HORTICULTURE RESEARCH INTERNATIONAL

EFFORD

Report to: Horticultural Development Council
18 Lavant Street
Petersfield
Hants GU32 3EW

Tel: 0730 263736
Fax: 0730 265394

HRI Contract Manager: Miss M A Scott
HRI Efford
Lymington
Hampshire SO41 0LZ

Tel: 0590 673341
Fax: 0590 671553

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CONTRACT REPORT

Tomatoes: An assessment of the Nitrate and Chloride salts of Potassium and Calcium; their effects on yield and fruit quality

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PRINCIPAL WORKERS

Dr D J Hand BSc (Hons), PhD, M.I. Hort (co-author of report)	Technical Officer
Mr M Fussell BSc (Hons) (Co-author of report)	Scientific Officer
Mrs S Foster	Scientific Officer
Miss S Horsley	Assistant Scientific Officer
Miss N Collins	Sandwich Student
Mr C Vigor	Nursery Staff
Mr P DeVries	Nursery Staff
Mr K Herridge	Nursery Staff
Mr J Webb	Nursery Staff
Mr M Pearce	Nursery Staff
Mr M Reay	Computer Systems Maintenance
Mr R H Edmondson MSc (HRI-Littlehampton)	Statistician

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 .... Margaret Scott
Deputy Head of Station

Date 21/5/93

Report authorised by ....
Signature

M R Shipway
Head of Station

HRI Efford
Lymington
Hants
SO41 0LZ

Date 21/5/93

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ACKNOWLEDGEMENTS

The authors would like to thank Dr Nigel Dungey (HDC project coordinator) for the provision of feed recipes used throughout this study. Advice on the costings presented in the "Relevance to Growers and Practical Application" section and the associated water use figures were kindly given by Mr Gerry Hayman.

RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

The commercial objectives of this study were two fold. Firstly, to evaluate the materials Calcium Nitrate, Calcium Chloride and Potassium Chloride as alternatives to Potassium Nitrate in the nutrition of a long season tomato crop. Secondly, to quantify their effects on fruit physical characteristics and shelf life and based on these data undertake a cost benefit analysis.

Neither yield or overall fruit quality were influenced by these materials as used within the scope of this study. Clearly therefore, the opportunity to incorporate these materials more widely into 'standard' feed recipes will be dictated by cost and other local practices.

The specific regimes evaluated are detailed in Table 1 and points to note are the varying K and Ca levels in the applied feeds and the reduced N levels where chlorides were utilised.

Table 1

Composition of the background and final applied feed

Element (mg/litre)	Background	Potassium		Calcium	
		Nitrate	Chloride	Nitrate	Chloride
EC (μS)	1700	2800	2800	2800	2800
N	210	295	210	295	210
NH_4	7	7	7	7	7
P	31	31	31	31	31
K	293	510	510	293	293
Ca	170	170	170	280	280
Mg*	50	50	50	50	50
Na	23	23	23	23	23
Cl	35	40	250	40	250
Fe	2.0	2.0	2.0	2.0	2.0
Mn	0.5	0.5	0.5	0.5	0.5
Cu	0.1	0.1	0.1	0.1	0.1
Zn	1.0	1.0	1.0	1.0	1.0
B	0.4	0.4	0.4	0.4	0.4
K/N		1.7	2.4	1.0	1.4
K/Ca		3.0	3.0	1.0	1.0

* Mg increased to 70mg/l until week 14.

Application of the treatments commenced on the 11 February, eleven days prior to first fruit pick. As stated above there were no 'statistically' significant differences in yield or the % Class 1 fruit. However, at 48.23 kgm^{-2} the use of Potassium Chloride increased the yield on average, by 2.4 kgm^{-2} to the final pick (2 October 1992). Monetary returns were therefore increased by an average of £1.27 m^{-2} to £25.94 m^{-2} for this treatment (monetary returns based on average class I and II prices as published in the Grower). This increase was again not 'statistically' significant within the context of this study.

Gold Spot was generally recorded at a higher level where Calcium salts had been added to the 'background' feed. From week 20 there was a tendancy for fruit grown with additional Calcium Chloride to produce marginally softer fruit; these two observations may be linked.

When considering cost the simplest approach may be to calculate the cost per unit of nutrient from the different sources and then, based on total crop water use, calculate the total cost.

Typical water use figures for 1992 were:

Rockwool (run to waste)	-	**1400 litres/m^{-2}**
NFT	-	**750 litres/m^{-2}**

Therefore using potassium in rockwool:

$KN0_3$ = 38.2% K : 1kg/1000 litres = 382 mg/l K
KCl = 50.2% K : 1kg/1000 litres = 502 mg/l K
Price:
$KN0_3$ = £29.72/100 kg = 29.7 p/kg = 77.7 p/kg K
KCl = £17.00/100 kg = 17.0 p/kg = 33.9 p/kg K

Therefore per kg of K; Potassium Chloride is less than half (43.6%) the price of Potassium Nitrate.

Example:

Assuming a target in the applied feed of 400 mg/litre.

Using **KNO_3** : 1.466 kg/1400 litres (applied feed/m^{-2}) gives 400 mg/litre and costs 43.5p/m^{-2}.
Therefore **14,660 kg/ha costs £4,354**.

Using **KCl** : 1.116 kg/1400 litres gives 400 mg/litre and costs 19.0p/m^{-2}.
Therefore **11,160 kg/ha costs £1,897**

Using Calcium in rockwool:

$Ca(NO_3)_2$ = 19% Ca : 1kg/1000 litres = 190 mg/l Ca
$CaCl_2$ = 29% Ca : 1kg/1000 litres = 290 mg/l Ca
Price:
$Ca(NO_3)_2$ = £16.48/100 kg - 16.48p/kg = 86.7p/kg Ca
$CaCl_2$ = £15.78/100 kg = 15.78p/kg = 54.4p/kg Ca

Therefore per kg of Ca; Calcium Chloride is 62.7% the cost of Calcium Nitrate.

Example:

In this worked example the price per additional 100 mg/litre above the background level has been calculated.

Using **$Ca(NO_3)_2$** : 0.736 kg/1400 litres gives an additional 100 mg/litre Ca and costs 12.1p/m^{-2}.
Therefore **7,360 kg/ha costs £1,210**.

Using **$CaCl_2$** : 0.483 kg/1400 litres gives an additional 100 mg/litre Ca at a cost of 7.6p/m^{-2}.
Therefore **4,830 kg/ha costs £760**.

Clearly, which materials are used and their relative proportions will be subject to local practice. In soft water areas for example the use of Calcium Chloride will serve to reduce the input of ammonium via Calcium Nitrate and thus reduce the incidence of blossom end rot. However, hopefully these figures will act as a guide from which a number of options may be calculated.

A secondary objective of this study was to assess the potential for reducing nitrate input to the crop. However, with target levels in the applied feed of 295 mg/litre (Nitrate salts) and 210 mg/litre (Chloride salts) Nitrate levels in the 'Chloride' treatments were still higher than a number of commercial crops. This aspect of the study will be fully evaluated in 1992/93 when N levels in the applied feed will be 65, 125, 165 and 247 mg/litre.

EXPERIMENTAL SECTION

SUMMARY

Work done at Efford during the 1991-1992 cropping season evaluated the materials Calcium Chloride, Calcium Nitrate and Potassium Chloride as substitutes for Potassium Nitrate in the nutrition of a long season tomato crop. The effects of these materials on yield, fruit quality and shelf life characteristics were quantified.

A long season tomato crop (*Lycopersicon esculentum Mill*) cv Calypso was sown on the 28 October 1991. Propagation and subsequent early growth was standard throughout and followed current commercial practice. Nutrient treatments commenced on 11 February 1992, eleven days before the first fruit were picked.

To the end of the season (2 October 1992) the highest yield was recorded where the 'background' feed had been augmented with Potassium Chloride (48.23 kgm^{-2}) although this was shown not to differ significantly from the other treatments which, on average, yielded 2.4 kgm^{-2} less. Overall fruit quality was similarly unaffected. Differences between treatments with respect to fruit size were evident during the early part of the season. The use of Potassium salts increased the proportion of D grade fruit (47-57 mm diameter) and consequently reduced the number of E's (40-47 mm diameter). However, these differences may be attributable to differences in the conductivity of the root zone and therefore results should be interpreted with caution.

The incidence of Gold Spot on the fruit was generally higher where Calcium salts had been used to augment the background, and there was an indication that at points throughout the season this may have been detremental to fruit shelf life.

INTRODUCTION

Tomato fruit quality has, and continues to be a topic attracting a great deal of attention from both the industry and consumer alike. A considerable body of information has been accumulated on the influence of variety and the glasshouse environment on fruit quality. Crop nutritional data however, is largely confined to the effects of raising the conductivity of feed solutions using either additional macro nutrients or Sodium Chloride. With the increased availability of alternatives to Potassium Nitrate it was felt important in the first year of this project to evaluate their potential for manipulating fruit quality and yield.

With increasing environmental awareness and possible legislation pending, a significant adjunct to this study was the possibility to both enhance fruit quality and simultaneously reduce the use of nitrates. Two EC directives already exist which will have a direct impact on glasshouse production. The ***Drinking Water Directive*** which sets a maximum admissible NO_3 level for the latter of 50 mg/litre (11.3 mg/litre NO3-N) and the ***Nitrate Directive*** which also addresses nitrate levels in surface and ground water. In Holland, growers are working towards achieving their ***Multi Year Crop Protection Plan*** **(MYCPP)** which stipulates that 80% of glasshouse vegetable production be based on closed systems by 1995 and 100% by the year 2000.

Furthermore, the use of alternatives to Potassium Nitrate may result in a nett saving to the grower, due to the present price differential.

Nutritional manipulation of the type described here in association with strategies to reduce the percentage run off, may offer valuable alternatives to the grower pending comprehensive assessment of recirculation techniques within the U.K.

OBJECTIVES

The commercial objectives of this study were therefore largely two fold. Firstly, to evaluate the efficacy of alternatives to Potassium Nitrate as a means of achieving desired conductivity levels. Secondly, to quantify their effects on fruit physical characteristics and shelf life.

MATERIALS AND METHODS

Site details

The trial was done at HRI Efford utilising one quarter of the P-Block facility. The layout of the trial is illustrated in Appendix I, Page 36.

Treatments

In addition to Potassium Nitrate; Potassium Chloride, Calcium Nitrate and Calcium Chloride were evaluated in the study described here.

Mixing and subsequent application of the nutrient treatments to the desired experimental plots was achieved using equipment specially commissioned for this purpose.

The system facilitated the mixing of a 'background' feed to an EC of 2300 μS @ 25°C. The components of the 'background' feed are listed in Table 1; a typical recipe to achieve the same is given in Appendix II, page 37.

The background feed was then split across four further tanks, each of which was then augmented with one of the four materials under study to a final EC of 2800 μS @ 25°C (Table 1). Application of these feeds to their respective plots was on the basis of light (per 100J/cm^2) or fixed time.

Cultural techniques

Seeds of tomato (*Lycopersicon esculentum Mill*) cv Calypso were sown on 28 October 1991, in rockwool multiblocks (40 x 40 x 40 mm) which had been wetted up the day before using feed solution with a pH of 5.0 and an EC of 1500 μS. Following germination the EC was raised to 2500 μS coincident with expansion of the cotyledons. Prior to blocking on, eleven days after sowing, the 0.65 litre rockwool blocks were wetted up with feed at pH 5.0 and an EC of 2500 μS, the aim being to achieve a stable block pH of c.6.0.

From blocking on to the time taken for the third true leaf to reach 10 mm in length, the EC of the applied feed was raised from 2,500 to 3,500 μS. The EC was then raised to its final level of 5,000 μS in preparation for slab contact.

Modified 'Blueprint' temperatures were applied throughout propagation.

The 'Blueprint regime'

Stage	**Target Air temperatures°C**		
	Day	Night	Vent
0. Sowing to Germination (4 days)	24	24	26
1. Germination to blocking on	20	20	24
2. Blocking on until 1st visible bud	20	16	24

The CO_2 level in the glasshouse was raised from ambient to 1,000 vpm (sunrise to sunset; using pure CO_2).

Following slab contact plants were strung to a 3 metre crop wire and layered on reaching wire height. In all respects crop management followed best commercial practice.

Pest and disease control

A number of beneficial insects were routinely introduced to combat the major tomato pests.

Predator	**Introduction frequency**	**Prey**
Encarsia formosa	Weekly	Whitefly
Dacnusa spp.	Weekly	Leaf Miner
Aphidius spp.	Weekly	Aphids

Fungicides were restricted to a minimum in line with current commercial practice, those applied are listed in Appendix III, page 38, along with a full crop diary.

Assessments

The following records were taken throughout the course of the study.

- Date of first and sixth anthesis, first and sixth fruit pick, number of fruit set and the number of marketable fruit on trusses 1-15 for four plants per plot.
- Graded and total marketable yield, percentage Class 1 fruit.
- Assessment of tomato fruit quality; including physical fruit appearance, shelf life studies and fruit sugar and acid levels.
- Daily monitoring of root zone pH and conductivity for all nutrient regimes.
- Routine analyses of applied feed and slab solution for nutritional content.
- Monthly analyses of leaf and fruit tissue for mineral content.
- Photographic record of crop development.
- Full monitoring of the glasshouse aerial environment.
- Additional assessments as required, eg. the incidence of Blossom End Rot.

Experimental design and explanation of statistical terms.

Each treatment was replicated four times (refer to trial plan, Appendix I, page 36). A balanced row and column design (Latin square) enabled the experimental data to be subjected to a full analysis of variance and hence assign statistical significance to any treatment differences.

Throughout the main body of this report and selected appendices a number of statistical terms are referred to; these are:

SED = The standard error of the difference when comparing two means in that column of data.

A statistical term easier to interpret:

LSD 5% = The least (minimum) difference when comparing any two figures within a given column that is required for those figures to be statistically different.

N.S. = Not significant.

* = P <0.05, ie. the probability of this result occurring by chance is equal to or less than 1 in 20 (0.05 = 5%).

** = P <0.01, ie. the probability of this result occurring by chance is equal to or less than 1 in 100 (0.01 = 1%).

*** = P <0.001, ie. the probability of this result occurring by chance is equal to or less than 1 in 1000 (0.001 = 0.1%).

Fruit Quality and Shelf Life Assessments

Tomatoes were sampled from those picked for sale prior to grading. Samples were taken fortnightly from week 12 to 38.

Disorder Assessments

Ten fruit were sampled at random from each plot and each fruit assessed for the following disorders.

Boxiness (hollow fruit)
Slab-sideness
Ribbing
Nippling
Netting (fine net cracking)
Radial Cracking
Gold Spot (calyx end)
gold Marbling (flecking - blossom end)
Blotchy Ripening
Red Noses

Disorders were scored from 0 (none present) to 4 (severe) for the 10 fruit, from which a mean was calculated for each plot.

Shelf Life Assessments and Chemical Analysis

Tomatoes were selected that fulfilled the following criteria.

Class 1 fruit
ATB Colour stage 4
Size D

Normally 10 fruit were selected. However when fruit picks were small or when fruit did not fulfil the above criteria, fewer fruit were selected or Size C or E fruit included.

Tomatoes were passed through a handling simulator (500-600 mm drop) and placed in plastic trays in the shelf life room where they remained for 6 days. The shelf life room was maintained at around 20°C and 50-60% Relative Humidity, with 12 hours of fluorescent lighting per day.

RESULTS

Flowering and fruit set

The time taken to 1st and 6th anthesis, 1st and 6th fruit pick, along with the number of fruit set and the number of marketable fruit on the first fifteen trusses were unaffected by the nutrient regime. These data are presented in Appendix IV pages 39 to 44.

Yield, gradeout and monetary returns

There were no significant differences in total yield or the percentage of Class 1 fruit to the end of May or September when comparing the four nutrient regimes. However, a trend was evident suggesting marginally higher yields from the Potassium Chloride treatment (Tables 2 and 3, pages 15 and 16). The same trend was therefore present when calculating monetary returns (£m^{-2}). Gradeout to the end of May was significantly influenced by the treatments. The use of Potassium Nitrate or Chloride increased the proportion of D grade fruit ($P<0.01$) and consequently decreased the number of E's ($P<0.001$). This effect was most marked when using Potassium Chloride, and is most likely to account for the increased yield to the end of May recorded for this treatment (Table 2). Differences in gradeout were not evident to the end of September. A full analysis of monthly data can be found in Appendix V pages 45 to 49.

The sample of fruit for each plot was weighed at the beginning and end of the 6 day shelf life period and the percentage weight loss calculated for the plot.

At the end of the shelf life period, the calyx was removed from each individual fruit before measurement of its compression (mm) under a 1kg load in a firmness meter. A mean compression was calculated for each plot.

Fruit were taken at the end of the shelf life assessments and divided for dry weight determination and conductivity, acidity and soluble solids determinations.

% Dry Weight: For each plot, quarters from each of 5 fruit were placed in a tray, weighed and then dried in a oven at 60°C for 3 days. The samples of fruit were weighed again and the percentage dry matter calculated taking into account the percentage weight loss during shelf life.

% Soluble Solids: The remaining tomatoes not used in the dry matter determinations were placed in plastic bags (one for each plot) and frozen. After thawing, fruit was pulped by hand and filtered for 2 hours to separate the juice. Two measurements of percentage soluble solids of the juice were made for each plot using a sugar refractometer (range 0-10% Brix) and an average taken. Readings were adjusted according to the temperature of the solution.

Conductivity μS: Measurements of the electrical conductivity of the juice were made using a hand held probe.

Acidity: This was determined by dissolving 0.38g tri-sodium orthophosphate ($Na_3PO_4.12H_2O$) in 20ml filtered juice. After 10 minutes the endpoint pH was measured with a hand held pH meter.

Table 2

Effect of nutritional regime on total yield (kg/m^{-2}), gradeout and crop monetary return (£m^{-2}) to the end of May

Treatment	kg/m^{-2}	% Class 1	% C's >57mm	% D's 47-57mm	% E's 40-47mm	£m^{-2}
Potassium Nitrate	14.64	86	9	70	21	11.25
Potassium Chloride	15.43	86	9	73	18	11.84
Calcium Nitrate	14.76	86	10	66	23	11.33
Calcium Chloride	14.42	88	7	67	26	11.09
SED (d.f= 6)	*0.368*	*0.9*	*1.3*	*1.3*	*0.8*	*0.346*
LSD 5%	*0.900*	*2.4*	*3.2*	*3.2*	*1.9*	*0.846*
Significance	*N.S.*	*N.S.*	*N.S.*	**	***	*N.S.*

Table 3

Effect of nutritional regime on total yield (kg/m^{-2}), gradeout and crop monetary return (£m^{-2}) to the end of September

Treatment	kg/m^{-2}	% Class 1	% C's >57mm	% D's 47-57mm	% E's 40-47mm	£m^{-2}
Potassium Nitrate	46.23	89	15	72	13	24.80
Potassium Chloride	48.23	89	16	74	10	25.94
Calcium Nitrate	45.75	88	15	70	14	24.54
Calcium Chloride	45.55	90	16	71	12	24.67
SED (d.f= 6)	*1.566*	*1.4*	*1.1*	*2.3*	*1.9*	*0.735*
LSD 5%	*3.832*	*3.4*	*2.7*	*5.6*	*4.6*	*1.798*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Fruit Quality

Disorder assessments

The results of the fortnightly disorder assessments are tabulated in Appendix VI, pages 50 and 56.

Gold Spot: High levels of this disorder were recorded, especially in weeks 24 to 28. (Figure 1, page 20). Gold Spot was the only disorder to show marked differences when comparing treatments. Higher levels of Gold Spot were consistently found where Calcium salts were used to augment the background feed. Differences between the Calcium and Potassium treatments were significant in weeks 20, 22 and 24 and in week 28 the Calcium Chloride treatment produced significantly higher levels of Gold Spot than all other treatments. The lowest levels of Gold Spot were usually found in fruit from the Potassium Nitrate treatment.

Other disorders: (Refer to Appendix VI pages 50 to 56). Levels of **Gold Marbling** were low in all treatments with no consistent differences. The highest levels were frequently found in the Calcium treatments, however, in week 30 the Potassium treatments showed significantly higher levels of Gold Marbling than those with Calcium ($P<0.05$).

Moderate levels of **Boxiness, Slab-sidedness** and **Ribbing** were recorded at the start of the season (Figures 2, 3 and 4 pages 21 to 23). Slabsidedness was also recorded at high levels late in the season. Differences between treatments were largely inconsistent. However, in week 16 significantly higher levels of Boxiness were recorded in the Potassium than in the Calcium treatments ($P<0.01$).

Levels of **Nippling** were consistently low for all treatments. The incidence of **Radial Cracking, Netting and Red Noses** were also generally low up until week 38, when high levels of Netting in particular were recorded for some treatments, however, differences were not significant.

Blotchy Ripening was common from week 22 in all treatments but differences between treatments were neither consistent nor significant.

Shelf Life and Internal Composition

The results of the shelf life assessments and internal composition determinations are tabulated for each week in Appendix VII, pages 57 to 63.

Compression: Fruit from the Calcium Chloride treatment were found to be significantly firmer than fruit from the two Potassium treatments in week 18. (Figure 5, $P<0.05$). However, from week 20 onwards there was a tendency for the Calcium Chloride treatment to produce the softest fruit; through these differences were not statistically significant.

Weight loss during shelf life: There were no consistent differences between treatments. In week 32 the Calcium Nitrate treatment showed significantly lower weight loss than other treatments ($P<0.05$). The lowest mean percentage weight loss was 2.08% from the Potassium Chloride treatment in week 28.

Endpoint pH: Differences between treatments were neither significant or consistent. The lowest mean endpoint pH (most acid) was 7.27 from the Calcium Chloride treatment in week 36.

Soluble solids content: Overall there were no significant or consistent differences when comparing treatments. However, the increased percentage soluble solids measured for the Calcium Chloride treatment in week 14, were significantly higher than those for Potassium Chloride. ($P<0.05$; Figure 6 page 25 and Appendix VII, page 57). However, this may be attributed to higher slab EC's for this treatment early in the season; (see discussion and the associated figure 10, page 31. The highest mean percentage soluble solids was 5.14% from the Potassium Chloride treatment in week 34.

Juice conductivity: Whilst significant differences between treatments were found in weeks 20 and 32 ($P<0.05$ and $P<0.01$), there was no consistent trend (Figure 7, page 26). In week 20 the Chloride salts resulted in juice with the highest EC (4705 and 4653 μS for Calcium and Potassium respectively) in contrast to Potassium Nitrate for week 32 (5275 μS). The highest mean conductivity was 5803 μS from the Potassium Chloride treatment in week 34.

Dry Matter content: Differences between treatments were neither significant nor consistent (Figure 8, page 27). The highest mean percentage dry matter was 6.80% from the Potassium Nitrate treatment in week 30.

Figure 1.
Effect of nutrient regime on the incidence of Gold Spot

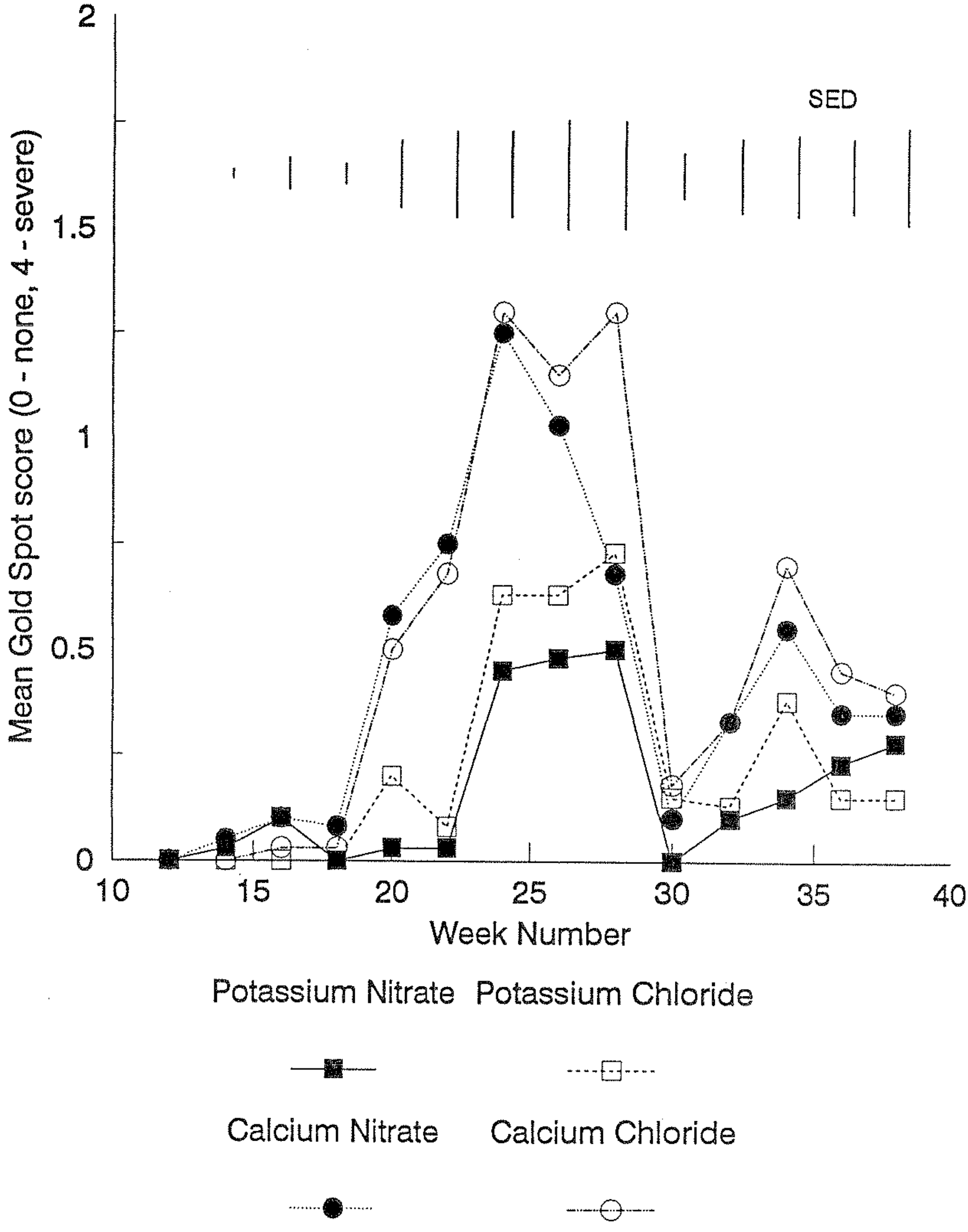


Figure 2.
Effect of nutrient regime on the incidence of Boxiness

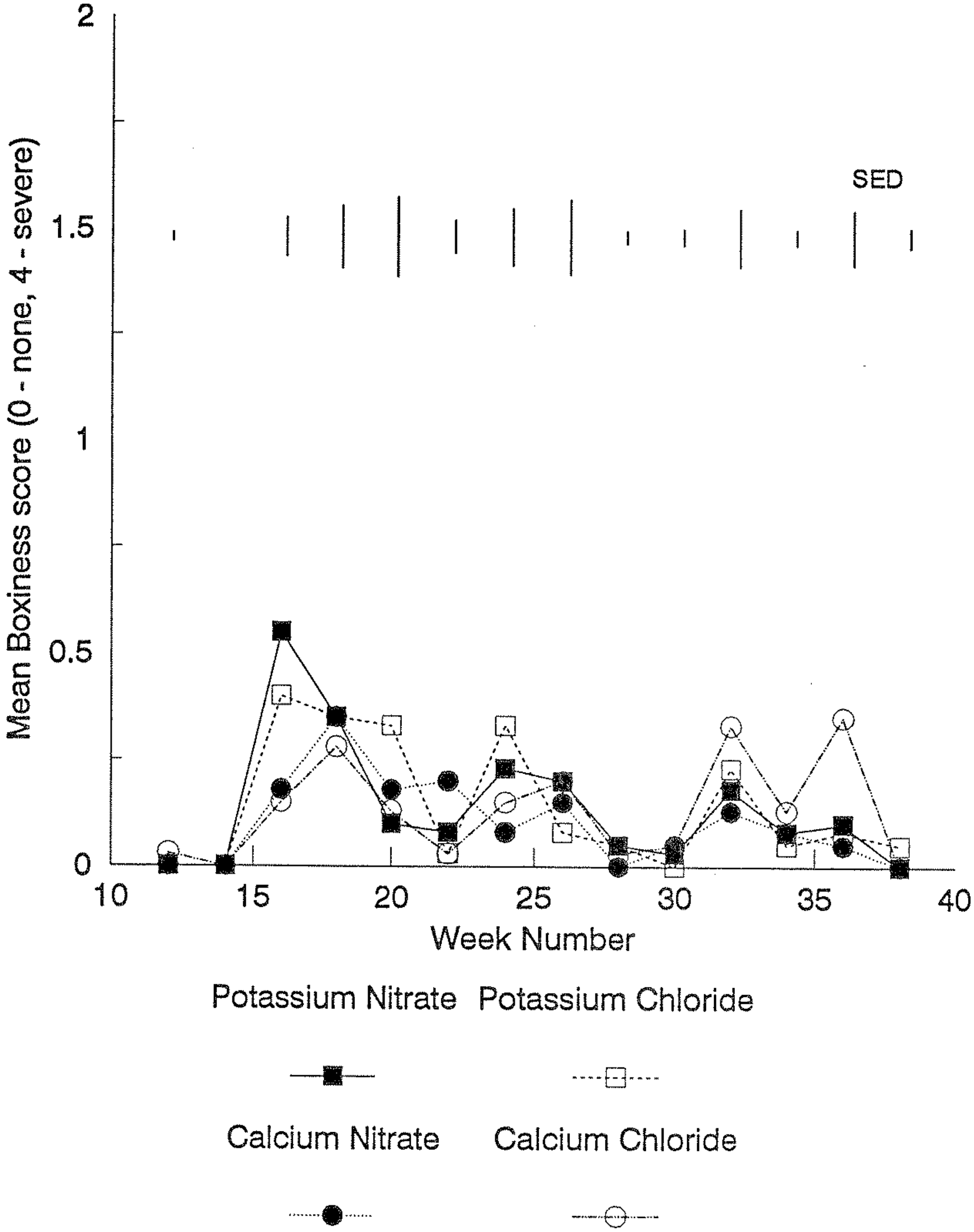


Figure 3.
Effect of nutrient regime on the incidence of Slab-sidedness

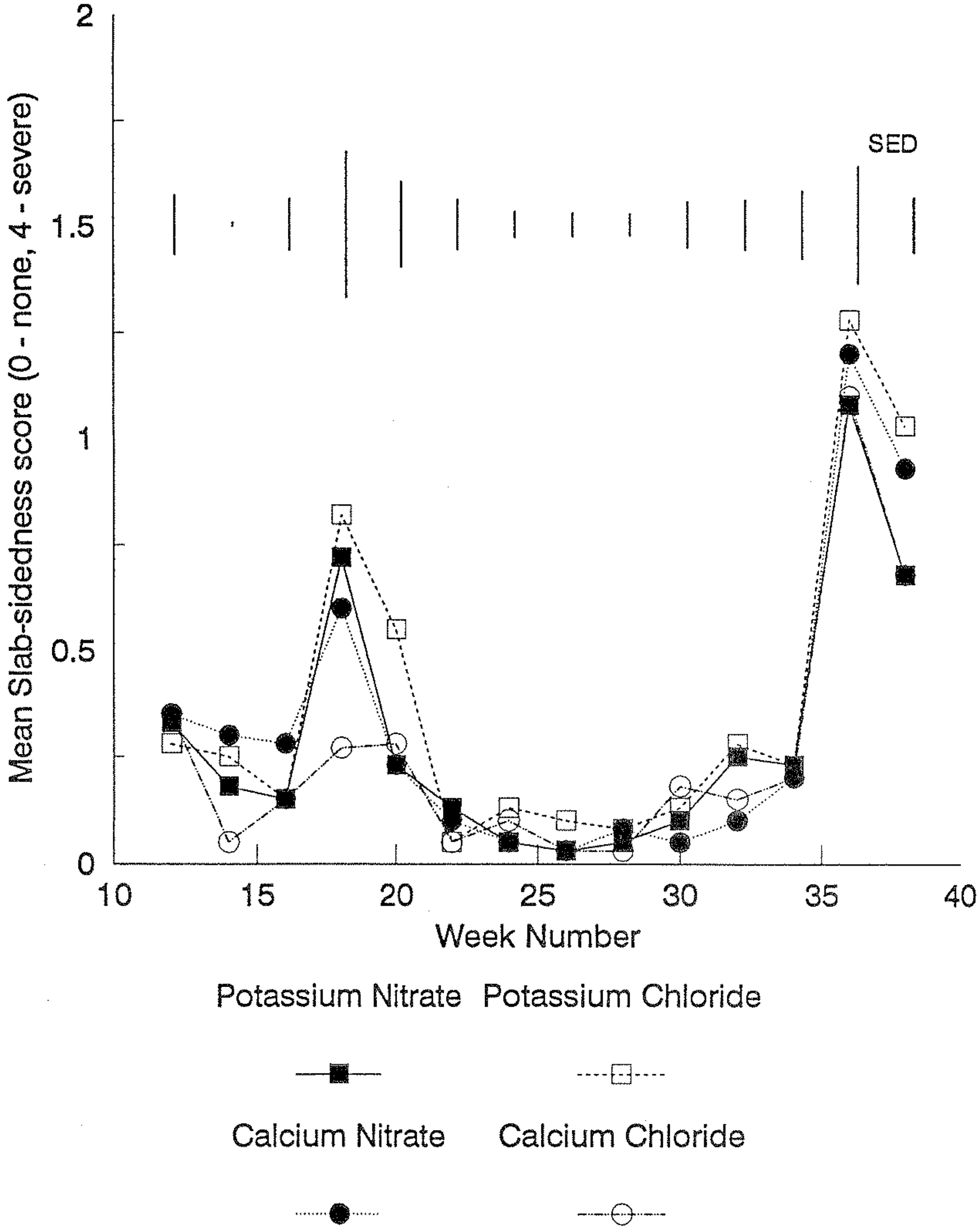


Figure 4.
Effect of nutrient regime on the incidence of Ribbing

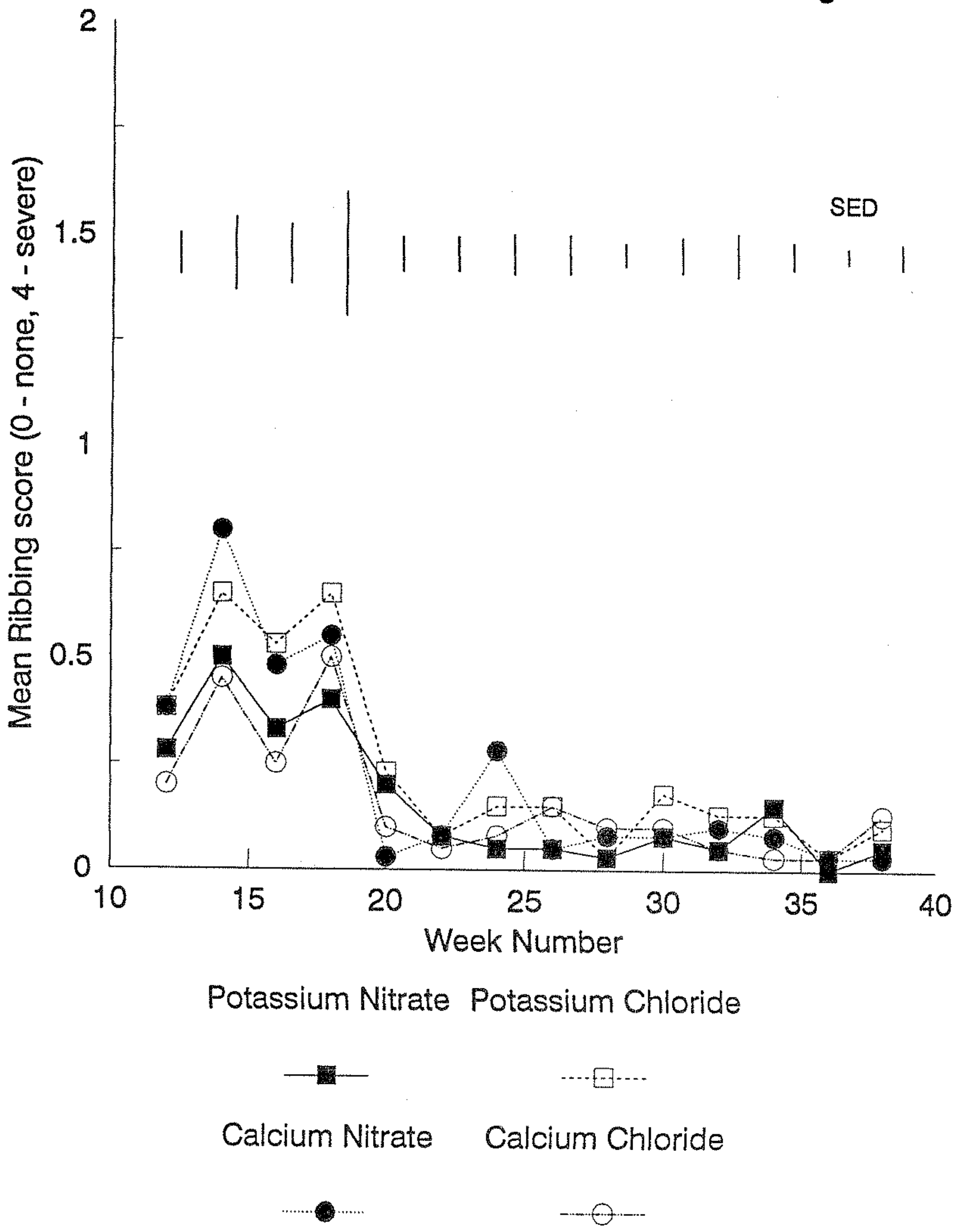


Figure 5.
Effect of nutrient regime on Compression after 6 days of shelf-life

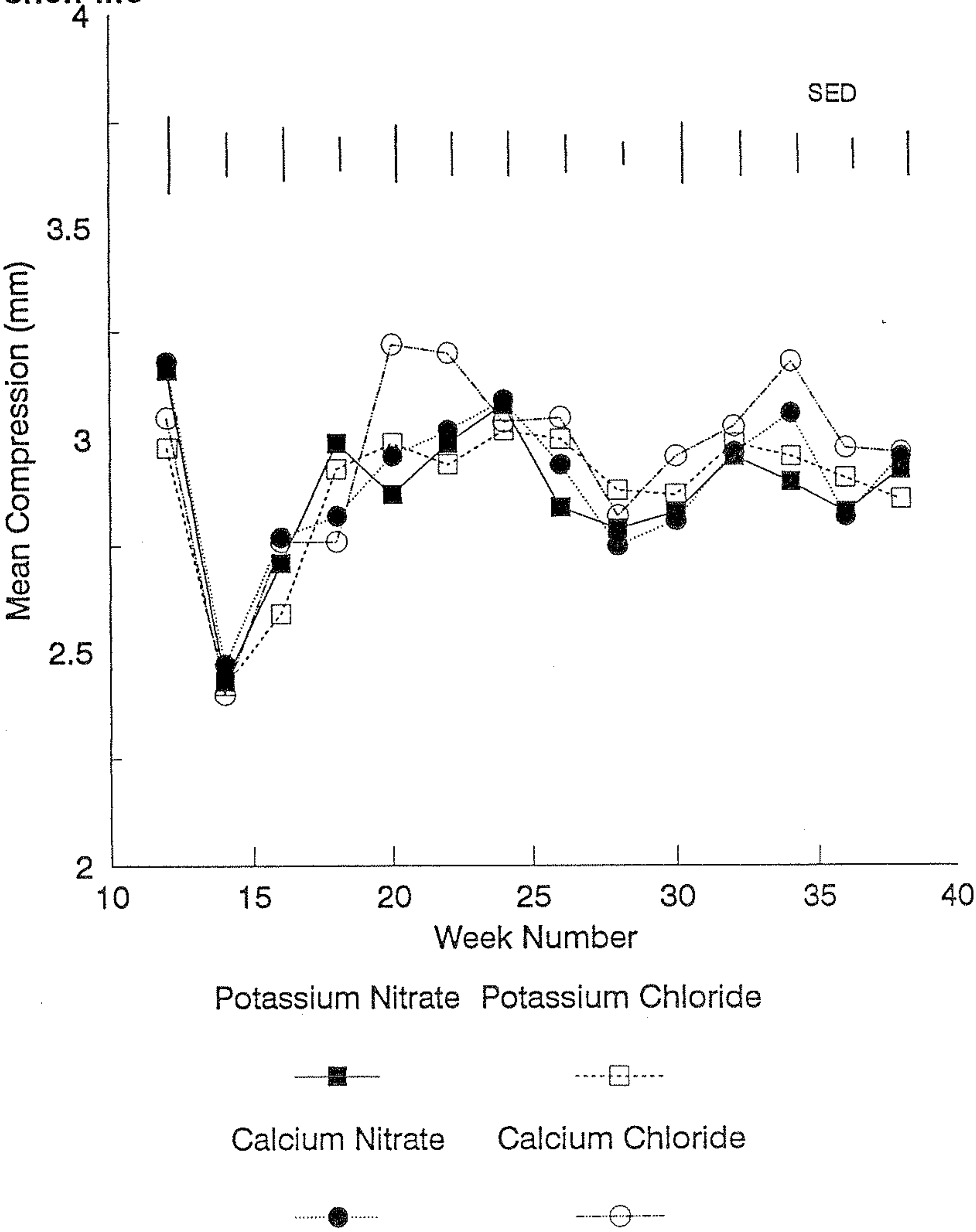


Figure 6.
Effect of nutrient regime on levels of Soluble Solids

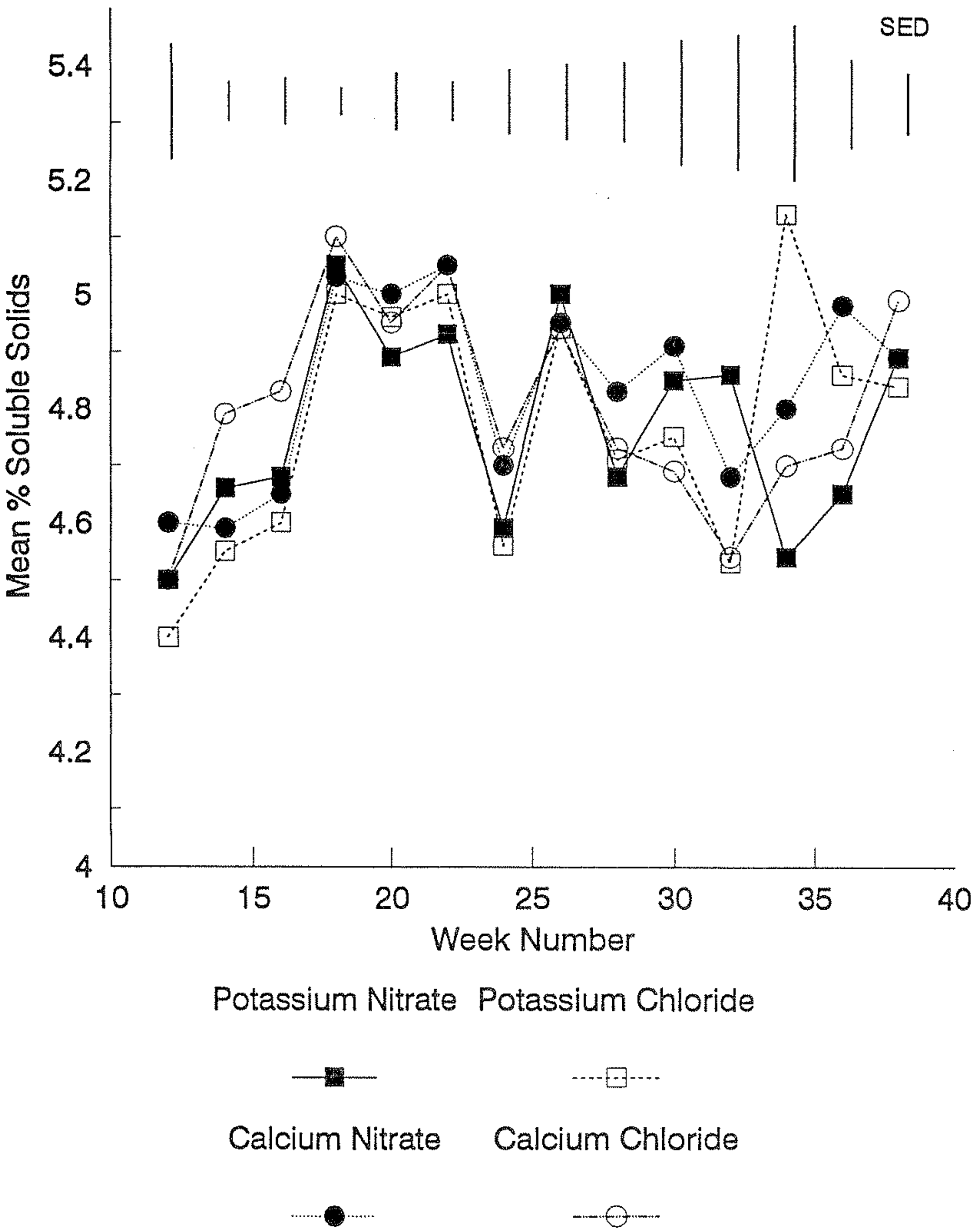


Figure 7.
Effect of nutrient regime on Juice Conductivity

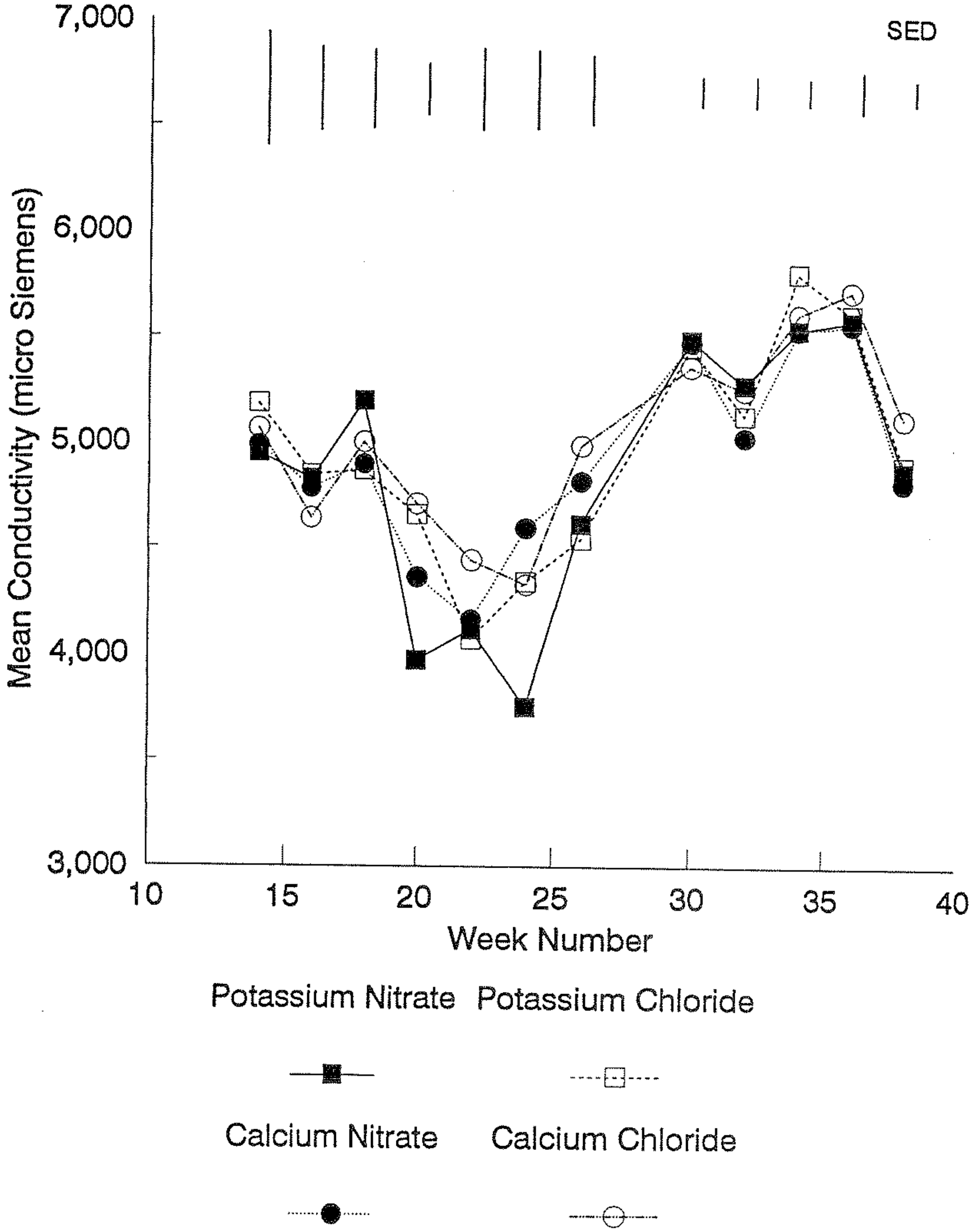
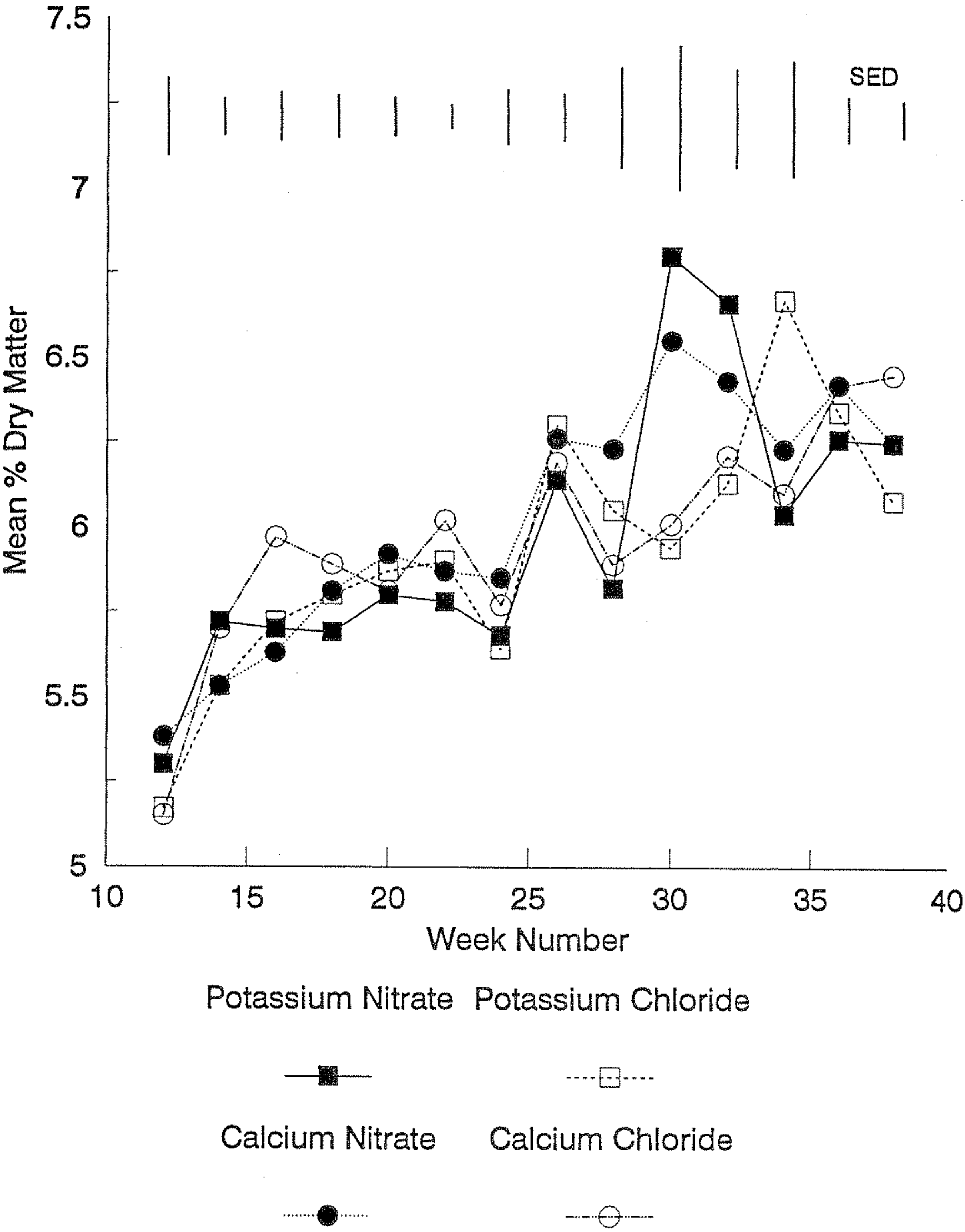


Figure 8.
Effect of nutrient regime on Percentage Dry Matter in fruit

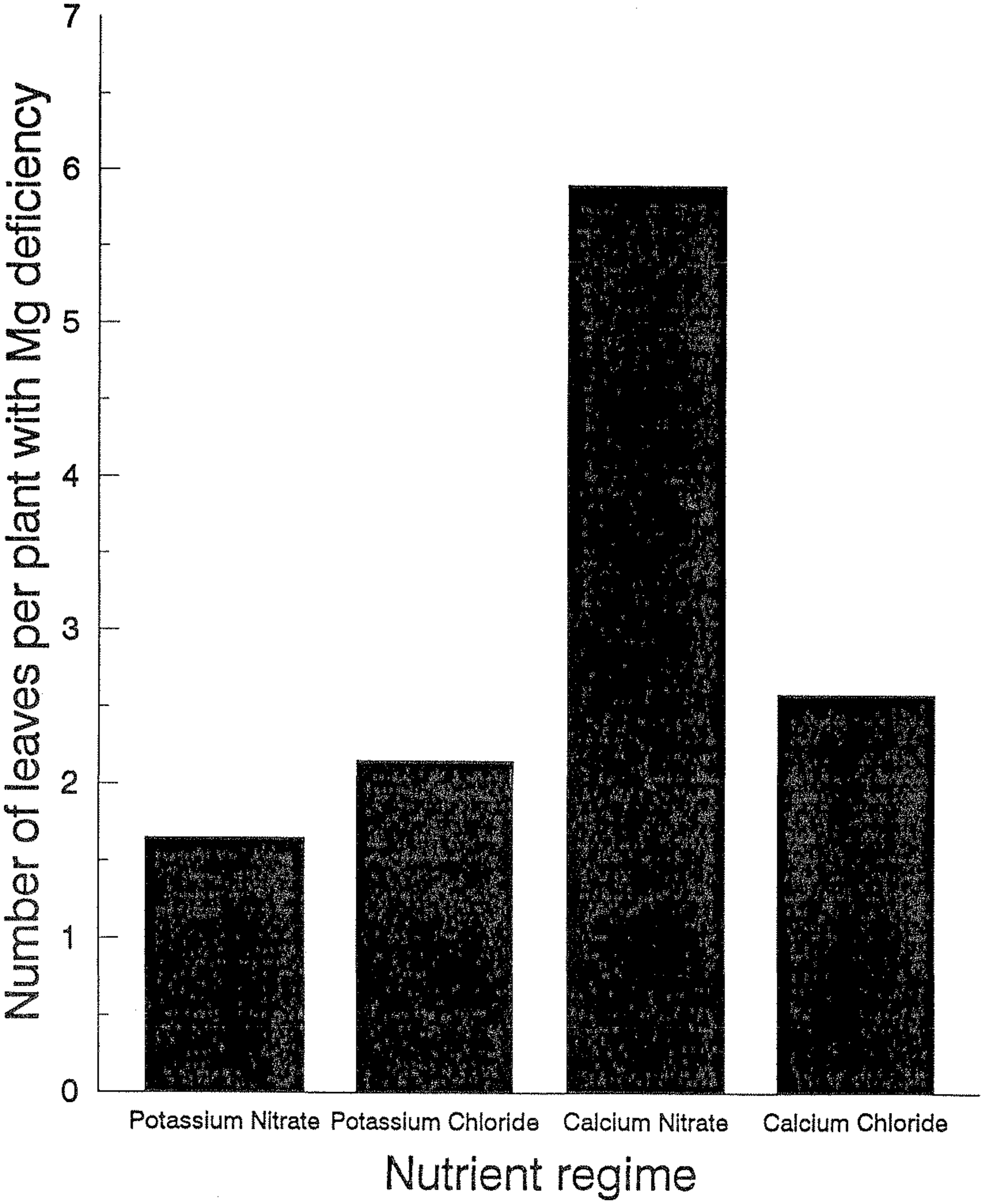


Fruit and leaf chemical composition

The incidence and level of magnesium deficiency in the trial was assessed on the 12 May 1992 (Figure 9, page 29). Plots receiving Calcium Nitrate were found to have a far higher incidence of magnesium deficiency when measured as the number of leaves per plant affected.

Monthly assessments on the chemical composition of fruit and young leaves (5th leaf down from the head) revealed no differences when comparing treatments. (Appendix VIII, pages 64 to 70).

Figure 9
Effect of nutrient regime on the incidence magnesium deficiency



DISCUSSION

Manipulation of crop nutrition of the type described here had no effect on the time of anthesis, number of fruit set, fruit development and hence the time of fruit pick; nor the number of marketable fruit on the first fifteen trusses.

Total yield was highest where the background feed was augmented with Potassium Chloride, $48.23 kgm^{-2}$. Whilst on average this exceeded the yield recorded for the other treatments by $2.4 kgm^{-2}$ this difference was not statistically significant within the context of this study. Similarly, there were no significant effects of the nutrient regimes on the percentage of Class 1 fruit.

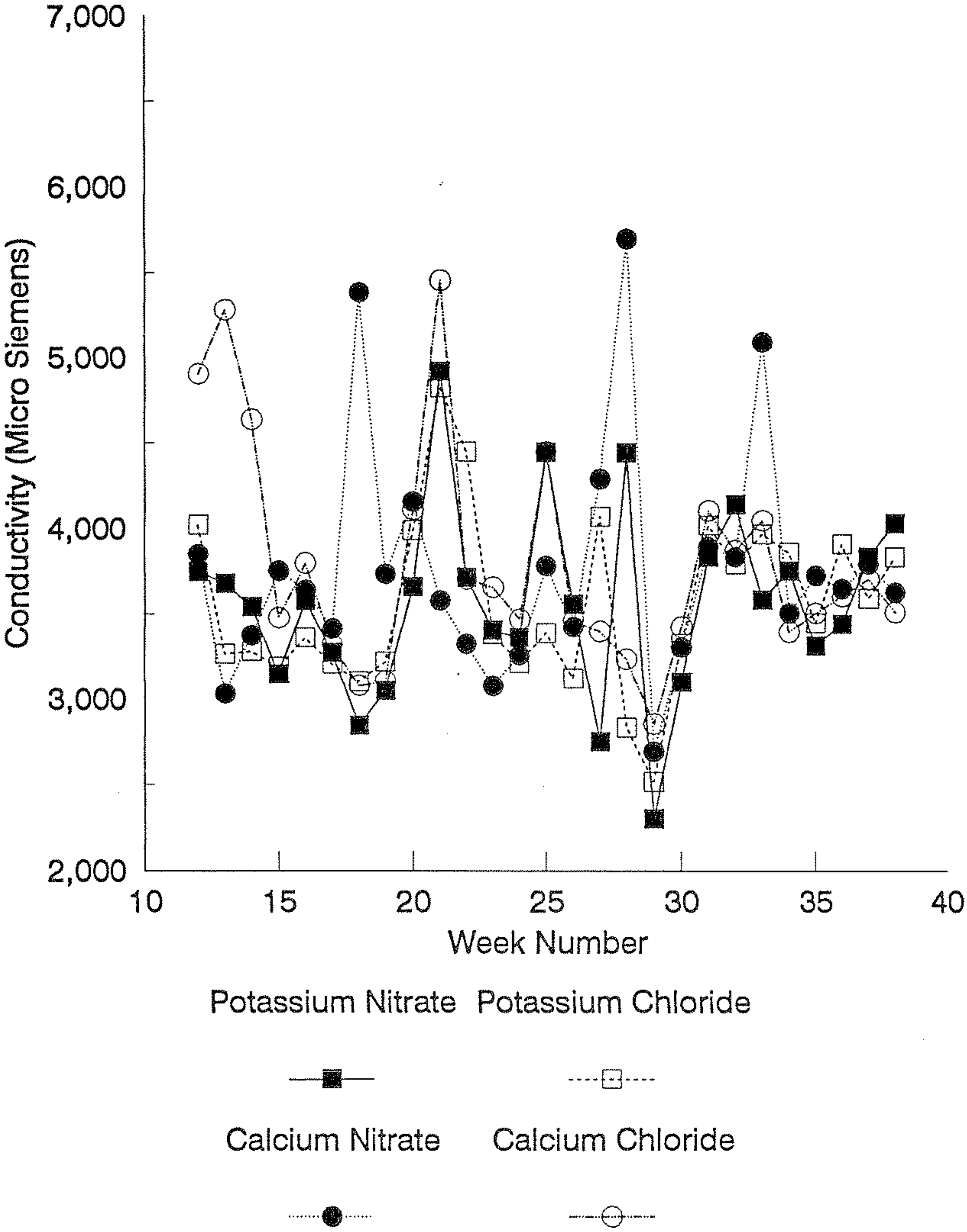
Early season gradeout (to the end of May) was however, influenced by the nutrient regimes. The use of Potassium Nitrate or Chloride significantly increased the proportion of D grade fruit and consequently decreased the number of E's. To the end of May truss eleven had been picked and picking on truss twelve had commenced.

However, from figure 10 (page 32) it can be seen that periodic rises in slab conductivity associated with the Calcium salts prior to week 22 (end of May) may have resulted in these treatments producing smaller fruit. The observed effect would therefore be a response to conductivity rather than nutrient treatment *per se*.

Reflecting the absence of any treatment effects on yield or the percentage Class 1 fruit meant that overall monetary returns ($£m^{-2}$) to the end of the season were similarly unaffected.

Detailed assessments of fruit physical disorders revealed that Gold Spot was the only defect to be significantly and consistently influenced by the treatments. Perhaps not surprisingly higher levels of this disorder were recorded where Calcium salts were used to augment the background feed. Conversely, the use of Potassium Nitrate tended to result in the lowest levels of Gold Spot. The low frequency of the other disorders evaluated would suggest that manipulation of the nutrition within the scope of this study was not detrimental to fruit quality.

Figure 10.
Slab Conductivity for each nutrient regime



The results of shelf life determinations demonstrated that fruit from the Calcium Chloride treatment were significantly firmer in week 18. In contrast, from week 20 there was a tendency for the Calcium salts, specifically the Calcium Chloride to produce the softest fruit. However, care should be taken with the interpretation of these data as differences were not formerly significant. One possible explanation for this observed trend is the increased incidence of Gold Spot over this period. The latter is believed to be linked to reduced shelf life.

Differences between treatments in internal fruit composition were both subtle and largely inconsistent and therefore little can be concluded from these data.

A secondary objective of this study was to assess the potential for reducing Nitrate input to the crop. However, with target levels in the applied feed of 295 mg/litre (Nitrate salts) and 210 mg/litre (Chloride salts) Nitrate levels in the 'Chloride' treatments were still higher than a number of commercial crops. As expected slab Nitrate levels in the 'Chloride' regimes reflected the reduced inputs. (Figure 11, page 33). This aspect of the study will be fully evaluated in 1992/93.

From Table 4 the influence of NO_3-N concentration in the drainage in association with the % run off can be seen expressed at Nitrate - N loss (kg/ha N).

Table 4

Nitrate - N loss from rockwool tomatoes (kg/ha N)

Drainage	**NO_3 - N Conc. in drainage (mg/l)**				
(%)	**100**	**150**	**200**	**250**	**300**
10	78	117	156	195	234
20	175	263	350	440	525
30	300	450	600	750	900
40	470	700	940	1170	1400
50	700	1050	1400	1750	2100

Figures based on a crop water **requirement** of 7 million l^{-1}/ha per season. % drainage calculated from the **total** applied ie. an application of 10 million l^{-1}/ha = 30% drainage.

Data courtesy of Dr Mike Marks
(ADAS - Wye).

CONCLUSIONS AND FURTHER WORK

1) Manipulation of crop nutrition as carried out in this study had no effect on fruit development, yield or overall fruit quality

2) Differences recorded with respect to gradeout may have been attributable to differences in the slab conductivity rather than nutrition *per se*

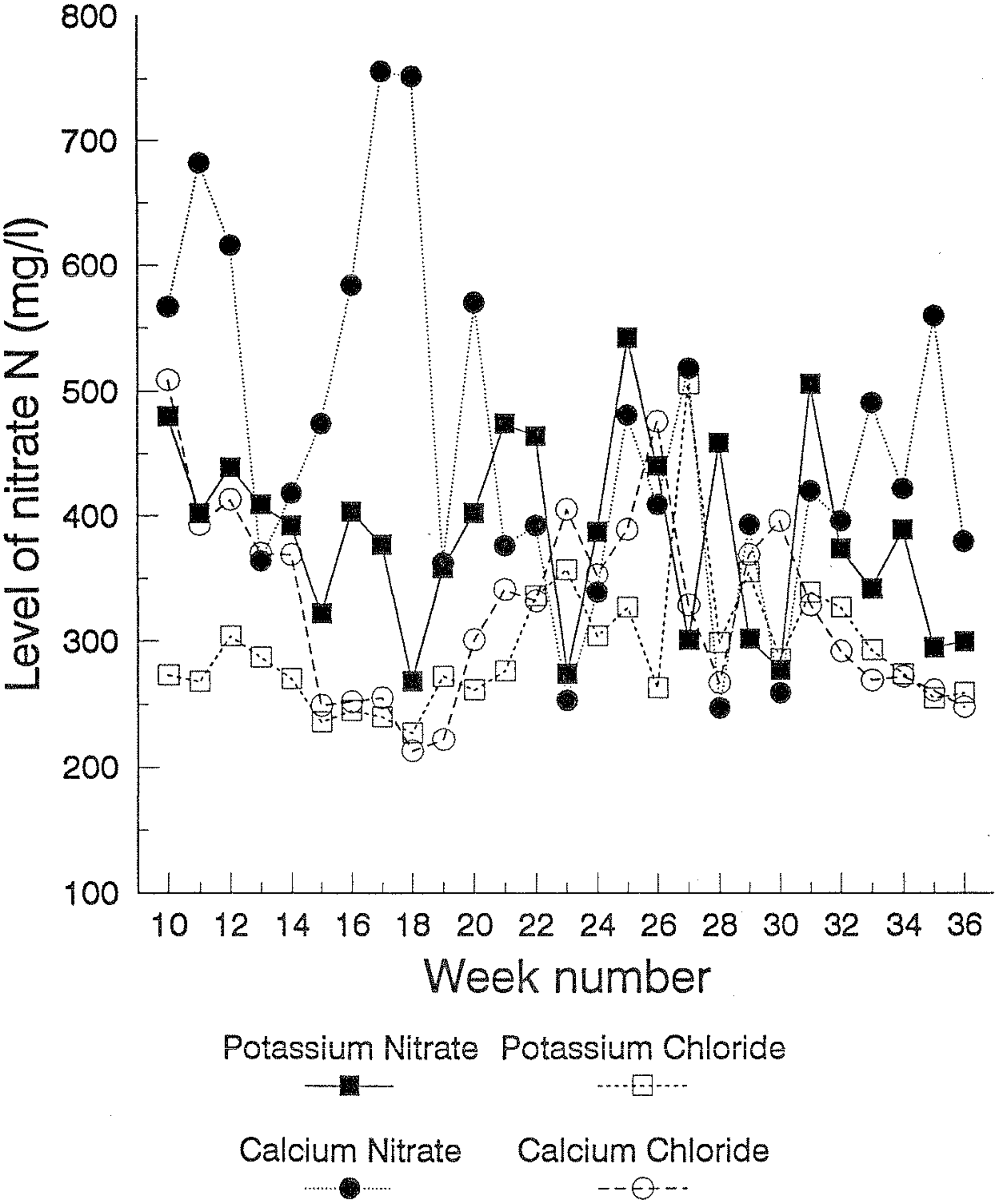
3) Calcium salts tended to increase the incidence of Gold Spot which in turn may account for the observation that these regimes, at times, produced fruit with a less robust shelf life.

Further work:

Work currently being undertaken will aim to both build on the study reported here and evaluate fully the degree to which Nitrate inputs may be reduced without a concomitant reduction in yield or fruit quality.

During the 1992/93 season four nutrient regimes will be evaluated with target N levels in the applied feed of 65, 125 185 and 247 mg/litre. The interaction between these regimes and the root zone volume will be evaluated by inclusion of both conventional double rows and the V - system.

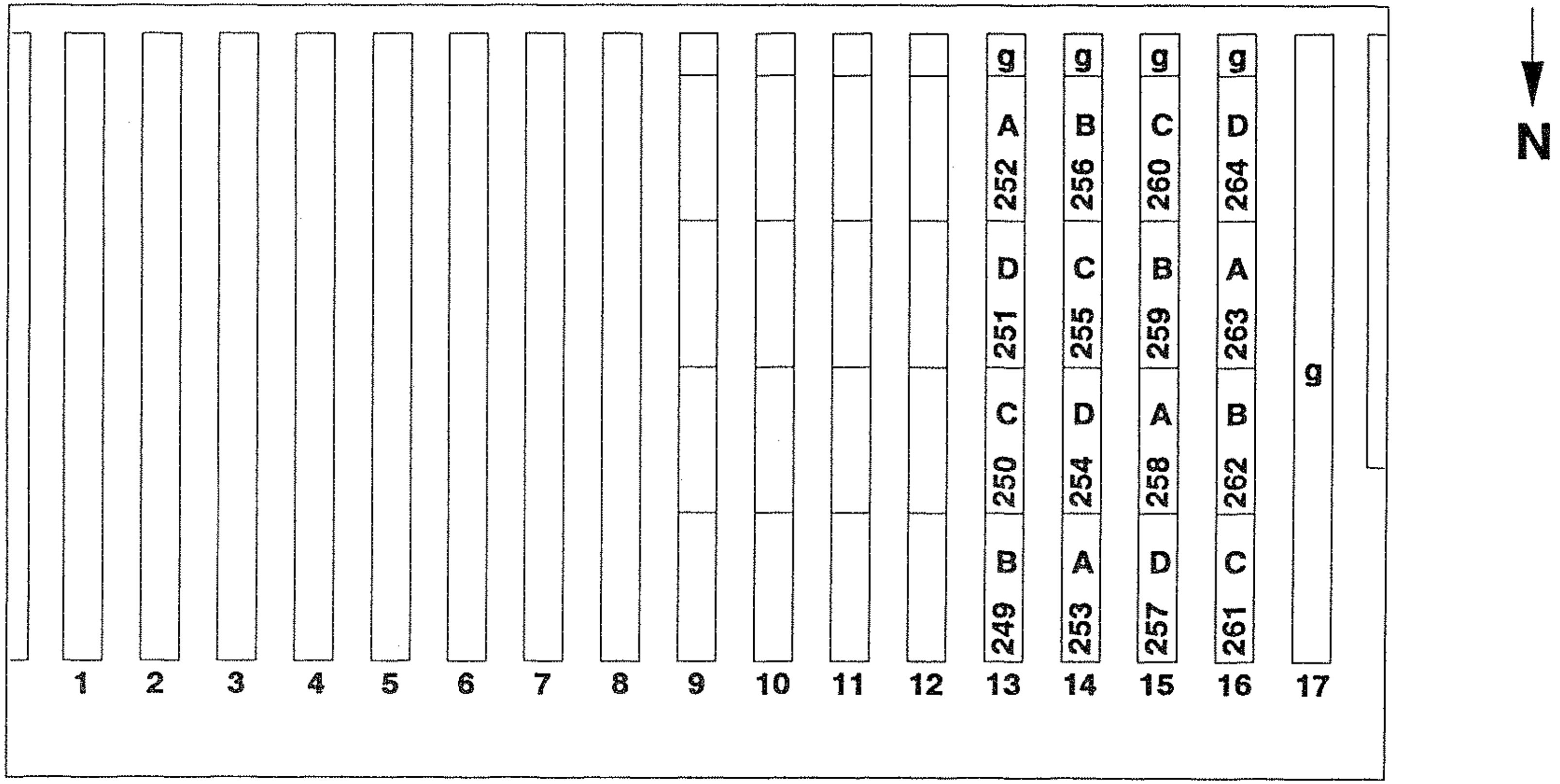
Figure 11
Influence of nutrient regime on the level of nitrate N in the slab



APPENDICES

APPENDIX 1

HDC NUTRITION TRIAL 1991/1992
PLAN OF TREATMENTS (P-BLOCK)



Treatments - Background feed augmented by

A	Potassium Nitrate
B	Potassium Chloride
C	Calcium Nitrate
D	Calcium Chloride

Variety = Calypso
g = Guard plants
Plant spacing = 476mm
Plot area = $6.66m^2$
16 plants/plot

Initial population
2.40 plants/m^2
or 9710/acre

Appendix II

Typical Background Feed Formulation

Tank A	per 100 litres
Calcium Nitrate (Prill)	4.1 kg
Potassium Nitrate	6.6 kg
Iron EDTA	153.8 kg

Tank B	
Potassium Phosphate	1.4 kg
Magnesium Sulphate (UNTIL WEEK 14 THEN)*	7.2 kg (5.4 kg)*
Ammonium Nitrate	140 g
Manganese Sulphate	16 g
Copper Sulphate	4 g
Solubor	19 g
Zinc Sulphate Monohydrate (Crystals)+	7 g (12 g)+
Ammonium Molybdate	0.8 g

Appendix III

Crop Diary

Seed sown	28.10.91
Seedlings blocked on	8.11.91
Plants moved to final growing position and stood on slabs	5.12.91
Slab contact	30.12.91
Nutrition treatments commenced	11.2.92
First fruit picked	22.2.92
Sideshoots taken on every fourth plant. Population raised from 9,710 acre to 12,137 acre	20.4.92
Final recorded pick and trial terminated	2.10.92

Fungicide Applications

Product	**Date**	**Target**
Rubisan (fenarimol)	10.4.92	Powdery Mildew
Elvaron (dichlofluanid)	17.4.92	Botrytis
Rubigan (fenarimol)	15.5.92	Powdery Mildew
Rovral (iprodione)	12.6.92	*Botrytis*
Elvaron (dichlofluanid)	10.7.92	*Botrytis*
Nimrod (bupirimate)	2.10.92	End of season clean up.

Appendix IV

Effect of nutritional regime on the date (day number) of first anthesis of trusses one to fifteen

Truss Number	**Potassium Nitrate**	**Potassium Chloride**	**Calcium Nitrate**	**Calcium Chloride**	**SED (d.f=6)**	**LSD 5%**	**Significance**
One	360	361	361	360	*0.26*	*0.64*	*
Two	9	10	10	9	*0.78*	*1.91*	*N.S.*
Three	17	18	18	18	*0.79*	*1.93*	*N.S.*
Four	25	26	27	26	*0.49*	*1.20*	*N.S.*
Five	33	34	33	32	*0.53*	*1.30*	*N.S.*
Six	40	41	41	40	*0.96*	*2.35*	*N.S.*
Seven	49	49	49	48	*0.71*	*1.74*	*N.S.*
Eight	58	58	57	56	*0.91*	*2.23*	*N.S.*
Nine	66	66	67	65	*0.99*	*3.44*	*N.S.*
Ten	74	74	74	73	*0.94*	*2.30*	*N.S.*
Eleven	82	82	83	81	*0.94*	*2.30*	*N.S.*
Twelve	89	91	90	89	*1.02*	*2.49*	*N.S.*
Thirteen	98	99	98	97	*1.07*	*2.62*	*N.S.*
Fourteen	107	107	107	106	*1.45*	*3.55*	*N.S.*
Fifteen	115	115	114	115	*1.34*	*3.28*	*N.S.*

Effect of nutritional regime on the date (day number) of sixth anthesis of trusses one to fifteen

Truss Number	Potassium Nitrate	Potassium Chloride	Calcium Nitrate	Calcium Chloride	SED (d.f=6)	LSD 5%	Significance
One	6	7	6	6	*0.61*	*1.49*	*N.S.*
Two	15	16	15	15	*0.95*	*2.32*	*N.S.*
Three	24	25	24	24	*0.93*	*2.27*	*N.S.*
Four	31	31	31	31	*0.86*	*2.10*	*N.S.*
Five	39	39	40	39	*0.95*	*2.32*	*N.S.*
Six	47	47	48	47	*1.10*	*2.69*	*N.S.*
Seven	56	56	56	55	*1.01*	*2.47*	*N.S.*
Eight	64	64	65	63	*1.18*	*2.88*	*N.S.*
Nine	73	73	73	72	*1.00*	*2.45*	*N.S.*
Ten	81	81	81	80	*0.99*	*2.42*	*N.S.*
Eleven	89	90	89	88	*1.06*	*2.59*	*N.S.*
Twelve	97	98	96	96	*0.99*	*2.42*	*N.S.*
Thirteen	106	105	106	106	*1.37*	*3.35*	*N.S.*
Fourteen	113	113	112	111	*1.75*	*4.28*	*N.S.*
Fifteen	120	120	120	120	*1.11*	*2.72*	*N.S.*

Effect of nutritional regime on the date (day number) of first fruit pick from trusses one to fifteen

Truss Number	Potassium Nitrate	Potassium Chloride	Calcium Nitrate	Calcium Chloride	SED (d.f=6)	LSD 5%	Significance
One	54	54	56	55	*0.93*	*2.27*	*N.S.*
Two	70	72	72	71	*2.04*	*4.99*	*N.S.*
Three	80	82	83	81	*2.44*	*5.97*	*N.S.*
Four	90	92	93	91	*1.56*	*3.82*	*N.S.*
Five	96	101	100	99	*2.46*	*6.02*	*N.S.*
Six	105	106	107	106	*1.80*	*4.40*	*N.S.*
Seven	114	116	116	113	*1.08*	*2.64*	*N.S.*
Eight	124	123	122	120	*1.66*	*4.06*	*N.S.*
Nine	131	132	131	130	*1.25*	*3.06*	*N.S.*
Ten	137	137	136	137	*0.91*	*2.23*	*N.S.*
Eleven	142	142	142	142	*1.09*	*2.67*	*N.S.*
Twelve	149	149	148	148	*1.62*	*3.96*	*N.S.*
Thirteen	154	156	155	154	*0.98*	*2.39*	*N.S.*
Fourteen	161	162	161	163	*1.46*	*3.57*	*N.S.*
Fifteen	167	168	167	168	*0.68*	*1.66*	*N.S.*

Effect of nutritional regime on the date (day number) of sixth fruit pick from trusses one to fifteen

Truss Number	Potassium Nitrate	Potassium Chloride	Calcium Nitrate	Calcium Chloride	SED (d.f=6)	LSD 5%	Significance
One	66	65	64	64	*0.87*	*2.13*	*N.S.*
Two	80	80	80	80	*2.04*	*4.99*	*N.S.*
Three	91	97	96	95	*3.86*	*9.44*	*N.S.*
Four	99	100	103	103	*1.34*	*3.28*	*N.S.*
Five	108	109	111	108	*2.61*	*6.38*	*N.S.*
Six	116	118	117	116	*1.27*	*3.11*	*N.S.*
Seven	122	125	125	122	*1.26*	*3.08*	*N.S.*
Eight	131	130	130	129	*1.52*	*3.72*	*N.S.*
Nine	137	138	137	137	*0.81*	*1.98*	*N.S.*
Ten	142	143	143	143	*0.75*	*1.83*	*N.S.*
Eleven	148	149	149	148	*1.63*	*3.98*	*N.S.*
Twelve	154	155	154	154	*1.00*	*2.44*	*N.S.*
Thirteen	161	163	161	161	*1.29*	*3.16*	*N.S.*
Fourteen	167	170	168	167	*1.43*	*3.49*	*N.S.*
Fifteen	174	175	174	175	*1.34*	*3.28*	*N.S.*

Effect of nutritional regime on the number of fruit set on trusses one to fifteen

Truss Number	Potassium Nitrate	Potassium Chloride	Calcium Nitrate	Calcium Chloride	SED (d.f=6)	LSD 5%	Significance
One	6.8	6.7	6.7	6.6	*0.13*	*0.32*	*N.S.*
Two	9.3	9.6	9.9	9.8	*0.33*	*0.81*	*N.S.*
Three	9.5	9.4	10.0	9.4	*0.14*	*0.34*	*
Four	9.6	9.7	9.7	9.4	*0.26*	*0.64*	*N.S.*
Five	9.7	9.6	9.6	9.9	*0.33*	*0.81*	*N.S.*
Six	9.3	9.7	9.6	9.6	*0.15*	*0.37*	*N.S.*
Seven	9.0	9.2	9.2	9.3	*0.28*	*0.68*	*N.S.*
Eight	9.5	9.4	9.6	9.2	*0.14*	*0.34*	*N.S.*
Nine	9.7	9.7	9.4	9.4	*0.11*	*0.27*	*N.S.*
Ten	9.8	9.2	9.4	9.5	*0.11*	*0.27*	*
Eleven	9.5	9.2	9.5	9.2	*0.19*	*0.46*	*N.S.*
Twelve	9.7	9.1	9.2	9.2	*0.25*	*0.61*	*N.S.*
Thirteen	9.4	9.3	9.2	9.1	*0.26*	*0.64*	*N.S.*
Fourteen	9.2	9.1	9.1	9.3	*0.31*	*0.76*	*N.S.*
Fifteen	9.7	9.4	9.0	9.5	*0.25*	*0.61*	*N.S.*

Effect of nutritional regime on the number of marketable fruit on trusses one to fifteen

Truss Number	Potassium Nitrate	Potassium Chloride	Calcium Nitrate	Calcium Chloride	SED (d.f=6)	LSD 5%	Significance
One	6.7	6.6	6.4	6.1	*0.22*	*0.54*	*N.S.*
Two	8.5	8.5	8.6	8.6	*0.31*	*0.76*	*N.S.*
Three	7.7	7.4	7.5	7.3	*0.32*	*0.78*	*N.S.*
Four	7.7	8.0	7.6	7.8	*0.26*	*0.64*	*N.S.*
Five	7.8	7.9	7.9	7.8	*0.43*	*1.05*	*N.S.*
Six	8.3	8.9	8.7	8.7	*0.21*	*0.51*	*N.S.*
Seven	8.4	8.5	7.7	8.8	*0.47*	*1.15*	*N.S.*
Eight	8.3	8.1	8.2	8.2	*0.24*	*0.59*	*N.S.*
Nine	8.9	9.1	8.9	9.1	*0.38*	*0.93*	*N.S.*
Ten	9.4	8.9	8.9	9.2	*0.18*	*0.44*	*N.S.*
Eleven	8.9	9.0	9.2	9.1	*0.21*	*0.51*	*N.S.*
Twelve	9.3	9.1	8.9	9.0	*0.18*	*0.44*	*N.S.*
Thirteen	9.2	9.3	9.0	9.1	*0.27*	*0.66*	*N.S.*
Fourteen	8.8	8.7	8.9	9.2	*0.32*	*0.78*	*N.S.*
Fifteen	9.3	9.2	8.6	9.1	*0.24*	*0.59*	*N.S.*

Appendix V

Effect of nutritional regime on total yield (kg/m^{-2})

Treatment	Feb	Mar	Apr	May	Total to May	June	July	Aug	Sept	Total to Sept
Potassium Nitrate	0.39	2.38	4.70	7.16	14.64	9.25	9.33	5.98	7.04	46.23
Potassium Chloride	0.40	2.52	5.00	7.51	15.43	9.34	9.66	6.00	7.80	48.23
Calcium Nitrate	0.43	2.20	4.92	7.20	14.76	9.11	9.26	5.85	6.77	45.75
Calcium Chloride	0.39	2.24	4.56	7.21	14.42	8.89	9.64	6.19	6.44	45.55
SED (d.f = 6)	*0.061*	*0.123*	*0.224*	*0.092*	*0.368*	*0.189*	*0.436*	*0.432*	*0.582*	*1.566*
LSD 5%	*0.149*	*0.300*	*0.548*	*0.225*	*0.900*	*0.462*	*1.066*	*1.057*	*1.424*	*3.832*
Significance	*N.S.*	*N.S.*	*N.S.*	*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutritional regime on the percentage Class 1 fruit

Treatment	Feb	Mar	Apr	May	Total to May	June	July	Aug	Sept	Total to Sept
Potassium Nitrate	94	94	79	88	86	94	93	90	77	89
Potassium Chloride	96	95	81	89	86	94	91	92	85	89
Calcium Nitrate	93	96	81	86	86	93	90	88	79	88
Calcium Chloride	87	95	82	89	88	94	94	91	83	90
SED (d.f = 6)	*4.9*	*1.8*	*1.3*	*0.9*	*0.9*	*0.5*	*1.9*	*2.7*	*6.7*	*1.4*
LSD 5%	*11.9*	*4.4*	*3.2*	*2.2*	*2.4*	*1.2*	*4.6*	*6.6*	*16.4*	*3.4*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutritional regime on the percentage Class 1 fruit within size grade C (> 57 mm diameter)

Treatment	Feb	Mar	Apr	May	Total to May	June	July	Aug	Sept	Total to Sept
Potassium Nitrate	0	2	6	14	9	28	21	4	7	15
Potassium Chloride	0	4	7	12	9	29	25	5	7	16
Calcium Nitrate	0	4	8	14	10	27	21	4	7	15
Calcium Chloride	0	1	3	12	7	29	25	4	6	16
SED (d.f = 6)	*0*	*2.1*	*2.7*	*1.2*	*1.3*	*1.8*	*2.6*	*1.1*	*1.9*	*1.1*
LSD 5%	*0*	*5.1*	*6.6*	*2.9*	*3.2*	*4.4*	*6.4*	*2.7*	*4.6*	*2.7*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutritional regime on the percentage Class 1 fruit within size grade D (47-57mm diameter)

Treatment	Feb	Mar	Apr	May	Total to May	June	July	Aug	Sept	Total to Sept
Potassium Nitrate	38	48	74	76	70	65	68	82	83	72
Potassium Chloride	45	57	77	78	73	64	70	89	84	74
Calcium Nitrate	43	53	68	71	66	65	69	83	82	70
Calcium Chloride	30	45	70	74	67	65	69	85	79	71
SED (d.f = 6)	*6.7*	*6.1*	*2.1*	*1.2*	*1.3*	*1.9*	*3.5*	*4.4*	*2.3*	*2.3*
LSD 5%	*16.4*	*14.9*	*5.1*	*2.9*	*3.2*	*4.6*	*8.6*	*10.7*	*5.6*	*5.6*
Significance	*N.S.*	*N.S.*	*	**	**	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutritional regime on the percentage Class 1 fruit within size grade E (40-47mm diameter)

Treatment	Feb	Mar	Apr	May	Total to May	June	July	Aug	Sept	Total to Sept
Potassium Nitrate	61	49	19	9	21	7	10	13	10	13
Potassium Chloride	55	39	16	10	18	6	5	6	9	10
Calcium Nitrate	57	43	24	15	23	8	10	13	11	14
Calcium Chloride	69	53	27	14	26	5	6	11	15	12
SED* *(d.f = 6)	*6.7*	*5.7*	*1.4*	*1.1*	*0.8*	*2.0*	*3.4*	*3.7*	*1.4*	*1.9*
***LSD* 5%**	*16.4*	*14.9*	*3.4*	*2.7*	*1.9*	*4.9*	*8.3*	*9.0*	*3.4*	*4.6*
Significance	*N.S.*	*N.S.*	***	**	***	*N.S.*	*N.S.*	*N.S.*	*	*N.S.*

Appendix VI

Effect of nutrient regime on the level of fruit disorders (Figures are a mean of 10 fruit from each of four replicates)
Week number 12

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.00	0.10	0.28	0.33	0.00	0.10	0.00	0.28	0.00	0.00
Potassium Chloride	0.00	0.05	0.38	0.28	0.00	0.05	0.00	0.30	0.03	0.00
Calcium Nitrate	0.00	0.05	0.38	0.35	0.00	0.13	0.00	0.33	0.00	0.03
Calcium Chloride	0.03	0.05	0.20	0.35	0.00	0.05	0.00	0.13	0.00	0.00
SED (d.f=6)	*0.018*	*0.079*	*0.086*	*0.121*	*0.000*	*0.049*	*0.000*	*0.095*	*0.018*	*0.018*
LSD 5%	*0.044*	*0.193*	*0.210*	*0.296*	*0.000*	*0.120*	*0.000*	*0.232*	*0.044*	*0.044*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Week number 14

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.00	0.03	0.50	0.18	0.00	0.03	0.03	0.05	0.00	0.00
Potassium Chloride	0.00	0.00	0.65	0.25	0.03	0.10	0.00	0.08	0.00	0.00
Calcium Nitrate	0.00	0.00	0.80	0.30	0.00	0.18	0.05	0.18	0.00	0.03
Calcium Chloride	0.00	0.03	0.45	0.05	0.00	0.15	0.00	0.05	0.00	0.00
SED (d.f=6)	*0.000*	*0.020*	*0.153*	*0.010*	*0.018*	*0.126*	*0.018*	*0.061*	*0.000*	*0.018*
LSD 5%	*0.000*	*0.049*	*0.374*	*0.024*	*0.044*	*0.308*	*0.044*	*0.149*	*0.000*	*0.044*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutrient regime on the level of fruit disorder (Figures are a mean of 10 fruit from each of four replicates)

Week number 16

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.55	0.00	0.33	0.15	0.00	0.00	0.10	0.03	0.00	0.00
Potassium Chloride	0.40	0.00	0.53	0.15	0.00	0.05	0.00	0.05	0.00	0.00
Calcium Nitrate	0.18	0.00	0.48	0.28	0.00	0.00	0.10	0.00	0.00	0.00
Calcium Chloride	0.15	0.00	0.25	0.15	0.00	0.03	0.03	0.03	0.03	0.00
SED (d.f=6)	*0.078*	*0.000*	*0.124*	*0.104*	*0.000*	*0.034*	*0.064*	*0.029*	*0.018*	*0.000*
LSD 5%	*0.191*	*0.000*	*0.303*	*0.254*	*0.000*	*0.083*	*0.157*	*0.071*	*0.044*	*0.000*
Significance	**	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Week number 18

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.35	0.05	0.40	0.72	0.00	0.08	0.00	0.03	0.00	0.00
Potassium Chloride	0.35	0.00	0.65	0.82	0.00	0.03	0.00	0.03	0.00	0.00
Calcium Nitrate	0.35	0.03	0.55	0.60	0.00	0.03	0.08	0.1	0.00	0.00
Calcium Chloride	0.28	0.00	0.50	0.27	0.00	0.00	0.03	0.05	0.00	0.03
SED (d.f=6)	*0.125*	*0.034*	*0.258*	*0.294*	*0.000*	*0.067*	*0.041*	*0.058*	*0.000*	*0.018*
LSD 5%	*0.306*	*0.083*	*0.631*	*0.719*	*0.000*	*0.164*	*0.100*	*0.142*	*0.000*	*0.044*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutrient regime on the level of fruit disorders (Figures are a mean of 10 fruit from each of four replicates)

Week number 20

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.10	0.05	0.20	0.23	0.00	0.18	0.03	0.15	0.00	0.00
Potassium Chloride	0.33	0.03	0.23	0.55	0.00	0.15	0.20	0.10	0.00	0.00
Calcium Nitrate	0.18	0.00	0.03	0.23	0.00	0.10	0.58	0.10	0.00	0.05
Calcium Chloride	0.13	0.00	0.10	0.28	0.00	0.38	0.50	0.28	0.00	0.00
SED (d.f=6)	*0.160*	*0.027*	*0.074*	*0.172*	*0.000*	*0.146*	*0.134*	*0.127*	*0.000*	*0.035*
LSD 5%	*0.392*	*0.066*	*0.181*	*0.421*	*0.000*	*0.357*	*0.328*	*0.311*	*0.000*	*0.086*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*	*N.S.*	*N.S.*	*N.S.*

Week number 22

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.08	0.13	0.08	0.13	0.00	0.05	0.03	0.03	0.00	0.08
Potassium Chloride	0.03	0.05	0.08	0.05	0.00	0.23	0.08	0.00	0.00	0.05
Calcium Nitrate	0.20	0.00	0.08	0.1	0.00	0.00	0.75	0.00	0.00	0.30
Calcium Chloride	0.03	0.10	0.05	0.05	0.00	0.03	0.68	0.08	0.00	0.18
SED (d.f=6)	*0.067*	*0.045*	*0.073*	*0.102*	*0.000*	*0.132*	*0.171*	*0.061*	*0.000*	*0.094*
LSD 5%	*0.164*	*0.110*	*0.179*	*0.250*	*0.000*	*0.323*	*0.418*	*0.149*	*0.000*	*0.230*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	**	*N.S.*	*N.S.*	*N.S.*

Effect of nutrient regime on the level of fruit disorders (Figures are a mean of 10 fruit from each of four replicates)

Week number 24

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.23	0.10	0.05	0.05	0.00	0.00	0.45	0.08	0.00	0.53
Potassium Chloride	0.33	0.00	0.15	0.13	0.00	0.00	0.63	0.08	0.00	0.55
Calcium Nitrate	0.08	0.08	0.28	0.05	0.00	0.00	1.25	0.23	0.00	0.60
Calcium Chloride	0.15	0.13	0.08	0.10	0.00	0.03	1.30	0.10	0.00	0.75
SED (d.f=6)	*0.115*	*0.046*	*0.084*	*0.053*	*0.000*	*0.018*	*0.172*	*0.119*	*0.000*	*0.198*
LSD 5%	*0.281*	*0.113*	*0.206*	*0.130*	*0.000*	*0.044*	*0.421*	*0.292*	*0.000*	*0.485*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	**	*N.S.*	*N.S.*	*N.S.*

Week number 26

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.20	0.03	0.05	0.03	0.00	0.00	0.48	0.05	0.00	0.15
Potassium Chloride	0.08	0.00	0.15	0.1	0.00	0.00	0.63	0.15	0.00	0.20
Calcium Nitrate	0.15	0.10	0.05	0.03	0.00	0.00	1.03	0.15	0.00	0.23
Calcium Chloride	0.20	0.03	0.15	0.03	0.00	0.00	1.15	0.15	0.00	0.33
SED (d.f=6)	*0.150*	*0.061*	*0.082*	*0.049*	*0.000*	*0.000*	*0.217*	*0.065*	*0.000*	*0.195*
LSD 5%	*0.367*	*0.149*	*0.201*	*0.120*	*0.000*	*0.000*	*0.531*	*0.159*	*0.000*	*0.477*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutrient regime on the level of fruit disorders (Figures are a mean of 10 fruit from each of four replicates)

Week number 28

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.05	0.00	0.03	0.05	0.00	0.03	0.50	0.18	0.00	0.23
Potassium Chloride	0.05	0.00	0.03	0.08	0.00	0.00	0.73	0.10	0.00	0.25
Calcium Nitrate	0.00	0.00	0.08	0.08	0.00	0.00	0.68	0.28	0.00	0.23
Calcium Chloride	0.03	0.00	0.10	0.03	0.00	0.00	1.30	0.15	0.00	0.13
SED (d.f=6)	*0.027*	*0.000*	*0.049*	*0.045*	*0.000*	*0.018*	*0.216*	*0.124*	*0.000*	*0.182*
LSD 5%	*0.066*	*0.000*	*0.120*	*1.101*	*0.000*	*0.044*	*0.529*	*0.303*	*0.000*	*0.445*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*	*N.S.*	*N.S.*	*N.S.*

Week number 30

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.03	0.00	0.08	0.10	0.00	0.00	0.00	0.15	0.00	0.18
Potassium Chloride	0.00	0.00	0.18	0.13	0.00	0.03	0.15	0.13	0.00	0.40
Calcium Nitrate	0.05	0.03	0.08	0.05	0.00	0.00	0.10	0.00	0.05	0.38
Calcium Chloride	0.05	0.00	0.10	0.18	0.00	0.00	0.18	0.00	0.00	0.40
SED (d.f=6)	*0.034*	*0.018*	*0.076*	*0.094*	*0.000*	*0.018*	*0.091*	*0.045*	*0.020*	*0.187*
LSD 5%	*0.083*	*0.044*	*0.186*	*0.230*	*0.000*	*0.044*	*0.223*	*0.110*	*0.049*	*0.458*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*	*N.S.*	*N.S.*

Effect of nutrient regime on the level of fruit disorders (Figures are a mean of 10 fruit from each of four replicates)

Week number 32

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.18	0.08	0.05	0.25	0.00	0.00	0.10	0.03	0.00	0.53
Potassium Chloride	0.23	0.00	0.13	0.28	0.00	0.05	0.13	0.00	0.03	0.60
Calcium Nitrate	0.13	0.05	0.10	0.10	0.08	0.05	0.33	0.25	0.05	0.80
Calcium Chloride	0.33	0.00	0.05	0.15	0.00	0.00	0.33	0.03	0.05	0.95
SED (d.f=6)	*0.117*	*0.040*	*0.091*	*0.102*	*0.053*	*0.041*	*0.148*	*0.179*	*0.057*	*0.252*
LSD 5%	*0.286*	*0.098*	*0.223*	*0.250*	*0.130*	*0.100*	*0.362*	*0.438*	*0.139*	*0.617*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Week number 34

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.08	0.00	0.15	0.23	0.00	0.00	0.15	0.00	0.00	0.15
Potassium Chloride	0.05	0.06	0.13	0.23	0.00	0.00	0.38	0.00	0.03	0.10
Calcium Nitrate	0.08	0.05	0.08	0.20	0.00	0.00	0.55	0.00	0.00	0.08
Calcium Chloride	0.13	0.05	0.03	0.20	0.00	0.00	0.70	0.00	0.00	0.03
SED (d.f=6)	*0.032*	*0.028*	*0.059*	*0.137*	*0.000*	*0.000*	*0.163*	*0.000*	*0.020*	*0.109*
LSD 5%	*0.078*	*0.069*	*0.144*	*0.335*	*0.000*	*0.000*	*0.399*	*0.000*	*0.049*	*0.267*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutrient regime on the level of fruit disorders (Figures are a mean of 10 fruit from each of four replicates)

Week number 36

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.10	0.08	0.00	1.08	0.00	0.08	0.23	0.00	0.03	0.30
Potassium Chloride	0.08	0.13	0.03	1.28	0.08	0.00	0.15	0.05	0.13	0.20
Calcium Nitrate	0.05	0.03	0.03	1.20	0.00	0.10	0.35	0.03	0.00	0.23
Calcium Chloride	0.35	0.00	0.03	1.10	0.00	0.10	0.45	0.03	0.00	0.43
SED (d.f=6)	*0.111*	*0.085*	*0.032*	*0.239*	*0.059*	*0.085*	*0.151*	*0.047*	*0.071*	*0.090*
LSD 5%	*0.272*	*0.208*	*0.078*	*0.585*	*0.144*	*0.208*	*0.369*	*0.115*	*0.174*	*0.220*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Week number 38

Treatment	Boxy	Nippling	Ribbing	Slab Sided	Radial Cracking	Netting	Gold Spot	Gold Marbling	Red Noses	Blotchy Ripening
Potassium Nitrate	0.00	0.10	0.05	0.68	0.43	1.30	0.28	0.18	0.05	0.58
Potassium Chloride	0.05	0.00	0.10	1.03	0.00	0.18	0.15	0.18	0.13	0.88
Calcium Nitrate	0.00	0.08	0.03	0.93	0.23	0.68	0.35	0.38	0.48	0.60
Calcium Chloride	0.00	0.13	0.13	0.68	0.23	0.62	0.40	0.53	0.08	0.60
SED (d.f=6)	*0.040*	*0.098*	*0.053*	*0.112*	*0.234*	*0.521*	*0.195*	*0.202*	*0.222*	*0.302*
LSD 5%	*0.098*	*0.240*	*0.130*	*0.274*	*0.573*	*1.275*	*0.477*	*0.494*	*0.543*	*0.739*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Appendix VII

Effect of nutrient regime on shelf life and fruit internal composition (Figures are a mean of 10 fruit from each of four replicates)
Week number 12

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (µS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	3.16	7.83	4.50	-	2.68	5.30
Potassium Chloride	2.98	7.52	4.40	-	2.34	5.17
Calcium Nitrate	3.18	7.50	4.60	-	3.33	5.38
Calcium Chloride	3.05	7.56	4.50	-	2.62	5.15
SED (d.f=6)	*0.153*	*0.152*	*0.171*	-	*0.408*	*0.194*
LSD 5%	*0.374*	*0.372*	*0.418*	-	*0.998*	*0.475*
Significance	*N.S.*	*N.S.*	*N.S.*	-	*N.S.*	*N.S*

Week number 14

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (µS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.43	7.43	4.66	4945	3.03	5.72
Potassium Chloride	2.42	7.58	4.55	5183	3.05	5.53
Calcium Nitrate	2.47	7.66	4.59	4983	2.90	5.53
Calcium Chloride	2.40	7.63	4.79	5063	2.65	5.70
SED (d.f=6)	*0.087*	*0.112*	*0.057*	*453.3*	*0.263*	*0.093*
LSD 5%	*0.213*	*0.274*	*0.139*	*1109.2*	*0.644*	*0.228*
Significance	*N.S.*	*N.S.*	*	*N.S.*	*N.S.*	*N.S.*

Effect of nutrient regime on shelf life and fruit internal composition (Figures are a mean of 10 fruit from each of four replicates)

Week number 16

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (μS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.71	7.62	4.68	4822	3.40	5.70
Potassium Chloride	2.59	7.54	4.60	4843	3.26	5.72
Calcium Nitrate	2.77	7.50	4.65	4780	3.60	5.63
Calcium Chloride	2.76	7.56	4.83	4637	3.12	5.97
SED (d.f=6)	*0.107*	*0.189*	*0.068*	*137.0*	*0.316*	*0.122*
LSD 5%	*0.262*	*0.462*	*0.166*	*335.2*	*0.773*	*0.299*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Week number 18

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (μS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.99	7.68	5.05	5195	3.81	5.69
Potassium Chloride	2.93	7.53	5.00	4863	3.80	5.80
Calcium Nitrate	2.82	7.53	5.03	4893	3.43	5.81
Calcium Chloride	2.76	7.69	5.10	4998	3.23	5.89
SED (d.f=6)	*0.067*	*0.140*	*0.040*	*314.4*	*0.269*	*0.107*
LSD 5%	*0.164*	*0.343*	*0.098*	*769.3*	*0.658*	*0.262*
Significance	*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutrient regime on shelf life and fruit internal composition (Figures are a mean of 10 fruit from each of four replicates)

Week number 20

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (μS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.87	7.89	4.89	3970	3.72	5.80
Potassium Chloride	2.99	7.92	4.96	4653	3.57	5.87
Calcium Nitrate	2.96	7.74	5.00	4360	3.62	5.92
Calcium Chloride	3.22	7.91	4.95	4705	3.97	5.81
SED (d.f=6)	*0.114*	*0.096*	*0.085*	*207.7*	*0.233*	*0.098*
LSD 5%	*0.279*	*0.235*	*0.208*	*508.2*	*0.570*	*0.240*
Significance	*N.S.*	*N.S.*	*N.S.*	*	*N.S.*	*N.S.*

Week number 22

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (μS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.99	8.43	4.93	4115	2.51	5.78
Potassium Chloride	2.94	8.54	5.00	4068	2.39	5.90
Calcium Nitrate	3.02	8.47	5.05	4160	2.51	5.87
Calcium Chloride	3.20	8.34	5.05	4440	2.47	6.02
SED (d.f=6)	*0.087*	*0.168*	*0.057*	*329.1*	*0.192*	*0.061*
LSD 5%	*0.213*	*0.411*	*0.139*	*805.3*	*0.470*	*0.149*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutrient regime on shelf life and fruit internal composition (Figures are a mean of 10 fruit from each of four replicates)

Week number 24

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (μS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	3.08	8.60	4.59	3750	2.28	5.68
Potassium Chloride	3.02	8.64	4.56	4340	2.61	5.64
Calcium Nitrate	3.09	8.36	4.70	4590	2.51	5.85
Calcium Chloride	3.04	8.06	4.73	4325	2.36	5.77
SED (d.f=6)	*0.089*	*0.224*	*0.095*	*314.8*	*0.241*	*0.138*
LSD 5%	*0.218*	*0.548*	*0.232*	*770.3*	*0.590*	*0.338*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Week number 26

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (μS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.84	7.77	5.00	4610	2.80	6.14
Potassium Chloride	3.00	7.81	4.94	4538	2.73	6.30
Calcium Nitrate	2.94	7.95	4.95	4813	2.70	6.26
Calcium Chloride	3.05	7.78	4.94	4983	2.70	6.19
SED (d.f=6)	*0.074*	*0.182*	*0.111*	*277.4*	*0.121*	*0.120*
LSD 5%	*0.181*	*0.445*	*0.272*	*678.8*	*0.296*	*0.294*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutrient regime on shelf life and fruit internal composition (Figures are a mean of 10 fruit from each of four replicates)

Week number 28

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (μS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.79	7.83	4.68	-	2.12	5.82
Potassium Chloride	2.88	7.72	4.71	-	2.08	6.05
Calcium Nitrate	2.75	7.57	4.83	-	2.19	6.23
Calcium Chloride	2.82	7.90	4.73	-	2.14	5.89
SED (d.f=6)	*0.044*	*0.131*	*0.118*	-	*0.177*	*0.251*
LSD 5%	*0.108*	*0.321*	*0.289*	-	*0.433*	*0.614*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Week number 30

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (μS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.83	7.93	4.85	5488	2.67	6.80
Potassium Chloride	2.87	7.98	4.75	5455	4.16	5.94
Calcium Nitrate	2.81	7.81	4.91	5475	2.75	6.55
Calcium Chloride	2.96	8.16	4.69	5360	2.74	6.01
SED (d.f=6)	*0.120*	*0.304*	*0.185*	*121.1*	*1.028*	*0.361*
LSD 5%	*0.294*	*0.744*	*0.453*	*296.3*	*2.516*	*0.883*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutrient regime on shelf life and fruit internal composition (Figures are a mean of 10 fruit from each of four replicates)

Week number 32

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (μS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.96	7.74	4.86	5275	3.31	6.66
Potassium Chloride	2.99	8.07	4.53	5130	3.23	6.13
Calcium Nitrate	2.97	7.89	4.68	5025	2.85	6.43
Calcium Chloride	3.03	7.91	4.54	5248	3.15	6.21
SED (d.f=6)	*0.091*	*0.194*	*0.201*	*51.3*	*0.109*	*0.248*
LSD 5%	*0.223*	*0.475*	*0.492*	*125.5*	*0.267*	*0.607*
Significance	*N.S.*	*N.S.*	*N.S.*	**	*	*N.S.*

Week number 34

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (μS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.90	8.18	4.54	5538	2.59	6.04
Potassium Chloride	2.96	7.75	5.14	5803	2.72	6.67
Calcium Nitrate	3.06	8.07	4.80	5535	2.53	6.23
Calcium Chloride	3.18	7.75	4.70	5610	3.19	6.10
SED (d.f=6)	*0.079*	*0.128*	*0.231*	*109.1*	*0.287*	*0.290*
LSD 5%	*0.193*	*0.313*	*0.565*	*267.0*	*0.702*	*0.710*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Effect of nutrient regime on shelf life and fruit internal composition (Figures are a mean of 10 fruit from each of four replicates)

Week number 36

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (µS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.83	7.44	4.65	5580	3.51	6.26
Potassium Chloride	2.91	7.46	4.86	5610	3.13	6.34
Calcium Nitrate	2.82	7.55	4.98	5562	3.16	6.42
Calcium Chloride	2.98	7.27	4.73	5717	3.40	6.42
SED (d.f=6)	*0.060*	*0.246*	*0.132*	*163.8*	*0.262*	*0.116*
LSD 5%	*0.147*	*0.602*	*0.323*	*400.8*	*0.641*	*0.284*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Week number 38

Treatment	Compression (mm)	Endpoint pH	% Soluble Solids	EC (µS)	% Weight Loss (6 days)	% Dry Weight
Potassium Nitrate	2.93	7.89	4.89	4865	3.64	6.25
Potassium Chloride	2.86	7.79	4.84	4893	2.87	6.08
Calcium Nitrate	2.96	7.87	4.89	4810	3.46	6.25
Calcium Chloride	2.97	7.58	4.99	5115	3.66	6.45
SED (d.f=6)	*0.088*	*0.120*	*0.091*	*97.9*	*0.354*	*0.095*
LSD 5%	*0.215*	*0.294*	*0.223*	*239.6*	*0.866*	*0.232*
Significance	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*	*N.S.*

Appendix VIII

Effect of nutrient regime on fruit chemical composition

Week 11

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Dry matter	4.4	4.6	4.8	4.8
pH	4.1	4.1	4.1	4.1
Conductivity μS/20°C	5870	6080	5960	6130
% Nitrogen	2.40	2.66	2.20	2.68
% Phosphorus	0.57	0.58	0.54	0.59
% Potassium	4.49	5.46	5.04	5.43
% Magnesium	0.15	0.15	0.13	0.15
% Calcium	0.17	0.12	0.09	0.09
% Chloride	0.4	0.4	0.4	0.4

Week 15

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Dry matter	5.1	5.1	5.3	5.4
pH	4.2	4.2	4.2	4.2
Conductivity μS/20°C	5600	5500	5110	5090
% Nitrogen	2.00	1.90	1.85	1.83
% Phosphorus	0.47	0.48	0.44	0.47
% Potassium	4.44	4.69	4.43	4.24
% Magnesium	0.13	0.13	0.11	0.13
% Calcium	0.07	0.08	0.10	0.10
% Chloride	0.5	0.5	0.5	0.6

Effect of nutrient regime on fruit chemical composition

Week 19

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Dry matter	5.1	5.0	5.8	5.5
pH	4.0	4.0	4.0	4.0
Conductivity μS/20°C	6670	6570	5350	5910
% Nitrogen	1.83	1.86	1.83	2.02
% Phosphorus	0.53	0.50	0.50	0.49
% Potassium	4.59	4.70	4.45	4.63
% Magnesium	0.16	0.15	0.13	0.14
% Calcium	0.19	0.14	0.17	0.16
% Chloride	0.4	0.5	0.4	0.5

Week 29

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Dry matter	5.5	6.0	5.3	5.4
pH	4.1	4.1	4.1	4.1
Conductivity μS/20°C	5600	5580	5820	5730
% Nitrogen	1.96	1.93	1.79	1.93
% Phosphorus	0.36	0.38	0.36	0.37
% Potassium	4.06	4.36	3.90	4.09
% Magnesium	0.14	0.15	0.13	0.14
% Calcium	0.14	0.15	0.14	0.12
% Chloride	0.4	0.4	0.6	0.5

Effect of nutrient regime on fruit chemical composition

Week 31

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Dry matter	5.4	5.3	5.2	5.3
pH	4.1	4.1	4.1	4.1
Conductivity $\mu S/20°C$	5320	5880	5670	5080
% Nitrogen	1.96	1.84	2.02	1.97
% Phosphorus	0.43	0.42	0.41	0.44
% Potassium	4.45	4.43	4.32	4.51
% Magnesium	0.16	0.14	0.15	0.15
% Calcium	0.15	0.16	0.14	0.15
% Chloride	0.4	0.4	0.4	0.4

Week 36

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Dry matter	6.1	6.1	6.6	6.9
pH	4.0	4.0	4.0	4.0
Conductivity $\mu S/20°C$	5360	5100	5300	5460
% Nitrogen	1.73	1.78	1.66	1.71
% Phosphorus	0.34	0.35	0.37	0.35
% Potassium	3.79	3.93	3.86	3.62
% Magnesium	0.13	0.13	0.13	0.13
% Calcium	0.14	0.12	0.19	0.14
% Chloride	0.4	0.4	0.4	0.4

Effect of nutrient regime on fruit chemical composition

Week 39

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Dry matter	5.7	5.7	5.7	6.0
pH	4.0	3.9	4.0	4.0
Conductivity $\mu S/20°C$	5530	5260	5320	5410
% Nitrogen	1.71	1.73	1.68	1.79
Dry weight g				
% Phosphorus	0.32	0.34	0.33	0.33
% Potassium	3.58	3.72	3.42	3.66
% Magnesium	0.11	0.12	0.10	0.12
% Calcium	0.15	0.12	0.12	0.14
% Chloride	0.4	0.4	0.3	0.3

Effect of nutrient regime on leaf chemical composition

<u>Week 11</u>

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Nitrogen	4.92	4.80	4.95	5.11
% Phosphorus	0.67	0.67	0.67	0.68
% Potassium	3.86	4.06	4.10	3.72
% Magnesium	0.34	0.32	0.30	0.31
% Calcium	0.83	0.61	0.79	0.49
Manganese mg/kg	78.0	81.0	83.0	50.0
% Chloride	0.6	0.6	0.6	0.6

<u>Week 15</u>

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Nitrogen	4.88	4.88	*	5.14
% Phosphorus	0.74	0.73	*	0.68
% Potassium	3.92	4.18	*	4.38
% Magnesium	0.39	0.45	*	0.36
% Calcium	0.66	0.86	*	0.80
Manganese mg/kg	96.0	96.0	*	83.0
% Chloride	0.4	0.5	*	0.6

Effect of nutrient regime on leaf composition

Week 19

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Nitrogen	4.82	4.69	4.61	4.58
% Phosphorus	0.58	0.60	0.54	0.55
% Potassium	3.67	3.26	3.38	3.34
% Magnesium	0.36	0.35	0.27	0.30
% Calcium	1.02	0.93	1.13	1.15
Manganese mg/kg	100	99.0	88.0	91.0

Week 27

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Nitrogen	4.70	4.81	4.82	4.97
% Phosphorus	0.49	0.48	0.47	0.48
% Potassium	3.28	3.19	3.45	3.55
% Magnesium	0.29	0.28	0.29	0.31
% Calcium	0.99	0.98	1.02	0.96
Manganese mg/kg	102	107	99.0	118

Effect of nutrient regime on leaf chemical composition

<u>Week 32</u>

Determination	Pot Nit	Pot Chl	Cal Nit	Cal Chl
% Dry matter	15.0	17.0	14.7	15.2
% Nitrogen	4.72	4.70	5.10	5.01
% Phosphorus	0.52	0.50	0.51	0.56
% Potassium	3.72	3.68	3.54	3.37
% Magnesium	0.31	0.31	0.31	0.29
% Calcium	1.50	1.34	1.51	1.44
Manganese mg/kg	132	158	148	149