quality but at the end of the season these treatments were not successful.

4. Extra day irrigation and the reservoir system increased fruit cracking and therefore decreased shelf life.

5. Night watering decreased fine net cracking.

6. Of the three varieties tested Mazurka produced the best yield and quality.

7. The results of this experiment suggest that the optimum growing regime to reduce BER and optimise fruit quality should include:

   i) The selection of a suitable variety, eg Mazurka.

   ii) The addition of extra leaves on each sideshoot to provide shading.

   iii) The addition of extra water, preferably at night, at times when fruit is expanding rapidly and load is high.

APPENDIX

Applied Irrigation (ml/plant/day)

DATE	Tmt A	Tmt B	Tmt C	Tmt D
15.4.92	1868	2114	2218	1868
16.4.92	1638	1887	1988	1638
17.4.92	961	1345	1311	961
18.4.92	2148	2406	2498	2148
19.4.92	1608	1897	1958	1608
20.4.92	1072	1553	1422	1072
21.4.92	1404	1719	1754	1404
22.4.92	1439	2102	1789	1439
23.4.92	1505	1942	1855	1505
24.4.92	2118	3140	2468	2118
25.4.92	1525	1921	1895	1525
26.4.92	2320	3576	2690	2320
27.4.92	2215	2249	2585	2215
28.4.92	2192	2524	2562	2192
29.4.92	1700	1761	2061	1691
30.4.92	1533	1842	1903	1533
1.5.92	2864	2671	3234	2864
2.5.92	1973	2130	2343	1973
3.5.92	1809	1831	2179	1809
4.5.92	2038	2361	2408	2038
5.5.92	1764	2559	2134	1764
6.5.92	434	1686	824	434
7.5.92	677	1147	1067	677
8.5.92	1357	1752	1747	1357
9.5.92	1046	1395	1436	1046
10.5.92	1278	1744	1668	1278
11.5.92	1150	1598	1540	1150
12.5.92	694	1122	1084	694
13.5.92	1800	2229	2236	1846
14.5.92	1561	1946	1951	1561
15.5.92	1171	1546	1561	1171
16.5.92	1504	2022	1894	1504
17.5.92	1339	1926	1729	1339
18.5.92	10341	10144	10731	10341
19.5.92	1009	1482	1399	1009
20.5.92	1137	1595	1527	1137
21.5.92	2315	2648	2705	2315
22.5.92	2141	2511	2531	2141
23.5.92	2284	2874	2674	2284
24.5.92	3784	4120	4174	3784
25.5.92	3784	4120	4174	3784
26.5.92	1974	2374	2364	1974
27.5.92	3800	4243	4161	3771
28.5.92	1558	2009	1948	1558
29.5.92	3431	3399	3821	3431
30.5.92	1625	1475	2015	1625
31.5.92	687	655	1077	687

Applied Irrigation (ml/plant/day)

DATE	Tmt A	Tmt B	Tmt C	Tmt D
1.6.92	2863	3067	3253	2863
2.6.92	1536	1928	1926	1536
3.6.92	2260	2930	2650	2260
4.6.92	969	1617	1359	969
5.6.92	967	1633	1357	967
6.6.92	3397	3994	3787	3397
7.6.92	3447	4095	3837	3447
8.6.92	1388	2383	1778	1388
9.6.92	2698	3455	3088	2698
10.6.92	3200	3353	3607	3217
11.6.92	3752	4189	4142	3752
12.6.92	3896	4231	4286	3896
13.6.92	3117	3668	3507	3117
14.6.92	1459	2268	1849	1459
15.6.92	2761	3233	3151	2761
16.6.92	2119	2638	2509	2119
17.6.92	2434	2954	2824	2434
18.6.92	964	1736	1354	964
19.6.92	1289	1536	1679	1289
20.6.92	1634	2211	2024	1634
21.6.92	1183	1597	1573	1183
22.6.92	5836	5638	6226	5836
23.6.92	4431	4930	4821	4431
24.6.92	5900	6102	6338	5948
25.6.92	7002	6416	7392	7002
26.6.92	5299	4978	5689	5299
27.6.92	1942	1850	2332	1942
28.6.92	4769	4960	5159	4769
29.6.92	4963	5457	5353	4963
30.6.92	1570	2491	1960	1570
1.7.92	1674	1612	2064	1674
2.7.92	1844	2305	2234	1844
3.7.92	1296	1609	1686	1296
4.7.92	1451	1773	1841	1451
5.7.92	2562	3027	2952	2562
6.7.92	2774	3448	3164	2774
7.7.92	1790	1911	2180	1790
8.7.92	1460	1761	1850	1460
9.7.92	1617	1767	2007	1617
10.7.92	2972	3431	3362	2972
11.7.92	1771	2082	2161	1771
12.7.92	3221	3412	3611	3221
13.7.92	2090	2352	2480	2090
14.7.92	2888	3066	3278	2888
15.7.92	2042	1874	2432	2042
16.7.92	2448	2623	2838	2448
17.7.92	1788	2183	2178	1788
18.7.92	1637	1962	2027	1637
19.7.92	3471	3526	3861	3471

Applied Irrigation (ml/plant/day)

DATE	Tmt A	Tmt B	Tmt C	Tmt D
20.7.92	1037	1074	1427	1037
21.7.92	2110	1882	2500	2110
22.7.92	2597	2376	2987	2597
23.7.92	1670	1795	2060	1670
24.7.92	2331	2535	2721	2331
25.7.92	1645	1934	2035	1645
26.7.92	1574	2011	1964	1574
27.7.92	2550	2599	2940	2550
28.7.92	1589	3336	1979	1589
29.7.92	1917	2663	2307	1917
30.7.92	2545	2719	2935	2545
31.7.92	1856	2313	2246	1856
1.8.92	1622	1387	2012	1622
2.8.92	1281	1678	1671	1281
3.8.92	1467	2038	1857	1467
4.8.92	1528	2169	1918	1528
5.8.92	1386	1869	1776	1386
6.8.92	2416	2546	2806	2416
7.8.92	1134	1647	1524	1134
8.8.92	939	1541	1329	939
9.8.92	939	1541	1329	939
10.8.92	1990	1539	2380	1990
11.8.92	1164	1645	1554	1164
12.8.92	4111	4615	4501	4111
13.8.92	1461	1715	1851	1461
14.8.92	1679	2052	2069	1679
15.8.92	2106	2332	2496	2106
16.8.92	1587	2226	1977	1587
17.8.92	2103	2503	2493	2103
18.8.92	1283	1929	1673	1283
19.8.92	1281	2393	1671	1281
20.8.92	1379	1958	1769	1379
21.8.92	3979	4097	4369	3979
22.8.92	1115	1732	1505	1115
23.8.92	1565	2015	1955	1565
24.8.92	2445	2915	2835	2445
25.8.92	1420	1879	1810	1420
26.8.92	834	1358	1224	834
27.8.92	1031	1440	1421	1031
28.8.92	1172	1570	1562	1172
29.8.92	1483	1898	1873	1483
30.8.92	1327	1958	1717	1327
31.8.92	1897	2325	2287	1897
1.9.92	2528	2843	2918	2528
2.9.92	958	1474	1348	958
3.9.92	1634	2009	2024	1634
4.9.92	1433	2239	1823	1433
5.9.92	1452	1923	1842	1452
6.9.92	945	1456	1335	945

Applied Irrigation (ml/plant/day)

DATE	Tmt A	Tmt B	Tmt C	Tmt D
7.9.92	1819	2233	2209	1819
8.9.92	1084	1551	1474	1084
9.9.92	963	1456	1353	963
10.9.92	1161	1579	1551	1161
11.9.92	1255	1668	1645	1255
12.9.92	1550	1796	1940	1550
13.9.92	792	1476	1182	792
14.9.92	1085	1593	1475	1085
15.9.92	1088	1588	1478	1088
16.9.92	1326	1797	1716	1326
17.9.92	909	1347	1299	909
18.9.92	2493	2606	2883	2493
19.9.92	600	1231	990	600
20.9.92	1090	1591	1480	1090
21.9.92	719	1249	1109	719
22.9.92	737	1267	1127	737
23.9.92	807	1498	1197	807
24.9.92	894	1345	1284	894
25.9.92	899	1190	1289	899
26.9.92	942	1377	1332	942
27.9.92	673	1203	1063	673
28.9.92	1130	1696	1520	1130
29.9.92	960	1541	1350	960
30.9.92	693	1346	1083	693
1.10.92	878	1172	1268	878
2.10.92	649	1107	1039	649
3.10.92	780	1370	1170	780
4.10.92	839	1339	1229	839
5.10.92	720	1222	1110	720
6.10.92	722	1240	1112	722
7.10.92	717	1203	1107	717
8.10.92	1022	1424	1412	1022
	999.875	1478.087	1389.875	999.875

Figure 11

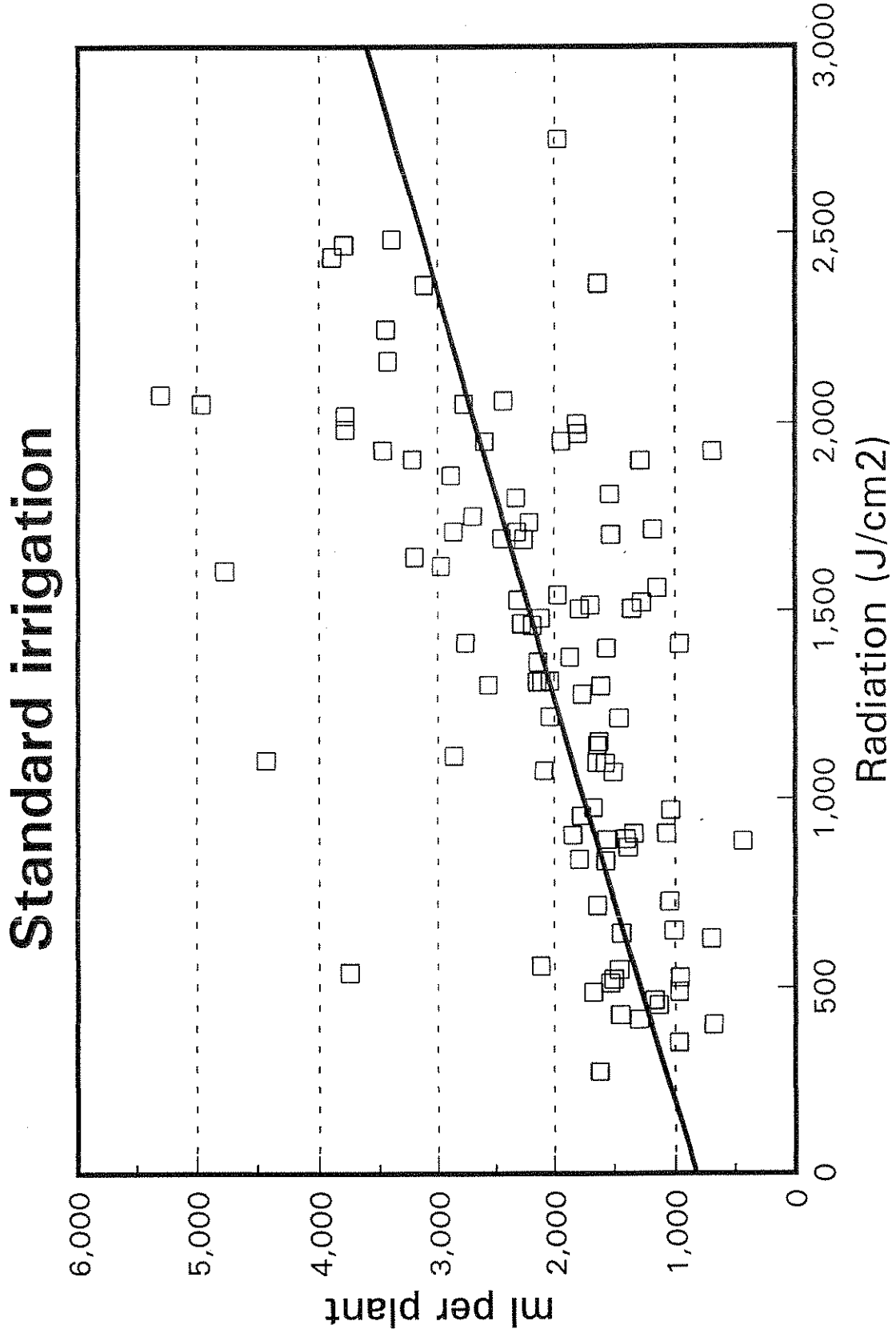
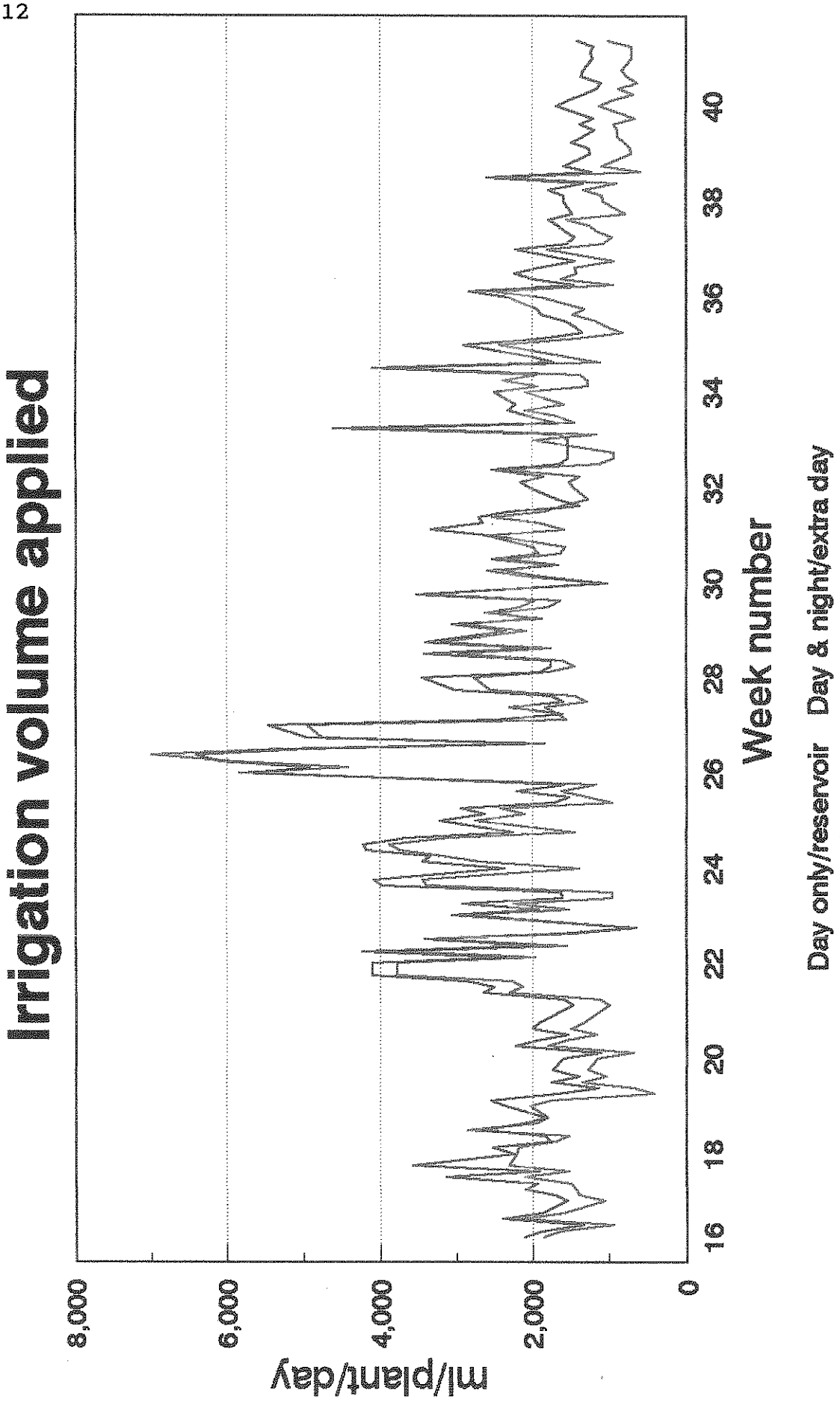

Standard irrigation
ml per plant
6,000
5,000
4,000
3,000
2,000
1,000
0
0
500
1,000
1,500
2,000
2,500
3,000
Radiation (J/cm2)

Figure 12


Irrigation volume applied
ml/plant/day
8,000
6,000
4,000
2,000
0
16
18
20
22
24
26
28
30
32
34
36
38
40
Week number
Day only/reservoir
Day & night/extra day