Profitability of Glasshouse Vegetables

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A Management Study of Glasshouse Vegetable Cropping in Auckland

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C O N T E N T S

F O R E W A R D

This report resulted from a survey partially financed by a group of Auckland tomato growers and its contents apply specifically to them. However, because it contained lessons for growers in other areas and exposed many weaknesses and areas in the industry for further study we decided to make it more widely available. Important criticism of cultural techniques is made such as late planting and low night temperatures, the high density of plants. These points require further investigation. The misleading conclusions that can be drawn from 'costs of production' surveys should serve as a warning to other horticultural industries and the suggestions on organised national marketing should not fall on deaf ears. The lack of economic viability of small businesses compared with large may not be news but the poor record of production and labour output in Auckland glasshouses will dent our self-satisfaction.

Finally it is clear that such work requires constant updating and this is particularly so if growers heed the advice given since then a new set of marketing factors come into play. It is to be hoped that this department can be entrusted with some of this.

T.M. Morrison

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A C K N O W L E D G E M E N T S

This study was initiated by the New Zealand Vegetable and Produce Growers' Federation Inc., who provided finance and facilities for the collation and analysis of data.

Grateful thanks are offered to the following:-

The Auckland growers who co-operated in providing information and hospitality.

The staff of the Ministry of Agriculture and Fisheries Advisory Division in Auckland. Particular thanks are due to Mr Eric Van Essen and Mr Ian Brice who made the initial contacts and provided transport and facilities for the field work.

Ms. Mandy Shaharudin who coded up the market records for computer analysis, Ms. Paula Moon who drew the diagrams and Ms. Jane Holmes who typed the first, second and third copies.

However any delay in producing the report and its contents are the full responsibility of the author.

Howard Gill
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I N T R O D U C T I O N

1. This study was initiated by the New Zealand Vegetable Growers' Federation with the objective of documenting factors pertinent to success in glasshouse vegetable growing in the Auckland area.

This report should not be seen as an economic study of glasshouse cropping. That is extrapolation of these results to the whole of the Auckland industry would be invalid. The time and budget available, and the lack of suitable statistics made it impossible to draw a sample representative of the whole industry.

1.2. Objectives of the Study

So far as is known to the author no previous comprehensive studies have been published in New Zealand on the financial results from glasshouse cropping.[1] The objective of this study was to attempt to explain the causes of variation in financial results between businesses.

Thus the report is divided into four main parts:-

1. An examination of financial results for the years 1970/71 - 1972/73
2. A comparison of growing methods
3. An examination of yields and returns
4. An examination of labour use

Concentration on these areas is to neglect other significant ones such as finance and taxation. This can be justified on two grounds; that these tend to be peculiar to individual businesses and that some measure of specialised advice is already available.

The study is orientated towards documenting common problems and to developing standards by which the efficiency of individual businesses can be assessed. In this the inter-relationship of cropping system, use of inputs and marketing are stressed. A subsidiary aim of the report is to present simple methods by which proposed changes can be evaluated. It is very much an introductory study but areas of more detailed work are suggested.

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[1] Other than gross margins and costs of production surveys little has been published on other horticultural crops.

1.3. Background Information

The total area of commercial glasshouse vegetable crops in New Zealand in 1973 was 118 ha. These crops were produced by a total of 1620 growers[2]. Virtually all the production is for the domestic market with 92% of the area being tomatoes. The cropped area has increased steadily in the recent past with a 20% increase from 1963 - 1972. Accurate statistics of the value of production are unavailable but a reasonable estimate would be $9-$10 million per annum.

The three major concentrations of glasshouse production are in the Auckland, Nelson and Canterbury regions. Of these the Auckland district is the largest, with the greatest rate of increase. The following table summarises the pattern of glasshouse vegetable cropping in Auckland[3].

Crop	Area (ha)	Total Yield (tonnes)	% of Total N.Z.	
			Area	Yield
Tomatoes	45	5470	42%	35
Cucumbers	3.2	632	46%	60
Beans	1.8	65	70%	90
Total	50		42%	

The number of glasshouse growers in the district has been estimated at 400; with $6m of capital equipment and an annual production valued at $4m. Although estimates cover the region from Papakura to Wellsford the majority of holdings are situated within a 19km radius of the Auckland Chief Post Office; that is in the metropolis. There are a number of local concentrations such as Henderson, on the west of Waitemata Harbour, and on the south of Mangere Harbour.

In the ten years 1963-1972 the area of glass in Auckland has doubled compared to a 20% increase in the rest of New Zealand. Glasshouse cropping in Auckland is favoured both by climate and proximity of consumers. However in the May to October period produce is distributed

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[2] N.Z. Horticulture Statistics p21, Economics Division, Ministry of Agriculture and Fisheries

[3] This information obtained from "Horticultural Development in Auckland", Ministry of Agriculture and Fisheries, Advisory Division, Auckland, March 1973.

to every centre of the country. The recent increases in the costs of heating fuels suggests that the locational advantages will have increased. This could lead to a further concentration of production in the area.

The metropolitan situation of the industry while providing proximity to markets and communications is also a disadvantage. The value of the present properties must be judged at urban use which can be from $20,000 to $50,000 per acre. Although this can provide retirement or redevelopment funds for existing growers, expansion of the present area through land purchase is unlikely. Thus relocation of the industry to more rural areas would appear imminent. To assist with this some form of land use planning is thought essential.

No statistical information has been published on the size distribution of properties nor on the type of facilities used. The majority of full-time businesses are around 1000m^2 and operated by the family without permanent hired staff. At the other extreme are a group of properties of 3,000-4,000m^2 with three or four full-time staff.

1.4. The Sample of Growers

In December 1973 the author collected information from a sample of Auckland growers on various aspects of their businesses. This included financial data from profit and loss accounts, plus the items on the field sheet shown as Appendix V.

The sample of growers overstates the more successful ones. Thus, while the report gives the potential of glasshouse cropping, it probably overstates the existing average. In selecting growers to include in the study an attempt was made to balance numbers by size group, cropping system, marketing method and location within the district.

It will be seen from the report that sample numbers vary. While 21 growers were visited usable information was not obtained from them all. Likewise a number of anomalies occurred such as with the shortage of information and the age of the business; these have been omitted.

1.5. Physical Facilities

All the glasshouses included in the study were heated and of timber construction. The majority of houses were 9m single span or modules of this width. Heating facilities were either oil or coal fired hot water piped systems or diesel fueled hot air units. All houses were equipped with soil level irrigation, usually of the trickle type. Liquid feeding was applied through this from either central dilution equipment or individual bottles. Every property possessed some form of grading equipment.

The cropping systems are described later in the report. However general features were the use of chloropicrin for soil sterilisation and the preponderance of the variety 'Potentate'.

1.6. Standardisation of Financial Results

From the information obtained two measures were calculated for comparative use; those of 'surplus' and 'disposable' income. No attempt was made to calculate 'return on capital'. This is because of difficulties in measuring the present value of the capital used by a business, because of depreciation practises and the problem of land values[4].

Some form of standardization is necessary to allow comparisons to be made between businesses. Business accounts are produced for taxation purposes rather than to record business success, and in many cases the "profit" as produced for taxation is an unsatisfactory comparative measure. Differences in "profit" between any two business can occur for three broad reasons:-

1. Success as a grower

2. Differences in consumption style. Items such as house or car are in part legimiate deductions for tax purposes. However the level of these reflect life style rather than growing ability.

3. Difference in business organisations. A limited liability company may well charge salaries for the grower and family, while private businesses do not.

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[4] In fact if the land and residential facilities are included in capital it is perhaps valid to include the capital gain, although unrealised, into returns.

The full standardisation procedure is shown in Appendix I, and only a brief summary given here. The basis for comparison was owner-occupier properties free of mortgage and producing only glasshouse crops. This has the following implications:-

1. Only returns and costs associated with glasshouse cropping are included

2. Interest and repayments on loans are excluded

3. Only costs directly variable with cropping are included. Hence, motoring expenses, dwelling house maintenance and depreciation and other factors dependant on the grower's life style are excluded

4. Wages of the grower and family are included

This procedure provides two figures to replace the profit drawn up for tax purposes.

1. Surplus - this is the difference between sales of produce and total costs relevant to that production, including family labour and management

2. Disposable income - in many ways this is a more realistic figure as it represents the amount of cash available to the business in any year. It is calculated:-

   Disposable Income = Surplus + value of grower and family labour + depreciation

It must be stressed that the whole of this disposable income is not available for personal consumption. In fact it must meet:-

1. The business share of motor and residential facilities
2. Interest and loan repayments
3. Taxation
4. Re-investment in capital equipment
5. Personal consumption

2. OVERALL FINANCIAL RESULTS 1970/71 - 1972/73

For a group of 11 growers, the growing system and cropped area were more or less consistent over the 3 year period. The results are summarized in Table 1.

TABLE 1: Results for 11 Growers

	1970/71	1971/72	1972/73
Mean area (m^2)	2185	2300	2792
Sales ($/$m^2$)	7.20 (0.65)	8.62 (0.88)	9.03 (1.62)
Expenses ($/$m^2$)			
Materials	0.63 (0.21)	0.71 (0.17)	0.75 (0.22)
Containers	0.38 (0.10)	0.49 (0.14)	0.52 (0.10)
Freight	0.32 (0.08)	0.38 (0.11)	0.40 (0.16)
Fuel & Elec.	0.29 (0.16)	0.23 (0.14)	0.24 (0.12)
Overheads	0.36 (0.11)	0.34 (0.11)	0.37 (0.11)
Repairs & Maintenance	0.23 (0.13)	0.21 (0.11)	0.26 (0.09)
Motor Expenses	0.05 (0.03)	0.05 (0.03)	0.06 (0.03)
Depreciation	0.61 (0.17)	0.68 (0.27)	0.65 (0.25)
Wages	0.78 (0.77)	0.91 (0.96)	0.98 (1.17)
Family labour	2.66 (1.19)	2.96 (1.40)	3.13 (1.39)
Total	6.29 (0.79)	6.96 (1.10)	7.35 (1.07)
Surplus	0.90 (0.91)	1.67 (1.15)	1.68 (1.68)
Disposable Income	4.17 (0.73)	5.27 (0.75)	5.46 (1.53)

Figures in brackets are standard deviations.
(Note: metric units are used throughout this report. For conversions see Appendix II).

TABLE 2: Indices for 11 Growers

	1970/71	1971/72	1972/73
Sales	100	119.8	125.5
Materials	100	112.7	119.0
Containers and freight	100	124.3	131.4
Fuel and electricity	100	79.3	82.8
Overheads	100	94.4	102.8
Repairs and maintenance	100	91.3	113.0
Motor expenses	100	100	120.0
Depreciation	100	111.5	106.6
Wages	100	116.7	125.6
Family labour	100	111.3	117.7
Total	100	110.5	116.7
Surplus	100	185.6	186.7
Disposable income	100	126.4	130.9
Total labour costs	100	112.5	119.5
Total non-labour costs	100	108.5	113.7

It should be noted that the growers included in Table 1 encompass all size groups and single cropping systems.

The mean figures of this table are not weighted for area. It is considered that the level of heating etc is the result of a grower's decision; given the unrepresentative nature of the sample this procedure is believed preferable to weighting by area.

In Table 2 the mean figures of Table 1 are expressed as indices with 1970/71 as a base of 100 for sales and expenses.

Tables 1 and 2 show there has been an increase in the level of sales, surplus, and disposable income over the three year period. Equally notable is the increased variation between growers in these items, as shown by the standard deviations. As is discussed below it appears that a significant gap is occurring between the more and the less successful growers.

Table 3 summarises the changes over the three years.

TABLE 3: Summarised Indices for 11 Growers

	1970/71	1971/72	1972/73
Sales	100	119.8	125.5
Non-labour costs	100	108.5	113.7
Total labour	100	112.5	119.5
Total costs	100	110.5	116.7
Surplus	100	185.6	186.7
Disposable income	100	126.4	130.9

	% Change	
	1970/71 to 71/72	1971/2 to 72/73
Sales	+19.8	+4.8
Non-labour costs	+ 8.5	+4.8
Total labour	+12.5	+6.2
Total costs	+10.5	+5.6
Surplus	+85.6	+0.6
Disposable income	+26.4	+3.6

Overall there was a major increase in sales, surplus and disposable income from 1970/71 to 71/72. The rate of increase was greater than that in expense items. In the 71/72 to 72/73 there was a smaller increase in sales etc., which was less than the rate of increase in expenses. However the mean income still showed an absolute increase.

The figures in the above tables must be considered in real terms. That is, compared to the rates of inflation. A convenient measure of inflation is the Government Statistician's Retail Price Index. The charge in this over the period is as follows (all groups index):-

1970/71 to 71/72	10.4%
1971/72 to 72/73	7.6%

Taking the two years together growers' incomes maintained and in fact increased their real values. This is a satisfactory state presuming there had not been a decline in the period prior to 1970. For this no information is available.

Relation of Costs to Sales

Examination of costs per unit area shows that the most significant increases have been for containers and freight and for labour, both paid and family. Since these inputs must increase if yields increase, it is more significant to study whether the efficiency of use has been maintained. A crude measure of productivity is to relate costs to sales. This is done in Table 4 which shows costs/$100 sales for the same 11 growers.

TABLE 4: Cost/$100 Sales (11 Growers)

	1970/71	1971/72	1972/73
Sales	100	100	100
Expenses			
Materials	8.8	8.2	8.3
Containers	5.3	5.7	5.8
Freight	4.4	4.4	4.4
Fuel & electricity	4.0	2.7	2.7
Overheads	5.0	3.9	4.1
Repairs & maintenance	3.2	2.4	2.9
Motor expenses	0.7	0.6	0.7
Depreciation	8.5	7.9	7.2
Wages	10.8	10.6	10.9
Family labour	36.9	34.3	34.7
Total costs	87.5	80.7	81.4
Surplus	12.5	19.4	18.6
Disposable income	57.9	61.1	60.5
Summary			
Sales	100	100	100
Non-labour costs	39.8	35.8	35.8
Total labour costs	47.7	44.9	45.6
Total costs	87.5	80.7	81.4

Thus over the period the efficiency with which the various input items are used has been maintained or improved.

Variation between Growers

It has been shown that there was a smaller mean growth in disposable income in 1972/73 as compared with 1971/72. The larger standard deviation figures show that there was more variability in the later years. This is further illustrated by Table 5 which divides the growers into two groups; those whose sales increased faster than the mean of +4.8% (71/72 to 72/73) and those where the increase was less.

TABLE 5: Growers with above Mean Sales Increase

(6 Growers)

	1970/71	1971/72	1972/73
Sales ($/m^2)	7.26	8.77	10.09
Costs	6.32	7.17	7.81
Surplus	0.94	1.60	2.28
Disposable income	4.32	5.27	6.40

Growers with below Mean Sales Increase

(5 Growers)

	1970/71	1971/72	1972/73
Sales	7.12	8.46	7.76
Costs	6.27	6.71	6.80
Surplus	0.85	1.75	0.96
Disposable income	4.00	5.27	4.32

Table 5 re-emphasizes the dominance of returns in determining financial success in horticulture. This is illustrated by graphs 1 and 2 which show the relationship between returns and surplus or disposable income.

Graphs 1 and 2 show very discernable trends for disposable income and surplus respectively to increase with returns for both large and small growers. (Large growers are defined as those with more than 3,000m^2 of glass). Graph 3 compares the level of surplus with total costs for large growers. No discernable trend can be seen on this graph.

Two conclusions can be drawn; that

1. the level of returns is the best indicator of financial success in glasshouse growing

2. cost reductions will only lead to increased profits where the level of returns is maintained. This should be self evident but if often appears that growers and others ancillary to the industry examine costs in absolute terms.

Graph 3 shows quite clearly that the lowest cost producers were not necessarily the most successful. On the other hand, it cannot be concluded that the growers with higher inputs are obtaining full value from these.

The range of cost levels also suggests that there is no single best way of successfully producing in the Auckland area. This will be discussed further below.

A further notable point is that of the five growers who had below average increase in sales and disposable income from 1971/72 to 72/73, three had increased their area of glass and one had changed from double to single cropping. As cash requirements are highest during expansion, this is particularly unfortunate. While the poorer performance may be temporary it raises the following:-

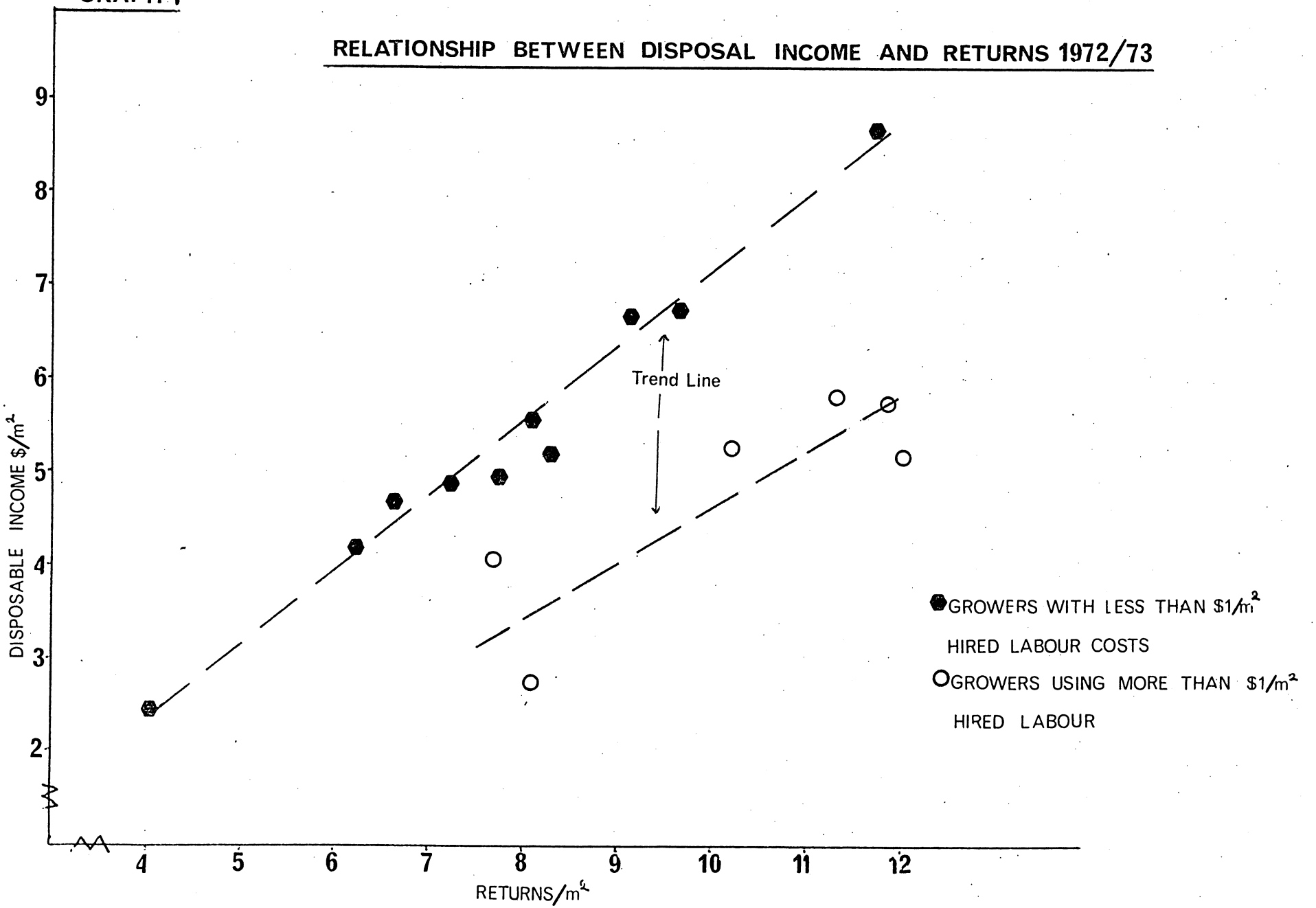
1. The need for more rigorous planning of expansion to reduce the likelihood and hence the consequence of delays

2. The problems faced by a grower in managing a larger area. Technical and managerial skills suited to small areas may not be so appropriate to larger areas. A particular problem appears to be that of maintaining high technical prowess where more tasks are performed by non-family labour.

It is felt that one area in which the Ministry of Agriculture Advisory Service might be more effective is through intensive advice at this stage. A very positive step would be the provision of a detailed schedule for the construction of new glass. While some delays are outside the control of the grower, a technique such as critical path analysis enables estimates to be made of the effect of these. The combination of 'historical' data of the time and cost requirements for the constituent activities of construction with 'guesstimates' of supply times would reduce the losses resultant from a late completion of facilities.

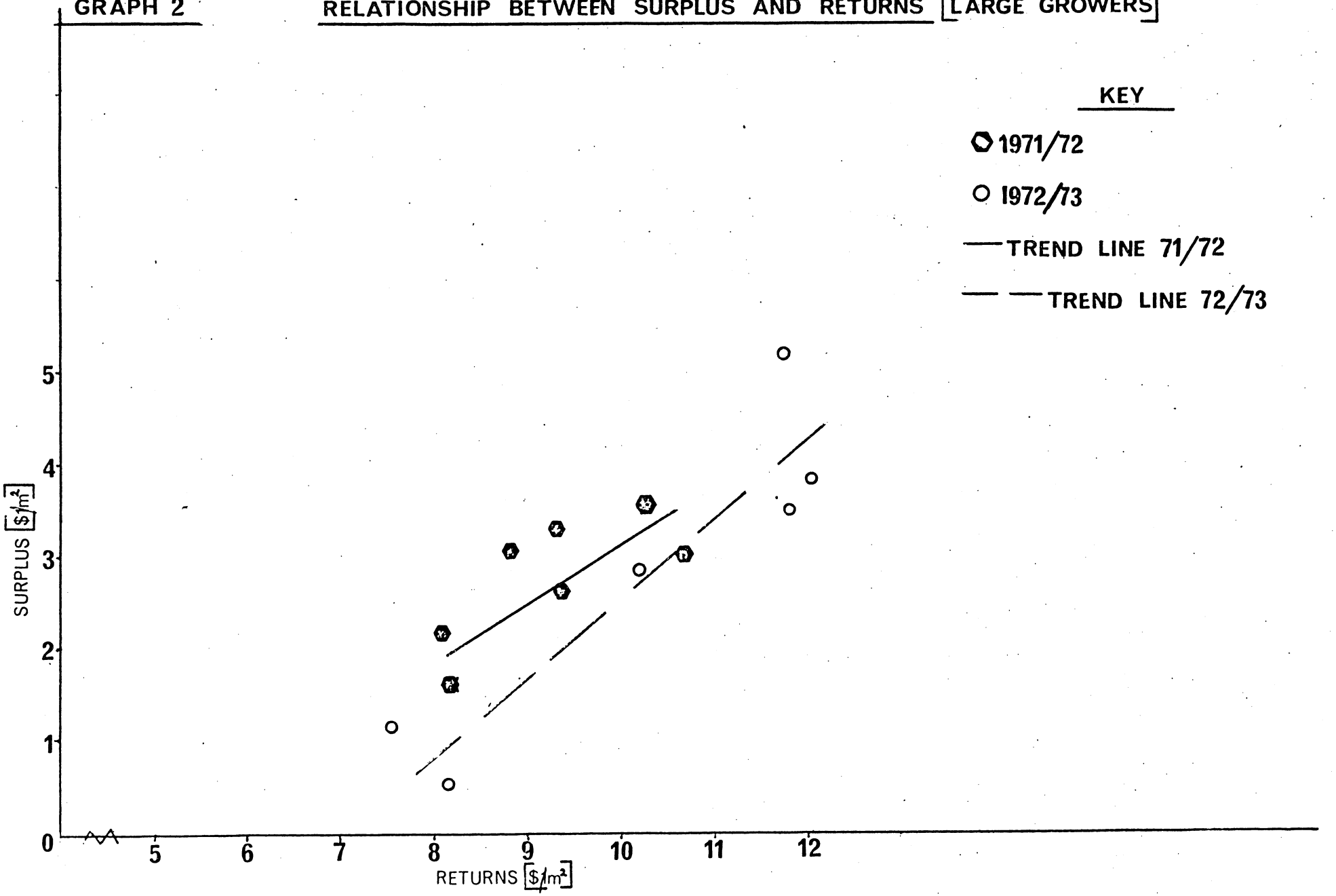
GRAPH 1

RELATIONSHIP BETWEEN DISPOSAL INCOME AND RETURNS 1972/73

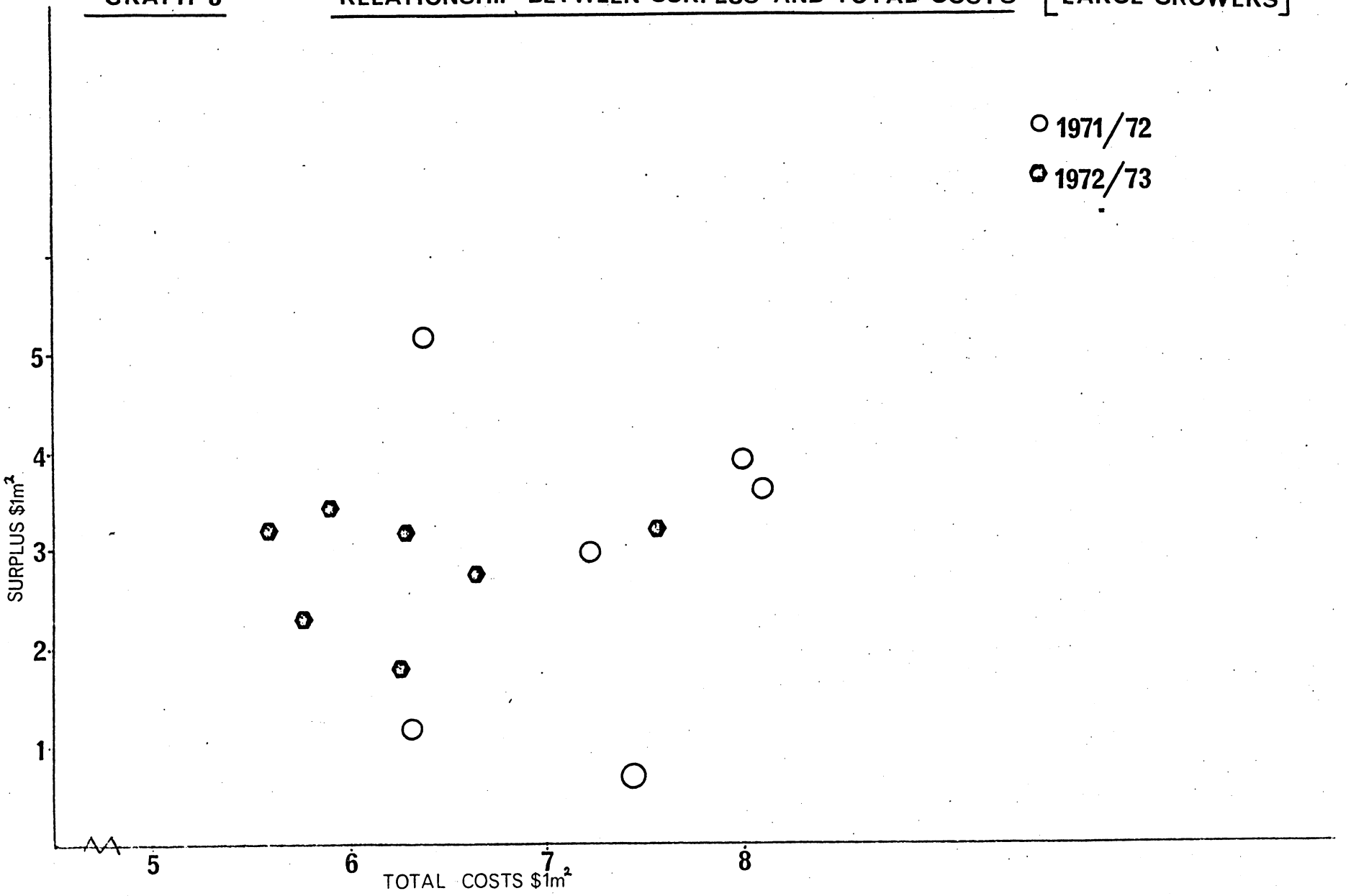


GRAPH 2

RELATIONSHIP BETWEEN SURPLUS AND RETURNS [LARGE GROWERS]



GRAPH 3 RELATIONSHIP BETWEEN SURPLUS AND TOTAL COSTS [LARGE GROWERS]



Effect of Property Size on Financial Results

Table 6 summarises results from large growers (more than 3000m^2 or labour costs greater than \$1/m^2) and Table 7 from small growers. However this division is very nearly also a division by cropping system, as almost all the large growers are 'single cropping' and the small growers 'double cropping'.

TABLE 6: Mean Results from Large Growers (\$/m^2)

	1970/71	1971/72	1972/73
Number	6	6	5
Mean area	3429 (819)	3550 (531)	3531 (598)
Sales	7.60 (0.67)	9.23 (1.07)	9.86 (2.0)
Purchases	0.48 (0.17)	0.54 (0.17)	0.63 (0.23)
Container & freight	0.78 (0.06)	0.95 (0.08)	1.10 (0.09)
Fuel	0.28 (0.14)	0.24 (0.11)	0.27 (0.10)
Overheads	0.32 (0.08)	0.34 (0.10)	0.33 (0.02)
Motor	0.06 (0.03)	0.06 (0.03)	0.06 (0.04)
Repairs & maintenance	0.24 (0.10)	0.25 (0.12)	0.29 (0.10)
Depreciation	0.51 (0.10)	0.52 (0.10)	0.55 (0.11)
Wages	1.69 (0.61)	1.88 (0.88)	1.93 (1.11)
Family labour	1.57 (0.28)	1.68 (0.26)	1.96 (0.43)
Total costs	5.93 (0.34)	6.46 (0.69)	7.11 (0.78)
Surplus	1.67 (0.50)	2.78 (0.67)	2.75 (1.87)
Disposable income	3.76 (0.60)	4.98 (0.67)	5.26 (2.20)

TABLE 7: Mean Results from Small Growers ($/m^2)

	1970/71	1971/72	1972/73
Number	7	7	8
Area (m^2)	1135 (233)	1211 (286)	1466 (393)
Sales	6.83 (0.71)	8.04 (0.82)	7.86 (1.17)
Expenses			
Purchases	0.71 (0.16)	0.83 (0.07)	0.78 (0.19)
Containers & freight	0.63 (0.08)	0.81 (0.13)	0.75 (0.11)
Fuel	0.24 (0.18)	0.19 (0.16)	0.19 (0.13)
Overheads	0.40 (0.14)	0.36 (0.14)	0.37 (0.14)
Motor	0.05 (0.01)	0.05 (0.02)	0.05 (0.02)
Repairs	0.20 (0.15)	0.14 (0.08)	0.22 (0.09)
Depreciation	0.70 (0.17)	0.82 (0.29)	0.71 (0.27)
Wages	0.31 (0.40)	0.35 (0.36)	0.19 (0.25)
Family labour	3.49 (0.79)	3.94 (0.92)	4.06 (0.94)
Total	6.72 (0.83)	7.48 (1.1)	7.31 (1.21)
Surplus	0.11 (0.88)	0.57 (1.1)	0.55 (0.92)
Disposable income	4.29 (0.85)	5.32 (1.1)	5.33 (0.92)

The most notable features in comparing large and small growers are the higher returns and surplus of the former group. Also of note is the greater total labour cost of the smaller growers. These are summarised in Table 8.

TABLE 8: Returns, Surplus and Total Labour Costs ($/m^2)

	1970/71	1971/72	1972/3
Small Growers			
Mean returns	6.83	8.04	7.86
Range	5.89 to 7.64	6.63 to 9.04	6.27 to 9.65
Mean total labour costs	3.80	4.29	4.25
Range	2.29 to 4.78	2.79 to 5.66	3.13 to 5.41
Mean surplus	0.11	0.57	0.55
Range	-0.82 to 1.4	-2.25 to 1.75	-0.81 to 1.87
Large Growers			
Mean returns	7.60	9.23	9.86
Range	7.08 to 8.59	8.10 to 10.72	7.56 to 11.81
Mean total labour cost	3.27	3.57	3.89
Range	2.80 to 3.56	2.81 to 4.40	3.16 to 4.95
Mean surplus	1.67	2.78	2.75
Range	1.16 to 2.42	2.30 to 3.56	0.62 to 5.29

The use of family labour, both manual and managerial appears as the only significant economy of scale. For the smaller growers, the lower surplus reflects both the generally lower value of returns and the higher labour costs. In each of the years, three of the seven or eight small growers showed a negative surplus (an economic loss) when family labour was taken as a cost of production. To some extent this reflects the greater hours the smaller growers and their wives report as putting into the business, as compared to larger growers.

In strictly economic terms such businesses must be considered as unprofitable. However, the level of disposable income per m^2 is still higher than the larger growers despite lower mean returns. For 1972/73, taking the mean area of $1466m^2$ the 'average' small grower would have available $7813 from which to meet tax, private and business use of vehicles, dwelling maintenance and loan repayment and servicing. This is despite a small economic surplus. For a grower, decisions as to whether to continue in business tend to be made by comparing cash availability from horticulture against that from other employment. In doing so, strict accounting for the hours in the business is rare.

However, it must also be pointed out that the labour input (in terms of hours of work reported) was very variable among small growers. This is indicated by the large range of Table 8 and the standard deviation of Table 7. Since the growers working longer hours were not producing higher returns or surplus, it appears that their labour is not as effective as it might be.

The fact that family labour contributes around 50% of total costs on small properties mitigates against attempts to regulate the industry. Such growers will tend to be insulated against shifts in economic profitability. Likewise, new entrants in the industry may feel their cash income sufficient, while in fact, in economic terms it is a deficit.

It is of general interest that the comparison of Tables 6 and 7 show the larger grower more successful on a unit area basis. It would be expected that in glasshouse cropping the highest level of returns would come from the smallest area. Experience suggests that glasshouse cropping requires a high technical skill plus attention to detail.

Growers with smaller areas would thus be expected to produce higher returns per plant. This is not the case in this Auckland study. The extent to which the production system and the marketing pattern affect returns is discussed below.

3. EFFECT OF CROPPING SYSTEM

Three types of glasshouse cropping were included in the survey; single cropping tomatoes, double cropping tomatoes - tomatoes and double cropping tomatoes - cucumbers or beans.

1. Single Crop Tomatoes

A general programme would be:-

Sowing date:	2nd-3rd week in March
Planting date:	2nd-3rd week in April
Growing method:	night temperatures around 9°C, high potash liquid feeding, hormone used for fruit setting
Harvesting:	commencing late July to early August. Continuing to mid-January to early February

There are a number of variations from this:-

(a) A spread of planting dates from late March to mid May
(b) A number of growers stopping harvesting immediately before Christmas
(c) The majority of growers use Potentate, but a small number are using Eurocross BB

2. Double Crop Tomatoes

A typical programme would be:-

mid January	sterilise soil
1st-2nd week Feb.	plant autumn crop
mid May	commence harvesting
end July	pull out autumn crop, plant spring crop
early-mid Nov.	commence harvesting
mid January	pull out second crop

3. Double Crop Tomatoes - Cucumbers or beans

The autumn crop of tomatoes is identical to system 2, but is followed by cucumbers or beans (or some houses of each crop). In this case, harvesting would recommence late September to mid October.

Major technical differences between the systems are as follows:-

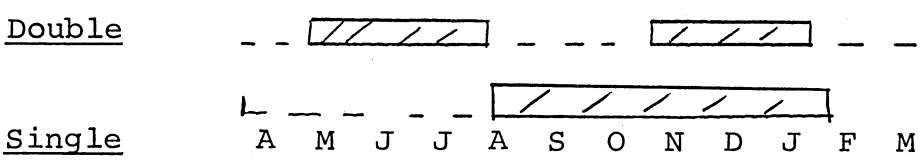
(a) The single crop will be technically more difficult to grow as the early trusses are developing in declining light conditions of winter.

(b) Double crop tomatoes will make less demand for fuel, the first crop will develop in the good light conditions of February to April and will only require heat for ripening. The autumn crop will grow with improving ambient light and temperatures and thus be easier to produce.

(c) Labour inputs for growing (excluding harvesting) should be lower for double cropping as the plants will not be taken "over the wire". On the other hand, the use of two sets of plants, string etc. will increase material costs. This is exaggerated by many double crop growers buying plants in, as compared to propagating on the property.

The Choice between Single and Double Cropping

The diagram below indicates the growing and harvesting period of the alternative systems.



Key: growing period

harvesting period

The overall harvest period for both systems is about six months. Because of the factors listed above, it is to be expected that the total weight of fruit would be higher for double cropping than for single cropping. Any advantage of one system over the other will be dependant on:-

(a) the relative value of yield at different times of the year
(b) any differences in costs

Results from the Various Cropping Systems

The full results from the three systems are shown in Tables 9, 10 and 11. From these the major conclusion is the marked superiority of single cropping in producing an economic surplus. Double cropping with cucumbers and/or beans gives a higher disposable income than single cropping. This occurs however because of the negligible use of hired labour with the smaller property size, hence almost all the labour cost is part of disposable income.

Other significant factors are:-

1. The lower fuel costs with double cropped tomatoes.
2. Higher material costs for double cropping.
3. Higher freight charges for single crop growers; this in part reflects the more national distribution by these larger growers.
4. The higher total labour costs of both double cropping systems as compared to single cropping. This probably reflects the greater working hours reported by smaller growers.

TABLE 9: Mean Financial Results for Single Crop Growers

	1970/71	1971/72	1972/73
Number of growers	6	7	6
Mean area (m^2)	3102	4447	3276
Returns	7.41	9.02	9.51
Purchases	0.48	0.58	0.63
Containers	0.38	0.43	0.56
Freight	0.35	0.45	0.50
Fuel	0.29	0.27	0.27
Overheads	0.30	0.33	0.33
Repairs	0.23	0.22	0.26
Motor	0.05	0.06	0.05
Depreciation	0.52	0.51	0.55
Wages	1.55	1.77	1.73
Family labour	1.63	1.65	2.04
Total	5.78	6.27	6.91
Surplus	1.63	2.75	2.60
Disposable income	3.78	4.86	5.19

TABLE 10: Mean Financial Results for Double Crop Tomatoes[5]

	1970/71	1971/72	1972/73
Number of growers	3	4	3
Mean area	1855	1791	1604
Returns	6.64	7.96	6.99
Purchases	0.57	0.82	0.66
Containers	0.43	0.46	0.50
Freight	0.27	0.35	0.19
Fuel	0.16	0.09	0.09
Overheads	0.45	0.40	0.32
Repairs	0.24	0.16	0.18
Motor	0.04	0.03	0.03
Depreciation	0.59	0.65	0.58
Wages	0.89	0.78	0.21
Family	3.10	3.57	4.35
Total	6.74	7.31	7.10
Surplus	-0.10	0.65	-0.11
Disposable income	3.59	4.87	4.82

[5] predominant cropping system - some growers had a 'mixed' system with part of property single cropped tomatoes

TABLE 11: Mean Financial Results for Double Crops

Tomatoes - Cucumbers (or Beans)

	1970/71	1971/72	1972/73
Number of growers	4	5	4
Mean area	1084	1091	1228
Returns	7.26	8.70	8.55
Purchases	0.81	0.86	0.91
Containeres	0.35	0.64	0.45
Freight	0.30	0.28	0.32
Fuel	0.30	0.23	0.24
Overheads	0.41	0.36	0.42
Motor	0.04	0.06	0.06
Repairs	0.18	0.14	0.27
Depreciation	0.75	0.97	0.85
Wages	0.09	0.09	0.05
Family	3.70	4.28	4.26
Total	6.93	7.91	7.82
Surplus	0.33	0.79	0.73
Disposable income	4.78	6.04	5.84

This data suggests that on the average, single cropping will produce the highest returns and surplus. Double crop growers are using more labour (usually their own) to less value. This can be emphasized by postulating the effects of changing from double to single cropping for a 1350 m^2 property, assuming mean returns and costs of Tables 9 and 11, and no change in fixed costs, (overheads, depreciation and repairs). Table 12 shows the results of the calculation.

TABLE 12: Effect of a Shift from Double to Single Cropping for a 1350 m^2 Property

	Double Tomatoes - Cucumbers	Single Tomatoes
Returns	11543	12839
Variable costs	2673	2714
Fixed costs	1809	1809
Labour	5819	5090
Total costs	10301	9613
Surplus	1242	3226
Disposable income[6]	7804	9059

It is presumed that there will be no change in the relative prices between different times of the year. It must also be stressed that from the financial information alone, it is impossible to examine the effect of market distribution on returns and surplus. This will be considered in the next section.

Optimum Level of Inputs

In Europe there has been considerable research on the optimum level of various input factors. This research culminated in such techniques as 'Programme Growing on Tomatoes' in Guernsey (first published 1965) and 'Blueprint Growing' in the U.K. (1968).

These techniques utilise the principle of declining marginal returns. Thus it is worthwhile increasing temperatures, and hence total fuel bill up to an optimum. Above this increases in return and profit will be less than the marginal cost increase. From this research it is possible to deduce 'cost standards' which serve as a guide to the success of the crop.

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[6] This supposes that all labour is supplied from the family

It has been pointed out that the data presented shows that total cost level is not an indicator of financial success. The only strong relationship found is between disposable income and returns (for small growers) and surplus and returns (for large growers).

Of the major inputs, only freight and containers appear to vary at all proportionately with returns. Fuel costs, labour costs and material costs show no consistent relationship with returns or surplus.

Simarly, no consistent relationships could be found for the relationship between location, cropping or marketing systems, and inputs or outputs. It is possible to find high and low levels of every input producing high and low returns. Thus for instance, why if one grower can get $\$11.72/m^2$ returns from \$0.14 fuel costs, does another require \$0.37 for the same level? Similar situations apply for all inputs.

A number of tentative reasons can be offered:-

1. The presence of intervening variables such as disease incidence, length of harvesting season.

2. Major differences in the skill which crops are grown.

3. Differences in physical efficiency such as that of heating units or work methods.

Of these the second is of most interest.

European research suggests the use of much higher temperatures for winter planted tomatoes, rather than those used in Auckland. This is despite lower ambient light intensities. Such temperature regimes (around $16.5\text{-}17^{o}C$ night temperature) have been shown to produce a higher earlier yield of fruit; which given the higher prices early in the year cover the increased fuel bill. Such temperatures must be associated with a more controlled plant growth.

These growing systems are more precise and to some extent the need for constant decision to produce satisfactory if not excellent returns is reduced. The exercise of skill then becomes imperative to ensure the growth and fruit development later in the season. Through this the best returns and profits are obtained.

It was said above that this data points to a lack of consistency over the whole sample, with an increasing gap between the more and less successful growers. Might not one reason for this be that with the lack of precise recommendations there is an increasing premium for skill?

A final conclusion to this section might be to suggest that the full potential of the Auckland climate is not yet being achieved. Nicholson (1971) in a review of tomato production in the British Isles states, "Thus the heaviest expenditure, the highest output and the greatest margins were associated with the earliest crops. These also produced the heaviest weight of tomatoes".[7] The question of earliness, yield and price will be considered in the following section.

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[7] Reference: Nicholson, J.A.H. (1971) The British Isles Tomato Survey, 3rd Report 1968 crop. Wye College, Ashford, Kent.

4. FACTORS AFFECTING RETURNS

It has been shown in sections 2 and 3 that surplus and disposable income are closely correlated with returns. Returns will be dependant upon:-

1. Total yield and the distribution of yield through the season
2. Quality and size of fruit
3. Prices received

These factors are examined in this section.

1. Effect of Yield on Returns - Single Crop Growers

Information on yield and prices was obtained from growers' records or from analysis of market advice notes. Yields were relatively constant over the three years and thus this portion of the analysis centres on 1972/73 as a representative example of the three years.

Table 13 presents yields from seven crops for season 1972/73; the crops are grouped according to planting date. Standard week numbers are used; these commence with April 1-7 as week 1. (The full list of dates is shown as Appendix III).

TABLE 13: Yields kg/m^2 for 1972/73 Season Single Crops

Weeks	planting date						
	early Apr		mid April		early May		
	G R O W E R						
	1	2	3	4	5	6	7
Up to 16	0.16	0.16	-	-	-	-	-
17-20	1.68	1.77	-	0.23	-	-	-
21-24	2.51	2.90	3.40	2.18	1.16	0.80	1.53
25-28	3.04	2.96	3.50	2.98	3.78	3.12	1.79
29-32	4.10	2.77	5.24	3.14	3.52	3.71	3.40
33-36	3.48	3.16	2.99	5.71	3.69	1.59	2.06
37-40	1.90	1.48	3.25	1.42	3.56	3.84	2.07
41-44	-	-	-	2.99	1.40	0.55	1.16
45-48	-	-	-	0.52	-	-	-
Total	16.87	15.10	18.40	15.58	21.13	15.75	12.01
Returns $/$m^2$	11.97	11.72	11.79	10.18	11.72	8.03	7.74
Mean price $/kg	0.71	0.78	0.64	0.65	0.55	0.51	0.64

This table shows that in isolation neither total yield nor mean price are sufficient explanation of the level of returns. Growers 1 and 2, 3 and 5 show that the early crop can be 4-5 kg lighter than the late crop and still produce the same total returns. However growers 4 and 7 show that factors other than earliness can also affect mean price. For both these crops yield to week 32 is significantly below that of similar crops yet the mean price for the season is higher. In these cases factors such as fruit quality and size or choice of markets have increased the prices received.

2. The Effect of Earliness

Table 13 raises the question of the benefits of early planting. Some measure of this can be gained from a comparison of grower 1 and grower 5. These illustrate two extremes, grower 1 planting in early April and growing at 9.5°C night and grower 2 planting in early May and growing at 7.2°C at night.

Graph 4 shows the cumulative yield and returns for these two crops. The effect of the lower night temperature is to delay the start of picking by a further two weeks.

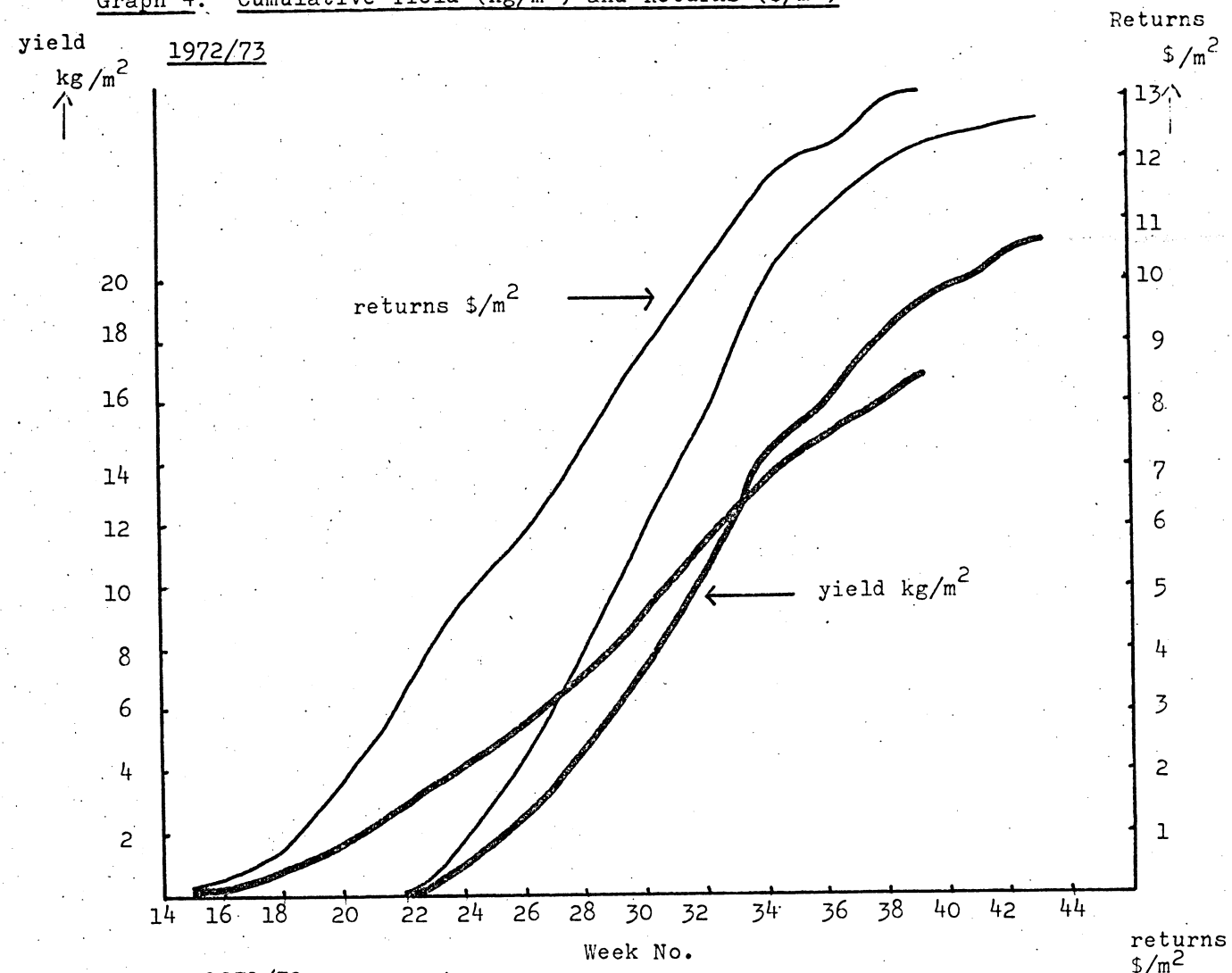
The graphs show that the build up of yield from the later crop is faster than from the early crop. It can also be seen that both yield and returns increase more evenly for the earlier crop. This is further illustrated by Table 14 which shows the cumulative yield and returns.

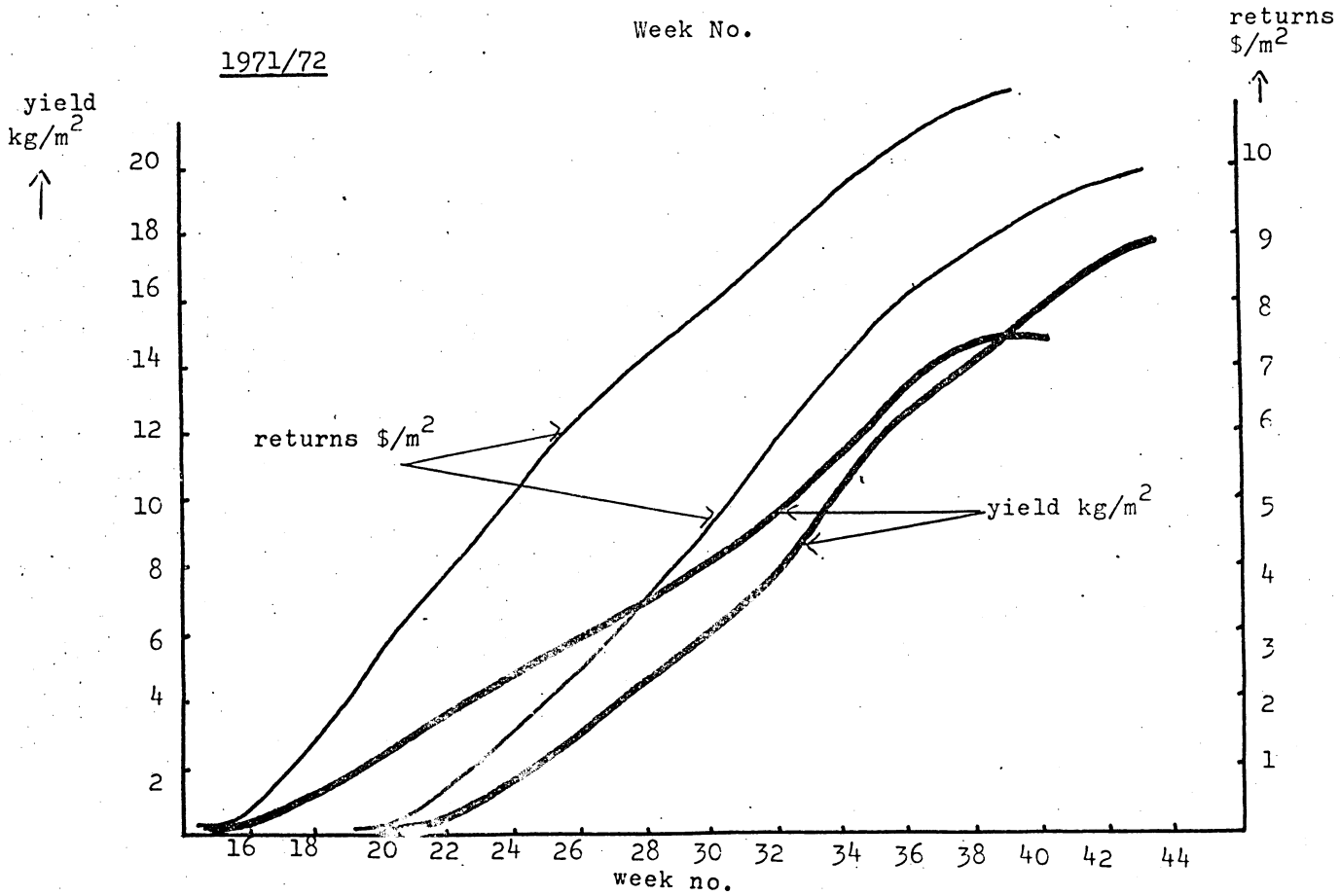
TABLE 14: Cumulative Yield and Returns 1972/73

Week Ending	Early crop cumulative %		Late crop Cumulative %	
	Yield	Returns	Yield	Returns
16	0.01	0.02	-	-
20	0.11	0.15	-	-
24	0.26	0.37	0.05	0.08
28	0.44	0.56	0.23	0.31
32	0.68	0.79	0.49	0.63
36	0.89	0.93	0.76	0.87
40	1.00	1.00	0.93	0.98
44	-	-	1.00	1.00

For both crops the first half of the crop earns 63% of the returns; however for the early crop 8.4 kg of fruit earn $6.56 while for the latter crop 10.63 kg earn $6.34.

Graph 4: Cumulative Yield (kg/m^3) and Returns ($\$/m^2$)





Later planting saves heating fuel; the average difference in fuel costs between the early and late growers was $\$0.23/m^2$.[1] Against this saving however must be put the increased harvesting and marketing costs of the later crop. At 1972/73 levels total marketing costs were around \$0.13/kg. Table 15 provides an estimate of the net effect of planting date.

TABLE 15: Effect of Planting Date

	planting date		
	1st week Apr.	mid Apr.	early May
Mean net price \$/kg	0.75	0.65	0.55
Yield kg/m^2	15.67	18.08	21.36
Returns	11.75	11.75	11.75
Fuel costs $\$/m^2$	0.39	0.30	0.16
Marketing costs	2.04	2.35	2.78
Margin	9.32	9.10	8.81

The net increase towards earlier planting is very marginal, being only 3% and 6% for mid April and early April respectively. This is very sensitive to any of the following:-

1. Shifts in the relative costs of input factors
2. Slight changes in market prices early and late in the season
3. Increases in efficiency of picking and packing

Likewise the calculation of Table 15 assumes that all harvesting labour is a variable cost - that is that the cost would be saved if the weight of crop was reduced. While this might be true for the larger grower it will not be so where family or permanent staff pick and pack.

Thus in terms of economics there appears little to choose between early and late planting provided a larger crop (around 38% more fruit) can be produced. The evidence from this sample of growers is that while this is possible, (eg. grower 5, Table 13), it is difficult. If planting later leads to loss of returns (as for growers 4, 6, and 7 of Table 13) there will be a fall in income.

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[1] At present price levels this will be around $\$0.60/m^2$.

The comparison of 1971/72 and 1972/73 shows that in the former year the build up of yield in the May planted crop was slower than in 1972/73. From the slope of the cumulative returns line it can be seen that the build up of the returns was likewise slower. The total yield from the early May crop was lower than in 1972/3 with the results shown in Table 16.

TABLE 16: Effect of Planting Date 1971/72

	planting date	
	early April	early May
Yield kg/m^2	14.79	17.76
Mean price $/kg	0.69	0.50
Returns	10.22	8.80
Fuel costs	0.34	0.12
Marketing costs	1.92	2.31
Margin	7.96	6.37

In this year the advantage of early planting was more substantial than 1972/73. This re-emphasises the problem of ensuring the substantially higher yield required to equalise returns.

Effect of Fruit Size and Quality

There was considerable variation between crops in all years in the proportion of second quality fruit and in the size grading.

Such differences are likely to affect returns through:-

1. A lower price received for smaller and second quality fruit
2. Total crop weight is likely to increase with an increase in mean fruit size.

Comparison between growers is confused by the range of size grades used. This is further complicated by some growers selling small and second quality fruit privately.

In 1972/73 the range of grading is shown in Table 17.

TABLE 17: % of Crop by Weight in each Grade

Grade	Mean %	Range
Large and No. 1	19.0	11.8 to 28.0
Medium and small-medium	61.4	38.9 to 77.1
Small and extra small	14.4	6.0 to 35.0
2nd grade	5.2	0 to 10.2

As can be seen from Table 17 there are substantial differences between growers. However no definite relationships could be found between planting date and either fruit size or quality. Similarly no relationship was found between mean price for the season and size or quality.

The proportion of small and second grade fruit was not consistent over the season. The total season proportions hide substantial differences within the season that are greater than those between growers. For all crops the proportion of small fruit increased to a peak 10-14 weeks after the commencement of picking. On the other hand the proportion of second grade fruit decreased steadily over the season. This would be expected as the plants become more balanced and growing and pollination conditions improve.

The distribution of the percentage of small fruit is shown for two representative crops in graphs 5(a) and (b). The peak of small fruit in weeks 26 to 32 (October to mid November) can be clearly seen. A number of cultural and disease factors could contribute to this. The major one is likely to be loss of vigour in the growth of the plant as the early trusses are ripening. It is at this stage that root diseases and virus will most adversely affect the plant. A contributing factor could also be excessive restriction of growth to obtain high quality early yield. The increase in the proportion of small fruit at this stage was present in all crops. It would appear to be a suitable subject for further study and research.

3. Prices Received and Marketing

The mean price received by all growers for the period week 19 (4-11 August) to week 40 (30 December to 6 January) was calculated.

The following figures were obtained:-

Year	mean price[8]		
	$/lb	$/kg	Index
1970/71	0.253	0.558	100
1971/72	0.288	0.635	113.8
1972/73	0.320	0.705	126.3

Fuller information on prices received was obtained from market sales notes. A computer programme was written to calculate weekly mean price for each market and grade. This was used to analyze the information extracted for the sales notes of eight growers. The data obtained covers the whole of New Zealand; however it refers to the prices received by Auckland growers. This is not necessarily the ruling or average market price in any centre[9].

Graph 6 shows the weekly mean price received for all grades in all markets for the three years. The figures in this graph will overstate the mean prices received by all Auckland growers in these years. This is because the sample of growers over-represented the proportion of all Auckland growers marketing outside the local area. However the relative trends in prices received by all growers are likely to follow these. The full list of prices received is shown as Appendix IV.

Graph 7 expresses all mean prices as an index of the price of 44.2 cents/lb in week 20 (12-18 August 1970). This enables the relative movement to be seen more clearly.

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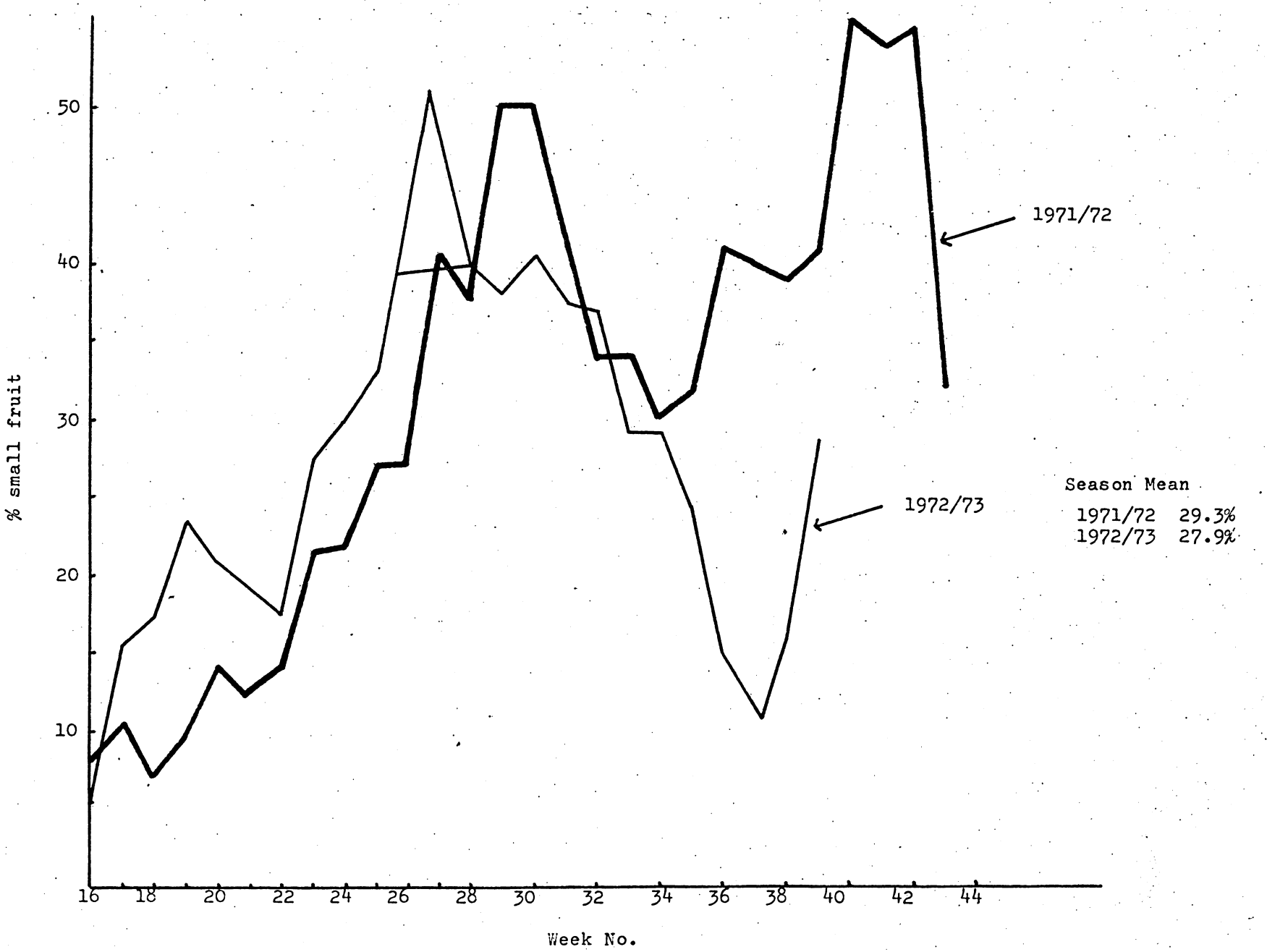
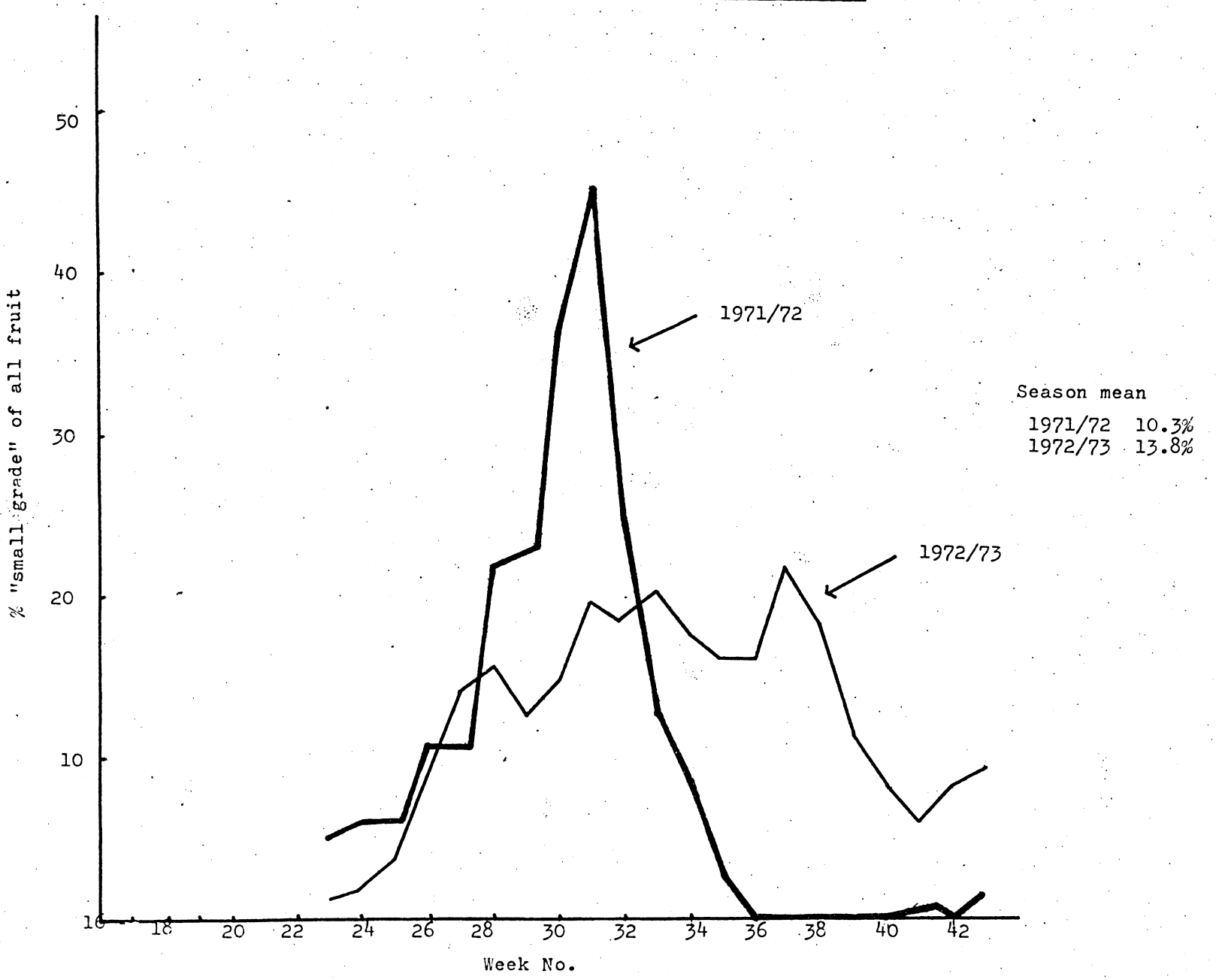
[8] Unless stated price is gross price as received at auction, no deductions are made for commission.

[9] In this analysis the "mean price" is a weighted mean, i.e. it is calculated by dividing the value of sales by the total weight sold. This is not equal to the average of the quoted prices. Appendix VI shows a section of the computed data.

Graph 5(a): Proportion of Fruit Graded "Small" by Week



Graph 5(b): Proportion of Fruit Graded "Small" by Week No.



Both graphs show:-

1. That the largest increases in prices have occurred early in the season in August and September.

2. The wave pattern of the price curve. Prices decline from a late August to early September peak. However there is a marked trough in week 25-26 followed by a recovery to a substantial though lower peak in weeks 27 to 30.

3. The marked unevenness of prices in late December through January.

Graphs 6 and 7 suggest that from 1970/71 to 72/73 there has been a change in the price pattern over the season. This was tested by fitting a regression line to each of the three year's price curve. Regression is a statistical technique which calculates the equation that most closely represents the relationship between a dependant variable and one or more independant ones.

Thus three equations were calculated of the form -

$$y = a + bx$$

where y = mean price in any week
x = week number
a and b are constants

The resultant straight lines are shown on graph 8.

The three lines can best be described as a model of the price-week relationship for the three years. The price pattern for weeks 19 to 44 can be reasonably approximated by straight lines. This is shown by the correlation coefficant (r), which is shown for each year; this measures the "goodness of fit" of the equation and the straight line to the data[10].

The three lines of graph 8 allow inter-year differences and intra-season differences to be seen. An absolute increase in early season prices from 1970 to 1973 is shown by the larger values of the graph from weeks 19-36. The extent of this can be gauged from the higher values of the regression constant. Intra-season price differences are indicated by the slope of the line. Over the three years the line has become

---

[10] the correlation coefficant r can take values from -1.0 to 1.0
r = -1.0 is a perfect negative relation, r = 0 no linear relation and r = +1.0 a perfect position relationship.
r^2 is the amount of the price variation explained by the week number - this varies from 71% (1970/71) to 88% (1972/73).

progressively steeper indicating an increase in early prices relative to later ones. The slope of the line is measured by the regression coefficient which equals the reduction in price per week. The information from the regression equations is summarised in Table 18.

TABLE 18: Information from Regression Equations

	predicted price Week 19	Weekly price (cents/lb) Reduction: 19-44
1972/73	53.6	1.79
71/72	44.2	1.25
70/71	40.0	1.10

These equations of the price trend can be used to estimate the return from early and late crops. In doing so the following assumptions are made:-

1. The early crop is marketed in weeks 19-38 inclusive
2. The late crop is marketed in weeks 23-42 inclusive
3. The total yield from both crops is 16 kg/m^2
4. A linear price equation of the form $y = a-bx$ applies where y = price in cents/kg and x = week number

In this situation the total returns from each crop will be given by -

$$\text{Returns early} = \sum_{i=19}^{38} Q_i y_i$$

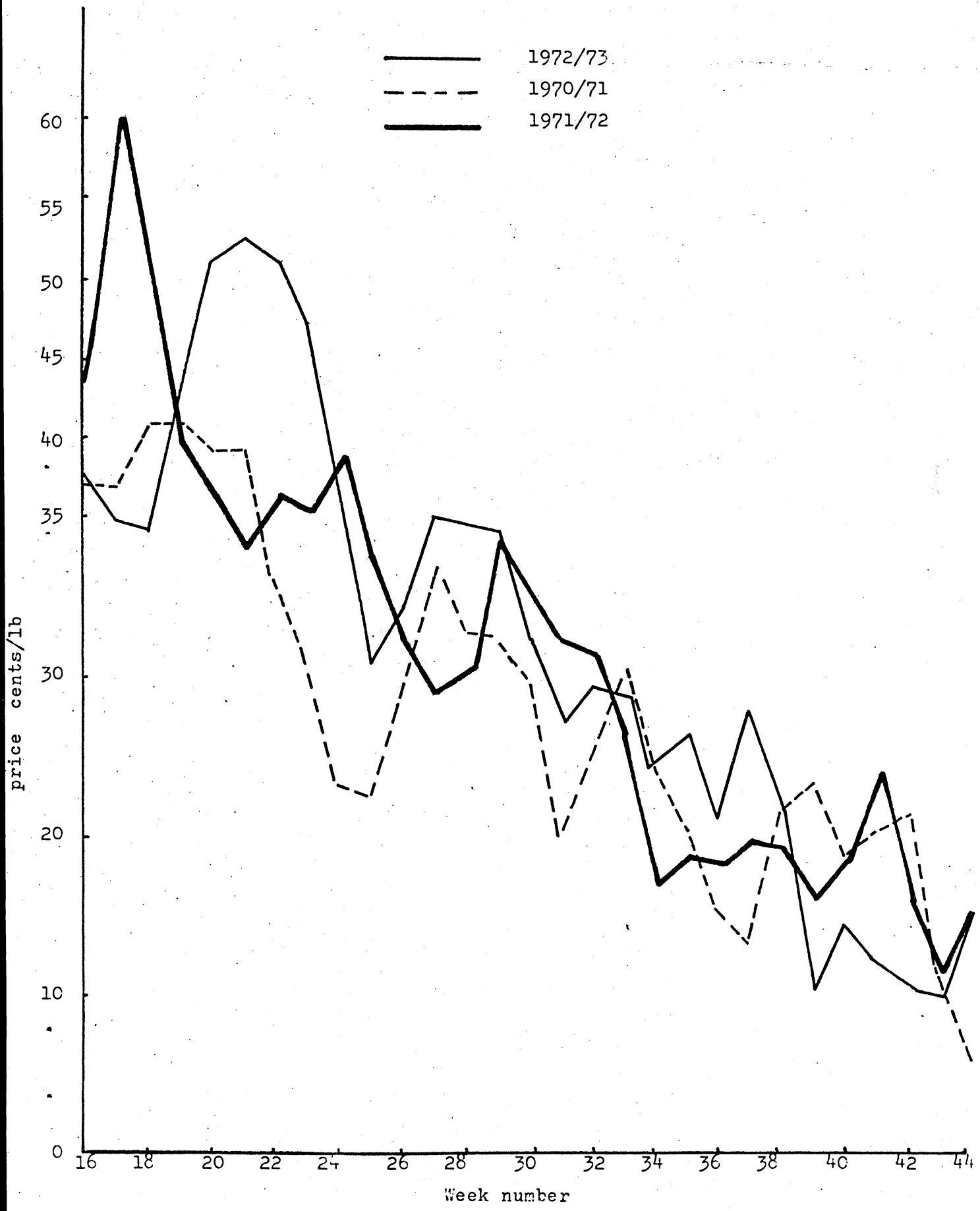
$$\text{and} \quad \text{Returns late} = \sum_{i=23}^{42} Q_i y_i$$

Where Q_i and y_i are the quantity marketed and price received in the ith week. (The symbol $\sum$ means "the summation of").

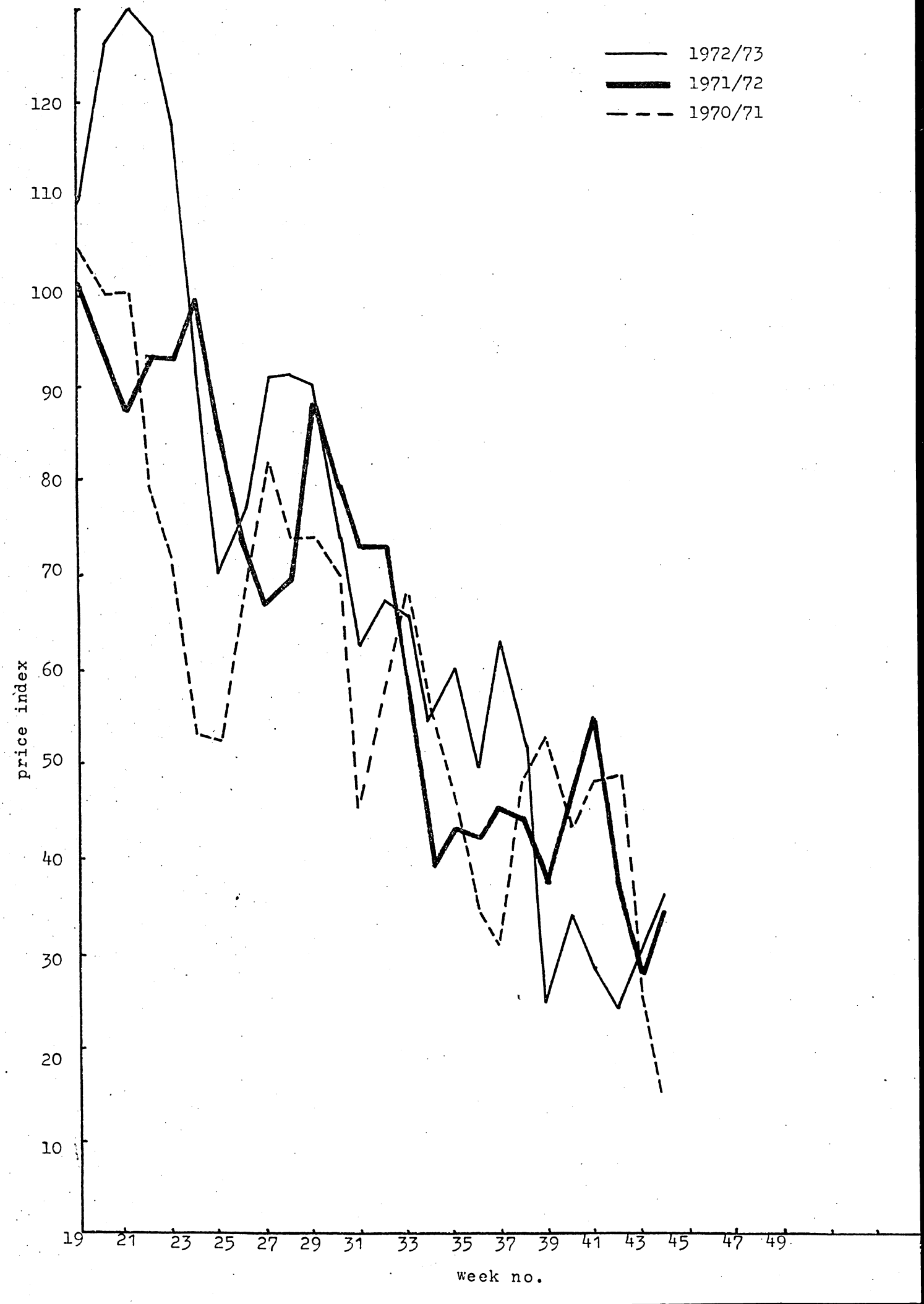
Hence the difference between the gross returns from the two crops will be:-

$$R_{early} - R_{late} = \sum_{i=19}^{38} Q_i y_i - \sum_{i=23}^{42} Q_i y_i$$

Graph 6: Mean Prices in Cents/lb - All Markets



Graph 7: All Market Prices: Week 20 1970=100



If it is further assumed that the total yield is harvested in equal weekly quantities (Graph 4 suggests that this is not too unrealistic) then

$$\text{net change} = Q\left(\sum_{i=19}^{22} y_i - \sum_{i=39}^{42} y_i\right)$$

and it can be shown that this reduces to

$$\text{net change} = 80bQ$$

where b is the regression coefficient of the price line and Q is the quantity harvested per week.

Thus using the three price equations determined (converted to prices in cents/kg) and setting Q as $\frac{16}{20}$ = 0.80 kg the effect of planting date can be calculated:

Year	b	benefit early planting $/m^2	
		gross returns	net returns[11]
1970/71	2.420	1.54	1.39
1971/72	2.758	1.76	1.59
1972/73	3.940	2.53	2.28

These calculations show that for similar yields the benefit in returns from early planting has increased over the three years.

In a similar way the increase in yield required to equate the returns from early and late planting can be calculated. In this case the net returns from the two crops will be equal when -

$$\sum_{i=19}^{38} 0.8975\, Q_i y_i = \sum_{i=23}^{42} 0.8975\, Q_i y_i$$

where 0.8975 is the result of deducting commission.

---

[11] Since prices are gross the actual returns net of commission and levy will be 10.25% less.

Assuming a constant weekly yield from each crop of Q_l and Q_e

then $$Q_e \sum_{i=19}^{38} y_i = Q_l \sum_{l=23}^{42} y_i$$

and $$\frac{Q_e}{Q_l} = \frac{\sum_{i=23}^{42} y_i}{\sum_{i=19}^{38} y_i}$$

The value of $\sum_{l=n}^{k} y_i$ is equal to the area under the price line between x=n and x=k

Thus for 1972/73 $$\frac{Q_e}{Q_l} = \frac{46.47 + 12.52}{53.63 + 19.67} = \frac{100}{124}$$

Thus to obtain the same returns the weekly (and hence total) yield must be 24% higher for the later than the early crop. This result is similar to the one arrived at previously from crop records. Hence the "market model" appears a reasonable representation of the actual situation.

In practice the decision as to date of planting will depend upon the following factors:-

1. The probability attached to the yields from different planting dates
2. Difference in fuel costs
3. Marketing costs and the proportion of permanent and casual labour in these

4. Choice of Market

The growers in this study can be divided into three groups in terms of market distribution:-

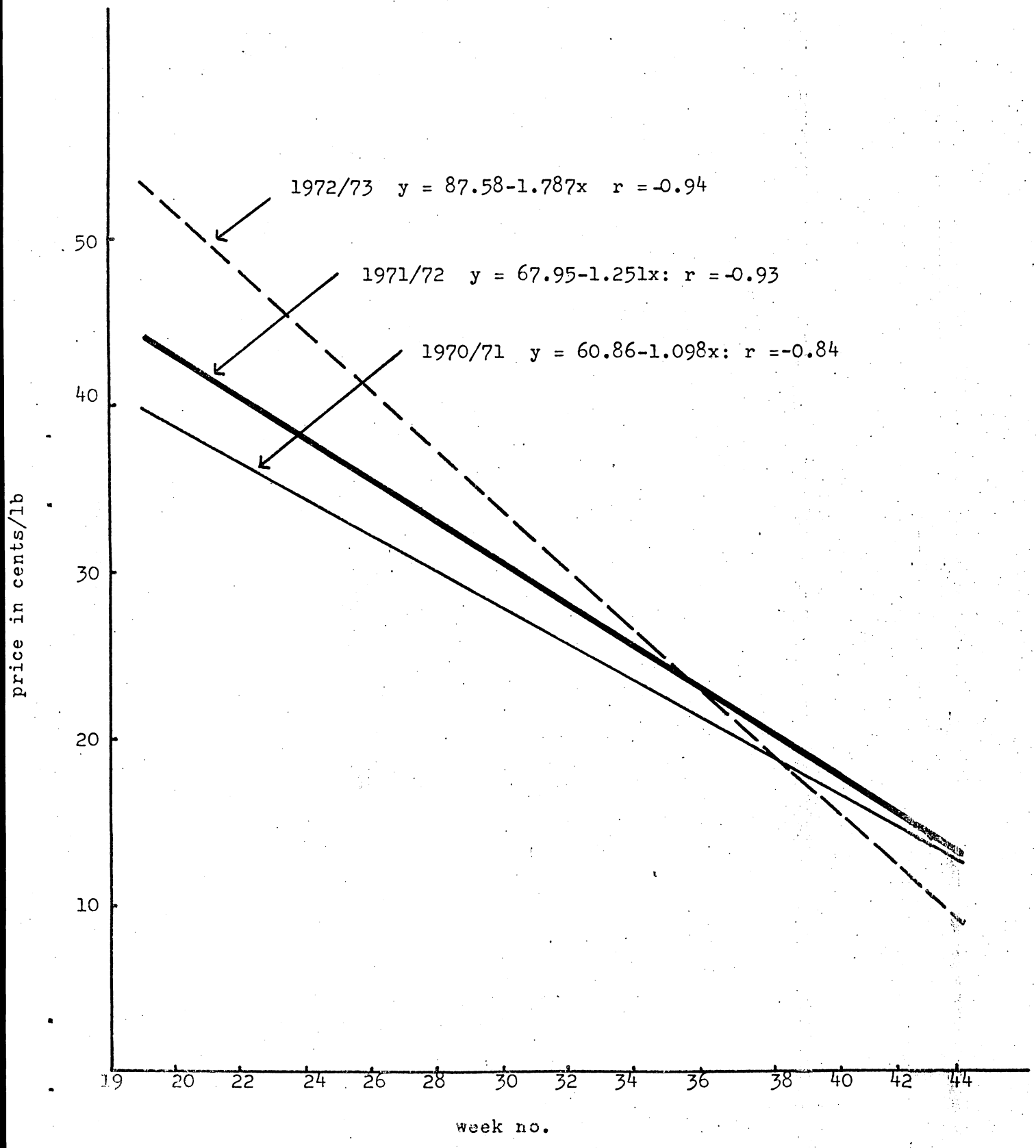
Group 1 - substantial proportion of fruit to South Island markets, principally Christchurch and cities to the south

Group 2 - southern North Island, principally Wellington and Palmerston North

Group 3 - northern North Island, principally Auckland and Hamilton

This classification describes the situation up to early November. Then as supplies to South Island markets

Graph 8: Trend Lines of Weekly Mean Price



from Nelson and Canterbury increase, Auckland growers re-trench and increase the proportion of their fruit sent to North Island markets.

Throughout the season however there is selectivity as to the grades sent to various centres. Dunedin and Christchurch receive only a small proportion of smaller and of second grade fruit.

Graph 9 shows the weekly mean price in 1972/73 received for No. 1 grade fruit by these three groups of growers. While No. 1 grade is only a small proportion (10-20%) of sales it was chosen as the only grade which was comparable between all growers.

Graph 9 shows that growers with the widest distribution had a relative gain in prices early in the season. This is most marked in weeks 18-26 and to a lesser extent in weeks 28-31. It can also be seen that the relative gain is largest when prices are falling. This is shown in weeks 23-25 and weeks 28-30.

Graphs 10 and 11 show the weekly mean prices in 1972/73 and 1971/72 for the four main centres. From this it can be seen that Dunedin tends to maintain an advantage throughout the season. However this data can be no more than an indication of relative changes. The prices used are the weighted mean of received prices. Because of the selective distribution of grades the proportion by grade to each centre will not be identical. In particular the shipments to Christchurch and Dunedin will have a greater proportion of higher grade fruit. Because of this the prices shown in graphs 10 and 11 will over-estimate the all grade mean.

In examining the effectiveness of market distribution the problem of interest groups is raised. In a perfectly regulated system the difference in prices between centres would just equal differences in transport costs.

The effect of this is best shown by a simple example:-

Situation 1	Quantity	Price	Extra costs	net returns
Centre A	3	9	-	27
Centre B	3	13	2	33
	6			60
Situation 2				
Centre A	2	10	-	20
Centre B	4	12	2	48
	6			68

In situation 1 centre A is over supplied relative to B and a shift in distribution would occur until the net price (price - transport) in A and B is the same. This results in:-

1. Increased price at A
2. Reduced price at B
3. Increase in total returns

However if a number of growers are supplying only centre A or B not all will increase returns. The group who continue to supply A will increase net returns; the group supplying B will suffer a reducation.

Likewise consumers at A will pay more and those at B will pay less. At the same time the total returns to all growers will increase.

In horticulture this dilemma is compounded by the large number of suppliers, the free entry to all markets, the lack of knowledge of present prices, and uncertainty of the short term future. Thus the perfect situation is unlikely to occur. If individual growers have good information as to prices in all centres and attempt to chase markets to maximise returns, fluctuations around the optimum situation are likely. On the contrary where growers have limited information and maintain a steady distribution pattern longer term differences between markets can occur.

The variation between markets is examined on graph 12. In this the (mean price - commission - transport) is expressed as a weekly index of the mean net price in Auckland. Thus in the perfect situation the index for all centres would equal 100. In graph 12 indices above 100 indicate relative under-supply and those less than 100 relative over-supply.

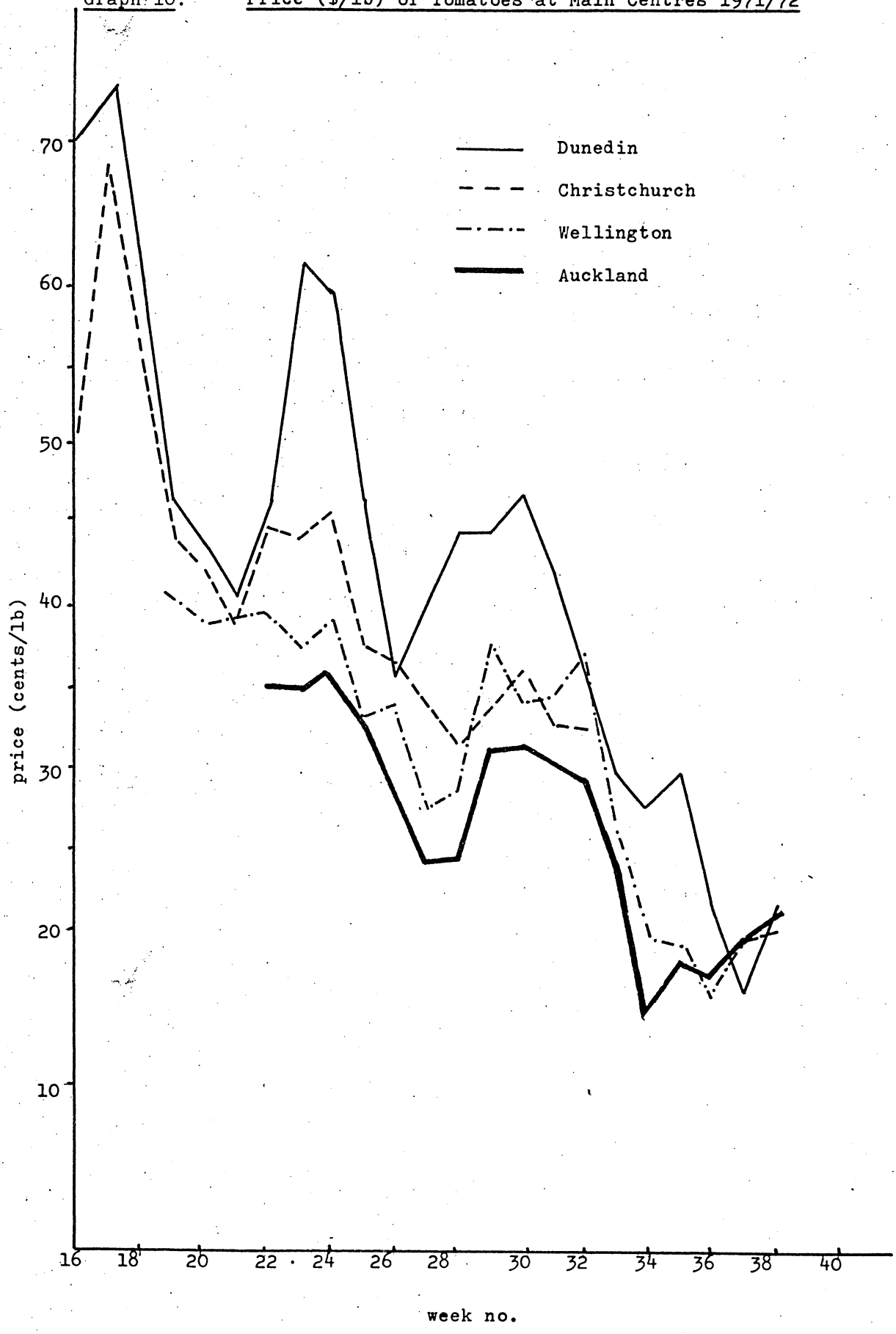
From this graph it can be seen that Dunedin and Christchurch prices have remained well above those in Auckland until mid November. As can also be seen from graphs 9, 10 and 11 prices in all markets appear to fluctuate together.

However the Wellington prices fluctuate around those In Auckland, and in many weeks growers would have been individually better off to market in Auckland rather than Wellington.

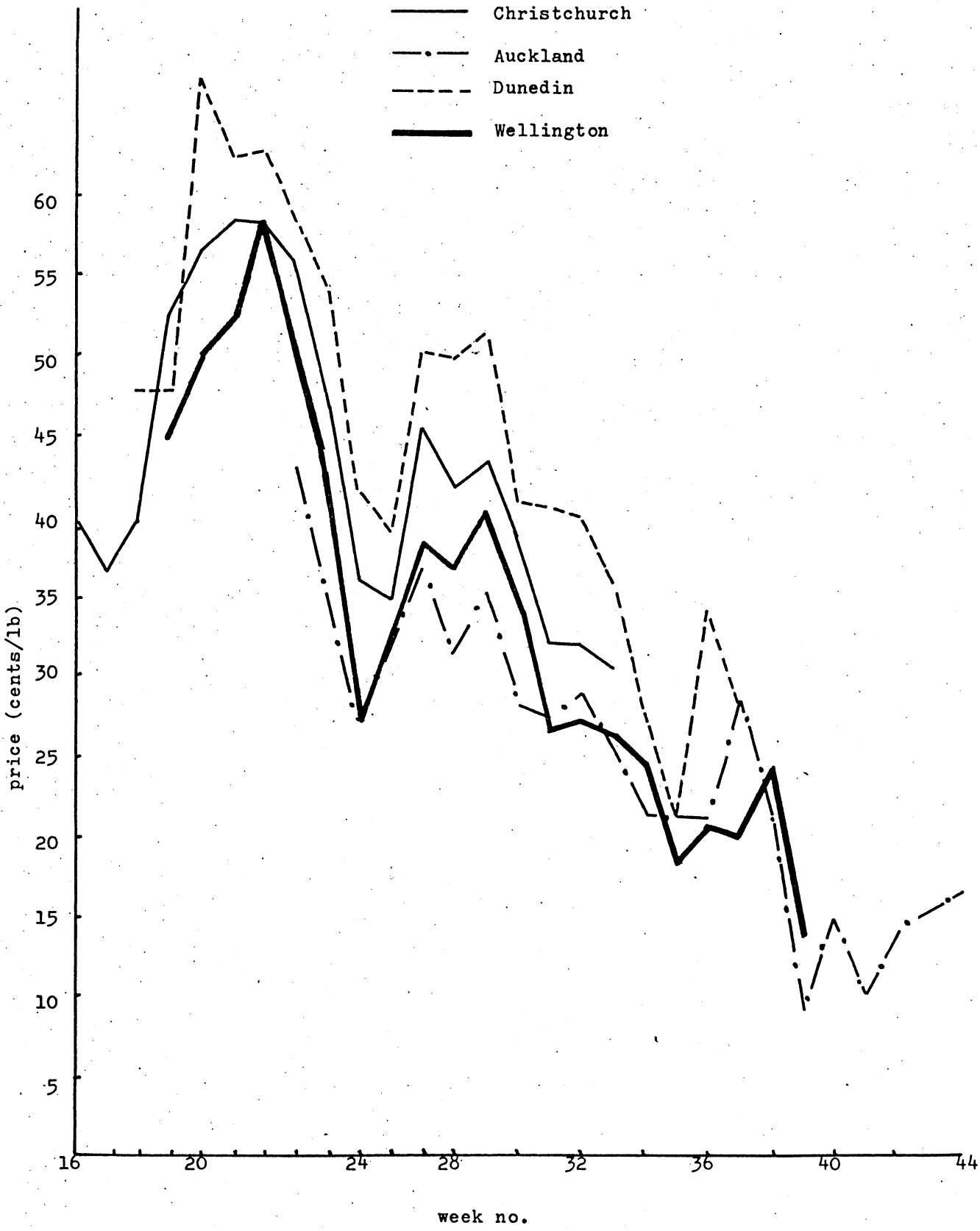
With the limited data available little further analysis can be made of the factors affecting short term price fluctuations. For instance there is no information available as to the sources and total quantity of tomatoes on any market at any time. Thus it is not possible to examine the relationship between Wellington and Auckland prices and total supplies. This is a study which must await the availability of fuller information from the

Graph 9: Mean price (cents/lb) received for No. 1 grade tomatoes - all markets 1972/73

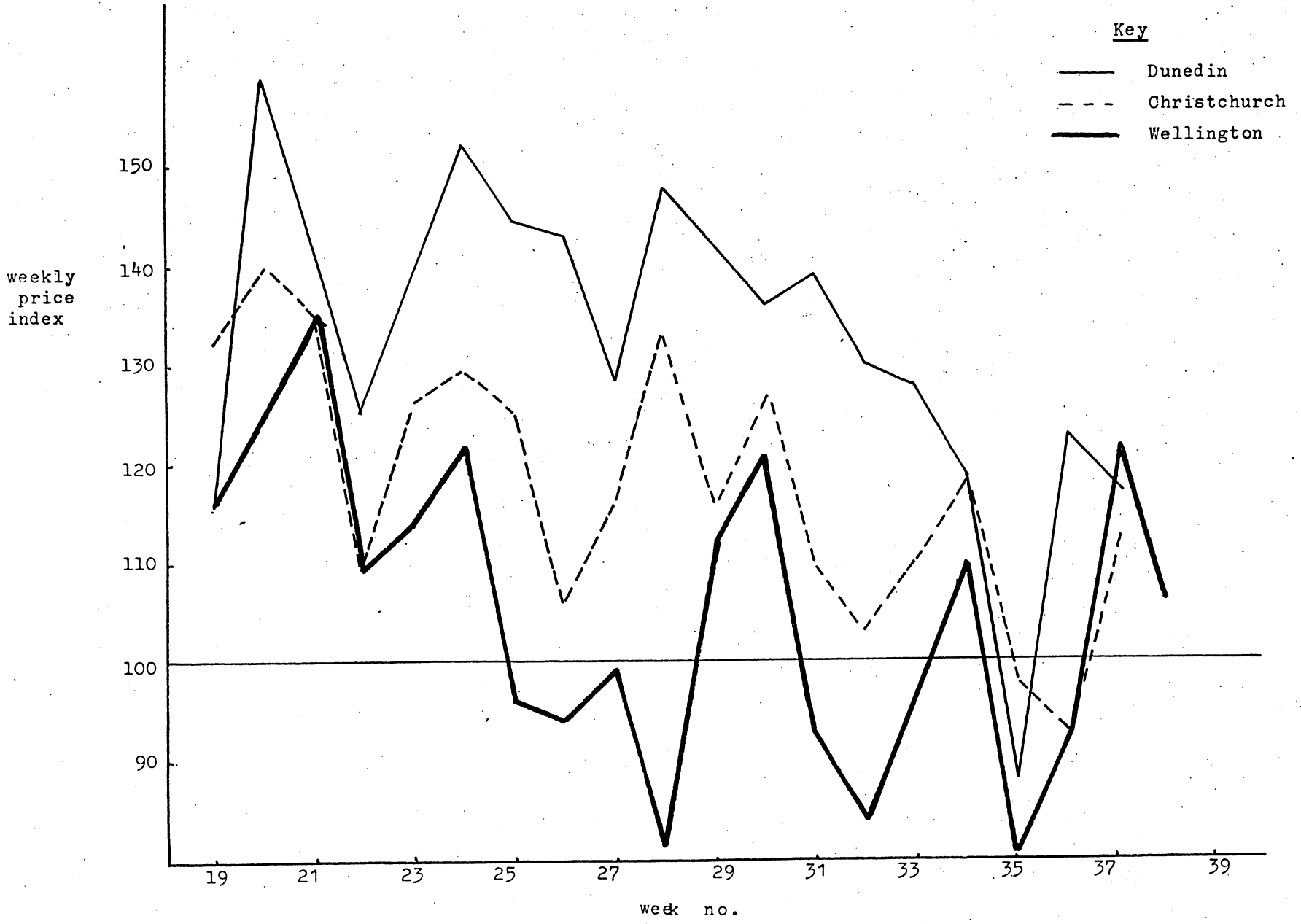
Graph 10: Price ($/lb) of Tomatoes at Main Centres 1971/72



Graph 11: Price of Tomatoes (all grades) - main centres 1972/73



Graph 12: 1972/73 - Weekly prices of four main centres, Auckland = 100
Prices are net of commission and transport



markets.

Graph 12 suggests that the overall returns would have been increased by a diversion of supplies from Auckland and to a lesser extent Wellington. This may not have occurred because of a number of reasons:-

1. Lack of information, i.e. market intelligence, as to prices in centres not being served.

2. Lack of market contacts. The logistical problem of supplying a new market can be quite considerable, particularly to the smaller grower. This could easily daunt such a person from switching supplies from close to distant centres.

3. Lack of encouragement - some growers reported that they had supplied the more distant markets but with disappointing results. This suggests that buyers and perhaps auctioneers prefer to deal with growers alrady established in the markets.

More balanced marketing could improve total returns of the Auckland glasshouse tomato industry. However this would entail a reduction in returns for growers already serving South Island markets and an increase for those serving local markets. It must be stated that an over increase in supplies to the more distant markets would reduce prices there.

The data from this section however points clearly to the fact that individual growers would benefit from adopting a national marketing pattern. However it must be equally clearly stated that if too many growers follow this advice it will be self defeating.

Returns from Double Cropping

In the examination of financial results it was shown that double cropping systems were generally less profitable than single crop tomatoes.

The major marketing periods for the double crops are:-

Autumn tomatoes	mid May (weeks 7-8) to early August (weeks 16-17)
Cucumbers or Beans	commencing September (25-27) to Christmas (39)
or Tomatoes	late November (33-34) to mid January (41-42)

Returns from Autumn Tomatoes

Table 19 shows the mean results obtained from autumn tomato crops.

TABLE 19: Mean Results from Autumn Tomato Crops

Year	yield kg/m^2	Returns \$/m^2
1970/71	8.30	4.05
1971/72	8.61	4.80
1972/73	9.26	5.60

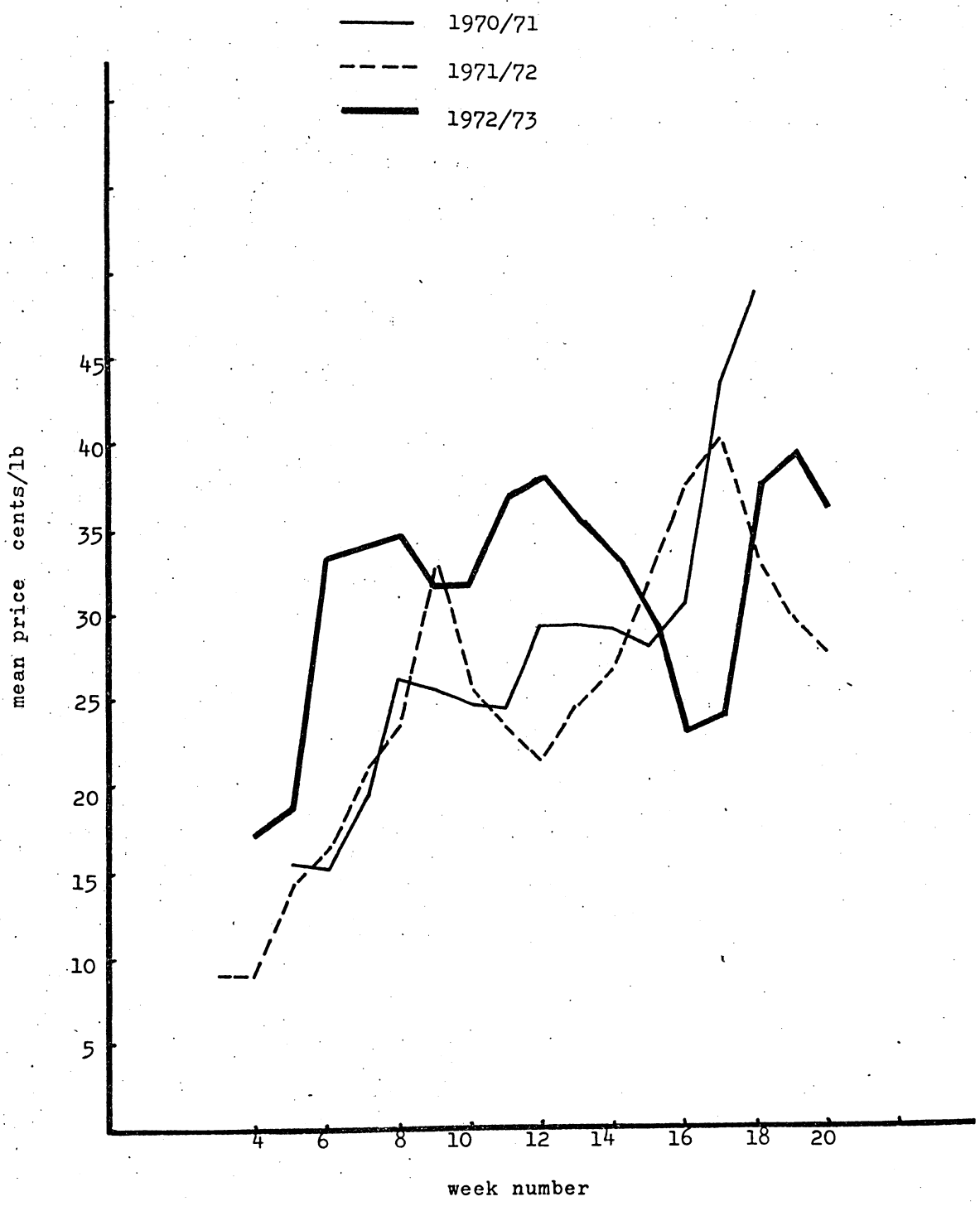
The autumn crop provides 55-65% of total revenue from double crop systems. This proportion was generally unchanged over the three years.

In each year there was a range of approximately ±25% in yields and returns around these means, across the sample. As can be seen from Table 19 there has been a steady increase in yields and returns.

The level of returns in an autumn crop is dependant on total yield and the date the crop is terminated. The reasons for this can be seen from graphs 13 and 14. Graph 13 shows the weekly mean gross price received by five Auckland growers. Again this is a weighted mean across all grades and markets served. From graph 13 it can be seen that there has been a small upward shift in prices over the three years. In each year however prices have been relatively stable over the period week 8-16, followed by the rapid increase around week 18.

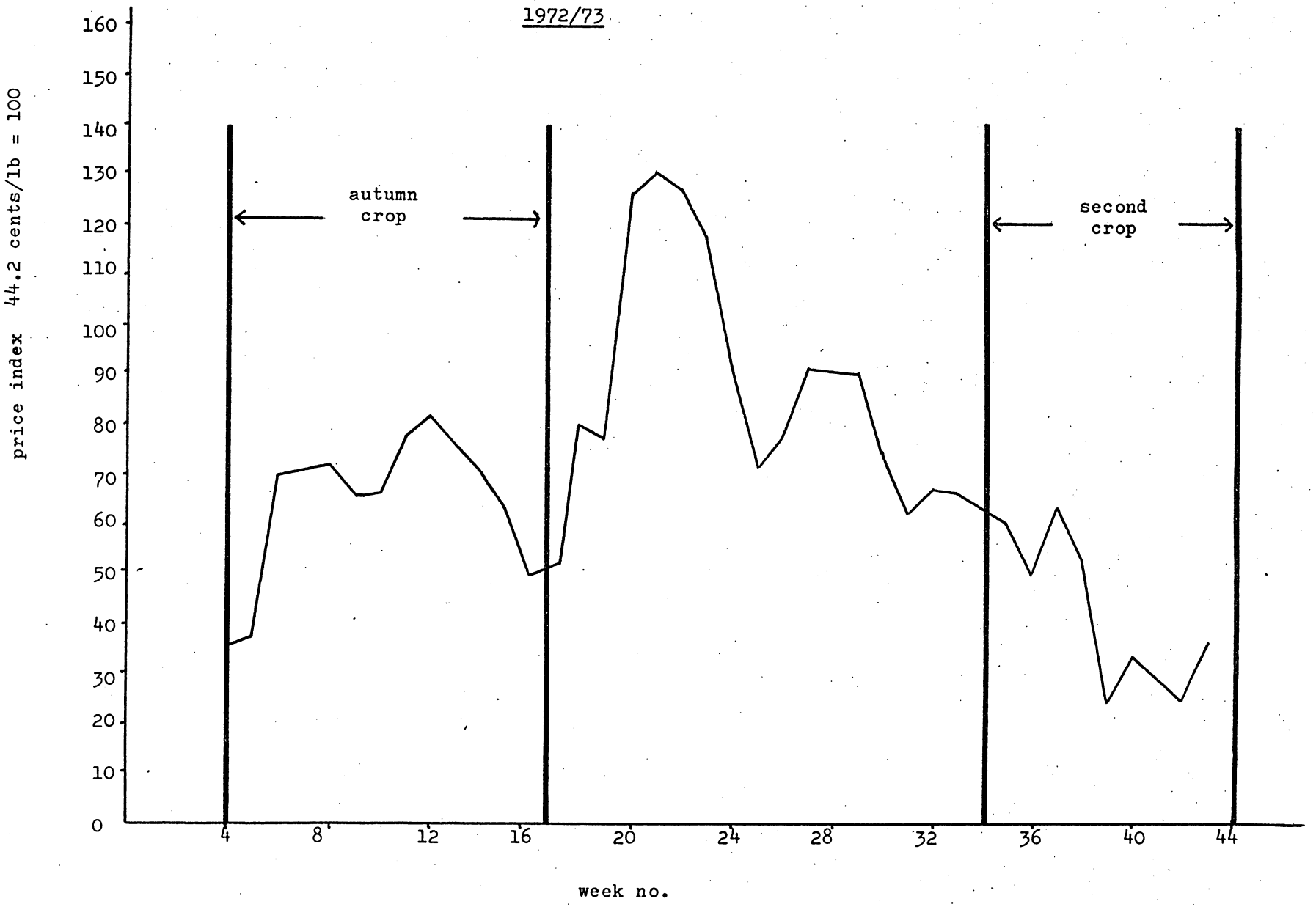
The period of stable prices emphasizes the dependance of returns on total yield. Graph 14 expresses prices from week 4-44 as an index of 44.2 cents/lb,

Graph 13: Weekly Mean Price: Autumn Tomatoes

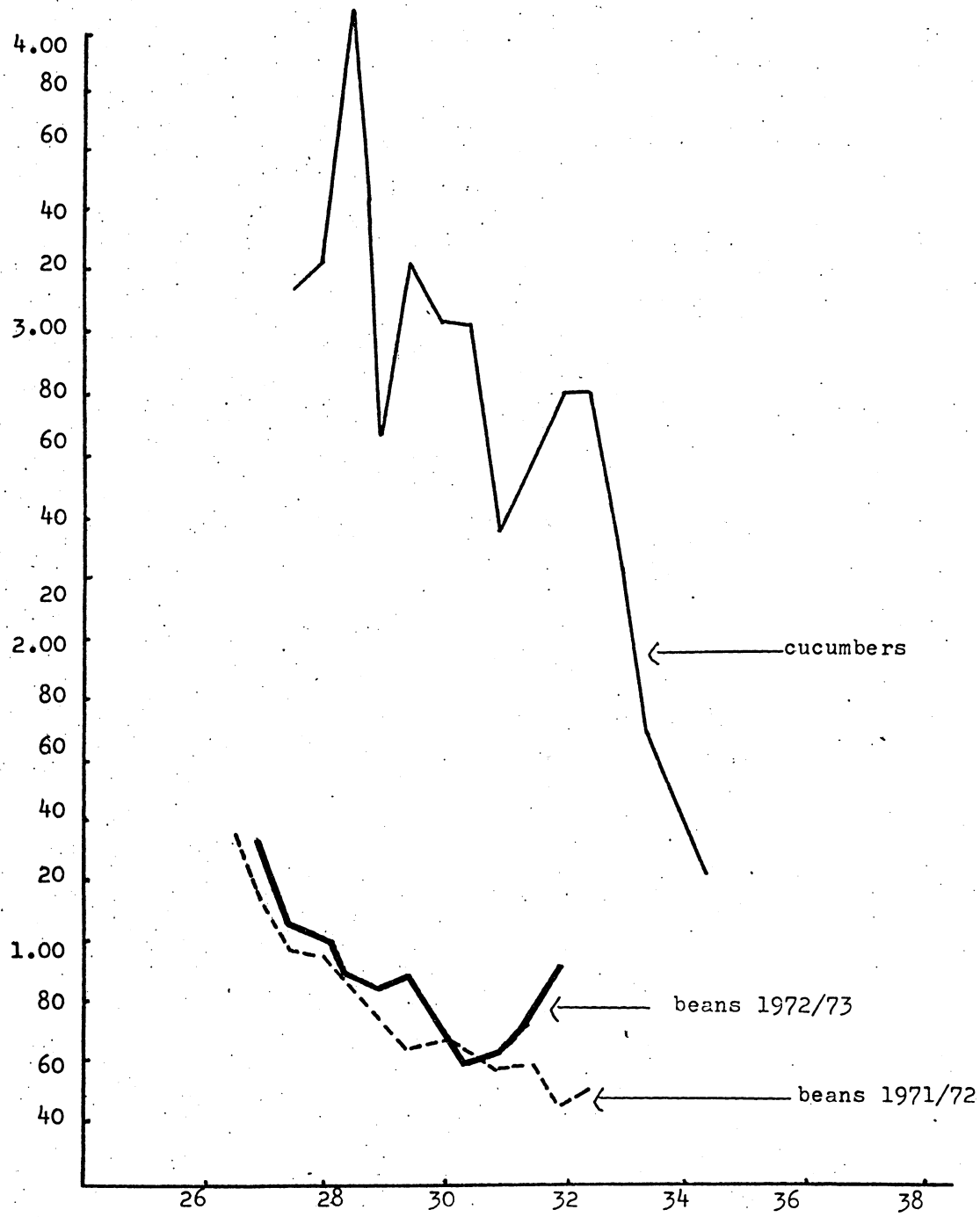


Graph 14: Tomato Prices (cents/lb) Week 20 1970= 100

1972/73



Graph 15: Average Cucumber Prices $/Case 1970/71 to 72/73



(this allows comparison with graph 7). From this it can be seen that returns from the autumn crop can be increased by extending the crop further into August or September. However this would mean that the following crop is later and marketed at lower prices.

The rate of reduction of tomato prices has already been discussed. Graph 15 shows some limited price information that was obtained for cucumber and bean crops. It can be seen that the October - December prices for these reduce at a faster rate than those for tomatoes. Hence the loss in revenue from a delay in harvesting the spring crop would be greater.

The stable prices makes returns very dependant on yield. The highest returns from autumn tomatoes were from the heaviest crops. The best yields were 10-11 kg/m^2 (6.4 - 6.8 lbs/plant). With all crops there was a trend for the weight picked to decline in the sixth-tenth week of harvesting. The Ministry of Agriculture and Fisheries Advisory Service has conducted some tomato variety trials with autumn crops and it appears that some newer varieties can give higher yields than the more traditional ones.

Returns from Spring Planted Crops

The returns from July-August planted crops is very dependant on planting date as already discussed. Limited information was gathered on these crops and the mean returns found were:-

	1970/71	1971/72	1972/73
Beans & cucumbers $/$m^2$	$3.14	$3.38	$3.78
Range	2.65-3.69	2.84-3.94	3.04-4.44

The variation between growers was greater than that between the two crops. Difference in returns resulted from the date that harvesting commenced and from total yield.

The Prospect for Double Cropping

It appears that there is a need for a detailed technical-economic study of double cropping systems. In this the relationships between Auckland climatic conditions and crop growth and development would have to be specified. That is projections of yield distribution from various planting dates & growing regimes must be made. These could then be evaluated using input data and a model of the price pattern. Such a task is beyond the possibilities of the information obtained in this study. However the lower incomes of double crop growers suggest that it is an urgent one. Such a study also exemplifies the author's belief of the direction horticultural research should take if it is to be of maximum utility to the industry.

5. THE USE OF LABOUR

Information was collected on the numbers of permanent staff employed. This was supplemented by collation of actual hours worked for the three years from the wages books of four large growers.

The usual permanent staffing rate is around 10 men/ha. of cropped area (4½ men/acre). Variation around this figure occurs with the use of family, part-time and casual workers.

The wages books' information has been used to draw the labour profiles shown in graph 16. In this allowance has been made for holidays and juvenile labour has been taken as half that of adults. Profile A shows the situation with single cropping; profile B that where part of the property is double cropped. Both profiles show the use of casual staff for marketing. However the double cropping system evens the peak across the season. A further noticeable feature of profile A (average of 3 growers x 3 seasons) is that the level of casual labour in weeks 32-40 is higher than weeks 20-28. This is despite the fact the quantity of fruit harvested is less in the later period; the yield is shown in the upper histogram.

The total annual labour usage with the two systems is approximately equal with a mean of 25.8 man hours/10m^2. The variation across the twelve sets of data for single cropping was 24.2 to 27.9 man-hours/10m^2. This is equivalent at a wage rate of \$1.40/hour to \$0.52/m^2/annum. Only a portion of this is explained by variation in yield; so that part is due to differences in efficiency.

The continued use of a high level of casual labour, despite lower quantities of fruit marketed is costing around \$250 on a 3500m^2 property. This is not a major economic factor, however it suggests a lack of attention to planning and control.

The causes of the continued high use could be:-

1. a degree of 'lumpiness' in the supply of casual labour. That is some guarantee of hours or number of weeks is given to temporary staff,
2. an increased work load with production tasks in these periods,
3. there is insufficient monitoring of actual labour requirements.

Labour use in Auckland can be compared with data available from Guernsey, Channel Islands. The States of Guernsey Horticultural Advisory Service has used the techniques of work measurement to determine standard times applicable to the tasks involved in tomato production. These have then been used as the basis of an incentive payment system[12].

A "standard time" is easiest conceived as the number of minutes required by an experienced worker to complete a unit task, following a specified method, and working at a defined performance. Performance is measured on a scale; such as the 0-100 scale where 100 is standard (or incentive) performance and 75 is average (day rate) performance. It is generally considered that, provided the specified method is followed, such a standard time is applicable wherever the job is performed. The Guernsey figures then provide a pertinant comparison for the Auckland situation.

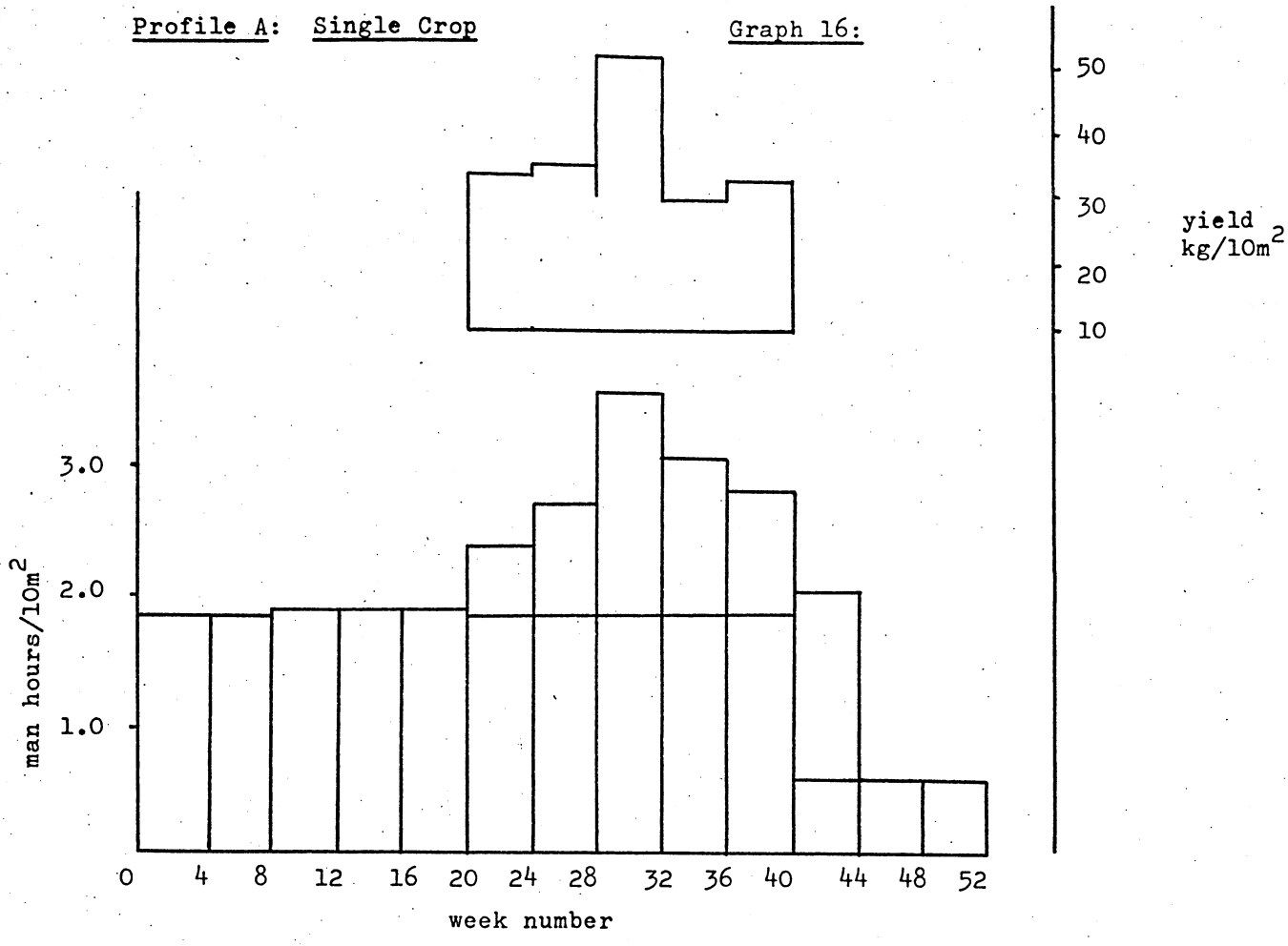
TABLE 20: Labour Requirements - Standard Hours/279m^2

	920 plants	1090 plants
Preparations	28.50	28.50
Sterilization	15.00	15.00
Plant propagation	9.50	11.51
Planting	4.50	5.45
Tying	3.25	3.94
Trimming weeks 2-9	32.00	38.76
10-12	15.00	18.17
13-32	86.50	104.76
Deleafing	45.00	54.50
Pulling down	18.00	21.80
	257.25	302.39
Harvesting & Marketing		
2.7 kg 30.69		
6.55 kg 37.39		
8.75 kg 64.17	132.25	132.25
	389.50	434.64
Annual requirement/10m^2	13.96	15.58
Maintenance etc.	1.50	1.50
Total requirement	15.46	17.08

[12] States of Guernsey Horticultural Advisory Service. "Incentive Scheme" and "A Programme for Early Tomato Growing".

Profile A: Single Crop

Graph 16:



Profile B: Double Crop

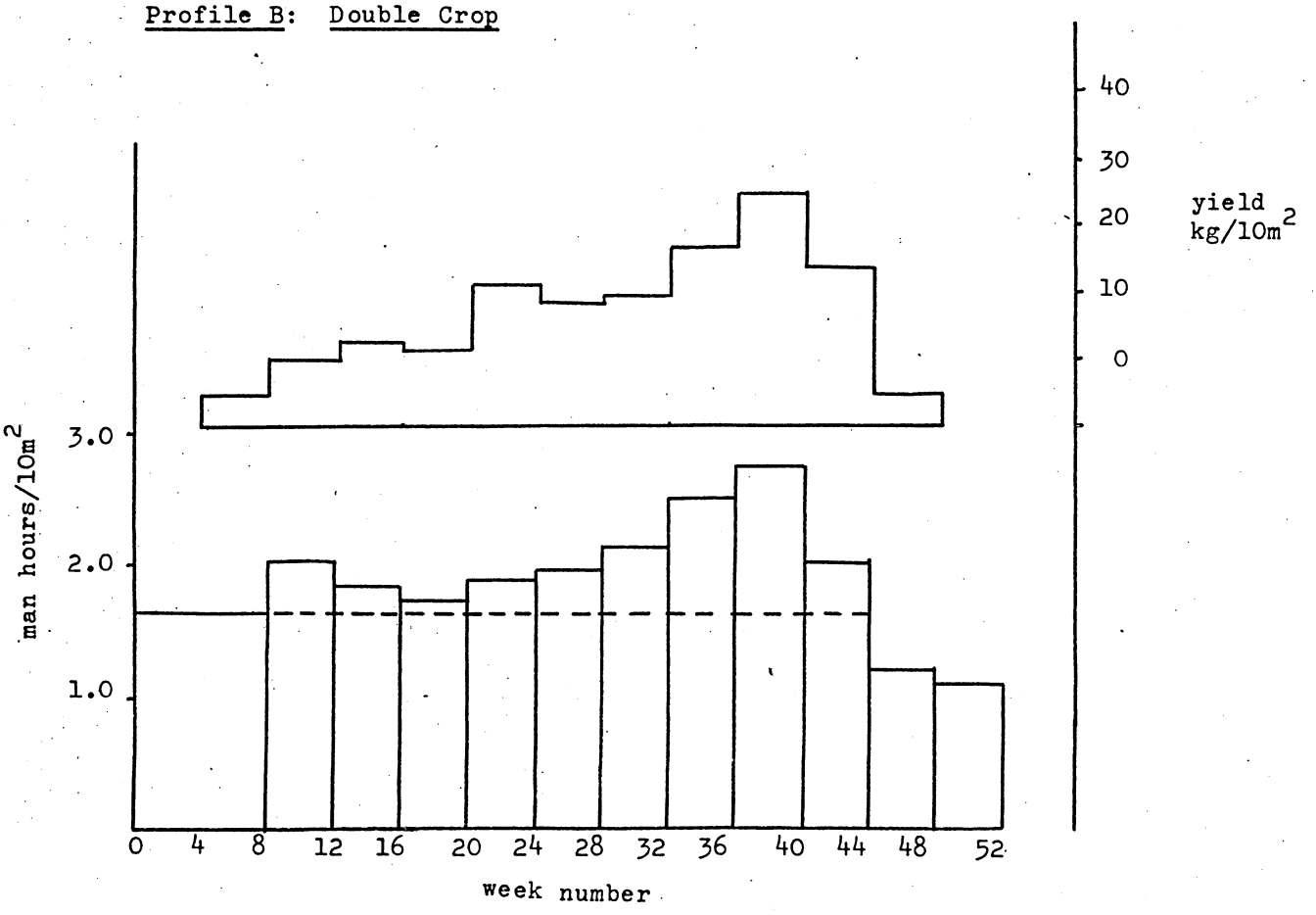


Table 20 shows itemised labour requirements for a 279m^2 (100x 30 ft) crop of tomatoes producing 17.20 kg/m^2. The crop is planted early April and grown to early January. The Guernsey figures do not include a number of tasks such as crop protection, hose watering or maintenance. These have been estimated at 1.5 hours/10m^2/year. In Table 20 two sets of figures are shown, one for 920 plants/279m^2 (the standard Guernsey spacing) and one for 1090 plants (the standard Auckland spacing).

The mean labour usage in Auckland is 25.8 man-hours/10m^2/year as compared to 17.08 standard hours/10m^2/year. This is an increase of 51%. This is a significant difference that raises many questions.

The Guernsey figures are based on standard of 100 performance. If a performance of 75 is accepted as the normal, without incentive rates, the requirement would be 22.27 man-hours/10m^2/year. The Auckland mean is still 14% above this.

The higher labour use in Auckland will be resultant from a combination of the following:-

1. The detailed work methods are less efficient than they could be. This is likely to be most serious with the regular tasks such as trimming, deleafing and picking.

2. More operations than necessary are being performed.

3. The level of permanent staff is too high. Where work requirements fluctuate over the season, there is a problem of combining permanent and casual staff levels. The labour profiles of graph 16 show the number of hours paid not the amount of work. Thus during the early part of the season, after preparation and planting there will be a period during which permanent staff may be under-employed. The grower is faced with the problem of minimising these troughs without being short-staffed in peak periods.

4. The achieved performance of growers and staffs may be too low. However because of factors 1-3 it is both impossible and unwise to pass any judgement on this.

There appears to be a requirement for detailed study of labour use in glasshouse crops. This could be a suitable project for the Advisory Service and groups

of growers. Two particular areas would be the comparison of methods of performing tasks such as trimming and picking and the determination of target work rates.

The overall labour requirement is closely related to the plant density. It has been shown that at a density of 1090 plants/279m^2 the mean labour use in Auckland was 51% higher than that derived from standard times. The traditional spacing in Guernsey is 920 plants (13" spacing in 10 rows/100' x 30' house). This has a requirement of 15.46 standard hours/10m^2/year; the Auckland mean of 25.8 hours is 67% higher than this.

Other studies in Guernsey have shown the possibility of reducing plant numbers further, without loss of total yield. For a total yield of 17.20 kg/m^2 the labour requirements are summarised below.

Plant density /279m^2	Standard hours /10m^2/yr	Index	Comparison with Auckland mean
1090	17.08	100	66.2
920	15.46	90.5	59.9
800	14.46	84.7	56.0
700	13.62	79.7	52.8

The final column of this table shows the standard hours at the various densities expressed as a percentage of the mean of 25.8. This table suggests that there is an immediate need for trial work with lower plant densities than those at present being used. So long as total yields can be maintained reduction in plant numbers can only be beneficial. Such wider spacings might also contribute to easing the small fruit problem discussed earlier.

6. DISCUSSION AND CONCLUSIONS

In this final section the main conclusions of the study will be presented together with a discussion of areas warranting further study.

1.0. General

The overall impression gained from this study is that for the sample of growers, businesses are soundly based and prospering. When the value of family labour is taken into account some of the smaller properties are making an economic loss. However because this labour makes up around 50% of total costs such properties of around $1000m^2$ provide a cash surplus of $5000-$6000 p.a. From this loan servicing and repayments, personal drawings and taxation must be met.

Over the three years studied the variation in surplus and disposable income between growers has increased significantly. The trend for the better growers to increase earnings faster than the poorer ones was one of the most notable features of the analysis.

This fact suggests that the solutions to poor performance lie with the individual grower rather than in over production and control of entry to the industry.

2.0. Financial Results

From the sample as a whole the following conclusions were drawn for the period 1970/71 to 1972/73:-

2.1. Sales/unit increased by 25.5%. The economic surplus and disposable income increased by 86.7% and 30.9% respectively.

2.2. The largest increases in costs/unit area occurred with wages and marketing expenses. However the efficiency of use of all input factors, relative to sales, was maintained.

2.3. The mean results from large growers were better than those from smaller ones.

2.4. Single crop systems were generally producing higher returns and surpluses than double cropping.

2.5. The level of returns/unit area was closely correlated with surplus and disposable income. No relationship was found between the level of costs and surplus.

2.6. Discussion

Because of the range of cropping systems and planting dates used net returns/m^2 is the most realistic standard to use. For the 1972/73 season a level of net returns of \$12/m^2/plant (\$1.12/sq ft) would have been a satisfactory performance. Tentative estimates are that for 1973/4 returns should have been \$12.50/m^2 and for 1974/5 around \$13.00/m^2.

It is suggested that extension agencies, in particular the Ministry of Agriculture Advisory Service, could be of most benefit to the industry by:-

(a) Emphasising the use of economic standards, in particular the level of returns, rather than yield.

(b) Emphasising the inter-relatedness of costs and returns.

(c) Development of simple models to allow comparison of cropping systems and planting dates using information from the individual property.

(d) Smaller growers with 1972/73 returns of \$7.00 to \$9.00/m^2 appear most likely to benefit from extension facilities. In these cases poorer performance appears to result from the cropping system used rather than deficiencies of technical ability.

(e) The frequent reduction in returns consequent on increased property size and/or a change in cropping system was discussed in Part I. There would appear to be substantial benefit from co-operation between growers' organisations, the Advisory Service, supply companies and lending institutions in planning such changes. In particular the use of network analysis techniques was referred to in the body of the report.

3.0. Technical Factors

The following conclusions were drawn:-

3.1. The general yields of single crops have been stable. There has been an upward trend in the mean yield from the autumn tomato crop.

3.2. For single crops the proportion of small fruit increases at 8-10 weeks after the start of picking. This is sometimes associated with a reduction in quantity.

3.3. Even the best total yields of this group of growers are low in comparison with standards quoted from Europe. In Guernsey, the Netherlands and United Kingdom yield standards of 250 tonnes/ha. are quoted. Likewise it was reported from Guernsey that in 1974 a break-even yield from single crop tomatoes was 200 tonnes/ha.

3.4. There are substantial differences in the level of major cost items, in particular materials, fuel and labour.

3.5. Discussion - The incidence of large proportions of small fruit suggests that crop management could be improved. It is suggested that the Advisory Service could pay more attention to the development of temperature, watering and feeding regimes. Likewise the optimum plant density should be examined. Wider plant spacings are now recommended overseas. These appear to produce equivalent yields and also reduce the labour input for planting, trimming etc.

The efficiency of use of inputs as against cost appeared to have received little attention from both growers and advisors. Profitable areas of study include efficiency of boilers, application of pesticides and fungicides, work methods for crop production and harvesting.

4.0. Marketing

4.1. There has been an upward trend in the prices received for both single and double crops.

Regression equations fitted to the weekly mean prices showed:-

(a) the increase in prices has been greatest in the September-October period

(b) there has been an increase in early season prices relative to those later in the season.

4.2. These price shifts suggest that early planted crops are becoming more profitable than later (May) ones. Total yield from a May planted crop must be 25-30% greater to produce equivalent profits.

4.3. Making allowances for transport costs there is a premium for marketing in more distant centres. Growers with a national distribution pattern are receiving higher mean prices.

The industry as a whole would increase returns by a wider distribution of fruit.

4.4. Discussion

Some rationalisation and improved efficiency in marketing could follow from a reduction in the number of size grades used. It is suggested that growers' organisations could initiate the reduction of the present 6-8 size grades to four.

The industry as a whole would benefit from a more rational distribution of supplies between centres. However this would be partly at the expense of those growers who already have a national distribution pattern. No assessment was made of the value of group packing and/or marketing. However with the geographic clustering of production such as in Henderson or Mangere, and the 'export' of produce out of Auckland, such facilities could benefit the industry.

The greater rate of increase in September-October prices was shown to enhance the advantage of early planting of the single crop. The same trend also affects the choice between double and single cropping. These price trends are so important that it must be worthwhile for grower groups or the Advisory Service to repeat this portion of the analysis as an annual task. Likewise there appears to be an opportunity for a technical and economic research project on the optimum timing of double crops.

5.0. Use of Management Information

During the field work for this study a number of points were raised that are of general interest.

5.1. Financial Information

There was large variation in the amount of information contained in financial accounts. In many cases the accounts function solely as a means of determining liability to tax. Little information was available to gauge the performance of the business. Instances were seen where all purchases, both crop and marketing, were presented under one heading. In such cases this was the only information available to the grower.

5.2. Depreciation

A number of cases were found where growers were either unaware of, or not claiming, special depreciation allowances to which they were entitled.

5.3. Market Returns and Market Intelligence

The amount of information kept on market returns was very variable. Some growers maintained a full list of prices, while others recorded very little. Comparison of weekly mean prices between growers showed substantial variations. It could also be seen that some growers were not adjusting their distribution pattern, despite prolonged price differences.

5.4. Discussion

There is no value in recording information unless it can improve business decisions. Conversely decisions are dependant on information. Growers' organisations and advisory services could assist growers by promoting simple recording systems and decision techniques.

The content of accounts should be improved; this is very much the responsibility of individual growers in instructing their accountants. However a joint extension effort by growers' organisations, Advisory Service and accountants to show what information is possible would be beneficial. Likewise more information on entitlements for depreciation and taxation should be provided.

Price information is required both on a day to day basis for marketing, and seasonally in crop planning. Short term information from markets other than those serviced is not readily available. Availability and use of this information could reduce the price variation between growers and between markets.

Such information could be provided by the markets. In the absence of this the individual grower cannot make comparisons between the prices realised by his produce and the ruling market price. A feasible alternative would be for a group of growers to pool their information. Such a scheme is operated by Canterbury growers.

The analysis of seasonal price trends is a more major task. However the importance of returns in determining profits, and the price trends shown in this report, suggest that it is an essential one. Again because the markets do not publish price information the only source is from growers' records.

A possible solution to the problem of data provision is for a group of growers to rent computer processing facilities. Individual growers could obtain more detailed information on returns and purchases and on market prices. Such facilities could also provide comparative price information, etc. From such a data store it would be a relatively simple task to collate seasonal price and market trends. It is suggested again that either the Growers' Federation and/or the Advisory Service could initiate discussions on this.

The impression was gained that both the Industry itself and the Advisory Service were weaker in the area of business management as compared to the technical and marketing aspects. Without pushing his own canoe the writer feels that there could be considerable benefit to growers by the employment of a management specialist in the area; either by the advisory service, the Growers' Federation or a growers' group. This person could provide the services discussed in the report, to individual businesses and to growers' groups.

APPENDIX I: STANDARDIZATION PROCEDURE

The basis for comparison was owner-occupied private businesses free of mortgage, producing only glasshouse crops.

To do this the following adjustments were made to profit and loss account information.

1.0. Returns

1.1. Earnings from non-glasshouse crops were omitted.

1.2. Income from outside employment interests, rents, dividends and interest were omitted.

1.3. The estimated value of produce consumed by the grower and of untaxed gate sales income was included.

1.4. Sales were calculated net of commission.

2.0. Costs

2.1. Materials

2.1.1. Where materials were purchased at the end of the season they were treated as an input for the following season.

2.1.2. Items purchased for non-glasshouse cropping use were omitted.

2.1.3. The cost of durables such as soil enrichment was apportioned over useful life.

2.2. Containers

In some instances the profit and loss account did not separate materials and containers. In these cases container usage was obtained from market records. As with materials an adjustment was made for end of season purchases.

2.3. Freight

Where growers used their own vehicles to transport produce to railhead or market this was costed and included under the heading 'freight'. An estimate of distance and frequency was multiplied by a mileage charge of 10, 11, 12 cents/mile for the years 1970/71 to 197//73 respectively.

2.4. Fuel and Electricity

An estimate of household fuel and power consumption was deducted from the total cost in cases where business and domestic use were not separated.

2.5. Overheads

The following were deducted from business overheads where applicable:-

2.5.1. Private use of telephone.

2.5.2. Any private insurances (including motor)

2.5.3. All interest payments.

2.5.4. Domestic share of rates.

2.5.5. In any instances where rent was paid this was replaced by an assessment of the depreciation charge of the items.

2.6. Repairs and Maintenance

2.6.1. The value of repairs to private dwellings was omitted.

2.6.2. Where capital items had been charged under this heading these were transferred to depreciation.

2.6.3. In some instances an infrequent major repair had been charged. The cost of this was apportioned over a number of years to avoid distortion.

2.7. Motor Expenses

This heading contains the maintenance and running costs of machinery directly involved in production. Costs associated with vehicles, shared between business and personal were omitted.

2.8. Depreciation

2.8.1. Depreciation on items such as house and car that are shared between business expenses and personal drawings was omitted.

2.8.2. The value of the business labour (including family) used in the construction of assets was added to capital cost for depreciation purposes.

2.8.3. Tax corrections to depreciation, and special allowances were apportioned over asset life.

2.8.4. No adjustments were made for differences between market value and book value of assets.

2.9. Wages

2.9.1. The values of any housing and other perks provided were added to wage costs.

2.9.2. Any directors' fees etc., paid to family members were omitted.

2.9.3. In some cases family members other than grower and wife received income under this heading. This was replaced by the actual value of work performed determined by hours multiplied by normal wage rate. This could mean either an increase or decrease in "wages paid".

2.10. Family Labour

This heading is confined to the grower and his wife if both contribute to the work force. Other family members were covered under 'wages'.

2.10.1. An estimate of hours worked was obtained.

2.10.2. The following wage rates were used:-

	70/71	71/72	72/73
Grower (up to 44 hrs)	1.10	1.20	1.30
" (hrs over 44)	1.65	1.80	1.95
Wife (up to 44)	0.87	0.93	1.00

2.10.3. To these were added a management allowance calculated as 5% of total business income in the year.

APPENDIX II: METRIC CONVERSIONS

The following metric imperial equivalents were used:-

Area: 1 sq ft = 0.093m^2
Thus the 100 x 30 ft greenhouse = 279m^2

Weight: 1 lb = 0.4536 kg

Yield/Unit Area: Approximate conversions for yield/plant assuming a density of 1 plant/3 ft^2 are:-

8 lbs/plant	13 kg/m^2
9	14.6
10	16.3
11	17.9
12	19.5
13	21.1
14	22.8

APPENDIX III: STANDARD WEEK NUMBERS

Apr.	1-7	1	Oct	7-13	28
	8-14	2		14-20	29
	15-21	3		21-27	30
	21-28	4		28-3 Nov	31
Apr	29-May 5	5	Nov	4-10	32
May	6-12	6		11-17	33
	13-19	7		18-24	34
	20-26	8		25-1 Dec	35
	27-2 June	9	Dec	2-8	36
June	3-9	10		9 -15	37
	10-16	11		16-22	38
	17-23	12		23-29	39
	24-30	13		30-6 Jan	40
July	1-7	14	Jan	7-13	41
	8-14	15		14-20	42
	15-21	16		21-27	43
	22-28	17		28-3 Feb	44
	29-4 Aug	18	Feb	4-10	45
Aug	5-11	19		11-17	46
	12-18	20		18-24	47
	19-25	21		25-3 Mar	48
	26-1 Sept	22	Mar	4-10	49
Sept	2-8	23		11-17	50
	9-15	24		18-24	51
	16-22	25		25-31	52
	23-29	26			
	30-6 Oct	27			

APPENDIX IV: MEAN GROSS PRICES RECEIVED BY AUCKLAND GROWERS FOR TOMATOES (CENTS/LB)

Week No.	1970/71	1971/72	1972/73
16	42.0	49.3	42.9
17	42.0	65.3	39.8
18	45.8	57.3	39.4
19	45.9	44.6	48.5
20	44.2	41.5	56.1
21	44.4	38.5	57.3
22	35.5	41.3	56.0
23	31.2	40.7	51.8
24	23.5	43.7	40.1
25	22.7	37.5	31.0
26	30.1	32.5	33.9
27	36.2	29.3	40.3
28	32.9	30.5	40.1
29	32.5	38.8	39.6
30	29.6	34.8	32.9
31	20.1	32.4	27.2
32	25.5	32.2	29.6
33	30.1	26.4	29.0
34	24.7	17.4	24.5
35	21.0	18.8	26.6
36	15.1	18.6	21.5
37	13.6	19.8	27.7
38	21.6	19.5	23.2
39	23.5	16.4	10.8
40	19.2	19.0	15.0
41	21.0	24.1	12.4
42	21.7	16.4	10.6
43	11.1	11.9	12.1
44	6.1	15.4	16.1

APPENDIX V: FIELD DATA SHEET

Auckland Management Study

Growers Code

1. Physical Description of Property

1.1. Greenhouses

No.	Date Erected	Area	Size of glass	Ventilation Area	Method of Heating	Method of Irrigation

1.2. Heating Equipment

Method (e.g.) central boiler, hot water, 2" pipe

Boiler Capacity

Grade and type of fuel

Temperature range between houses

1.3. Facilities

(a) Total area

(b) Sheds, offices etc.

(c) Water supply

1.4. Equipment (in addition to detail on accounts)

2. Cultural Methods

(a) Sowing and planting dates

(b) Propagation method

(c) Varieties grown

(d) Spacing and total number of plants

(e) Growing method (including temperatures)

3. Yields

(a) Information on yield/plant and total yield

(b) Information on differences between greenhouses, planting dates, varieties etc.

(c) Grading of fruit

4. Marketing

(a) Markets sent to, case sizes, cartage

(b) Information on prices obtained

5. Labour

(a) Permanent staff

Age
Sex
Qualifications
Years with business
Hours worked
Payment method
Extra benefits

(b) Casual labour

Age
Sex
Hours worked
Payment method
Extra benefits

(c) Grower and family

Working hours
Value of labour

6. Investment

(a) Present market value of land

(b) Present market value of assets

(c) Means of finance used

7. Adjustments to Accounts

Information will be needed on the extent to which materials paid for by the business are used for personal consumption. The following items often come into this category:-

(a) Telephone
(b) Vehicles' fuel, repairs, insurance
(c) Insurances
(d) Rates
(e) Heating fuel and electricity

Could you estimate either the value of private use or the proportion to which they are used privately.

(f) Often materials are bought at the end of one financial year for use in the following season.

Could you estimate for the following items the quantity and/or value which were unused at the end of the financial years.

	Yr. 1.	Yr. 2	Yr. 3
Cases			
Fuel			
Fertiliser			
Other materials			

APPENDIX VI: Example of Computor Print-out Showing Price Analysis

AUCKLAND GLASSHOUSES F GILL 1973

FFIT TO MATO 70- 71

WEEK NO 11

DATA BY GRADE

CODE	NAME	NO SALES	QUANTITY	PER CENT	VALUE	PER CENT	AV PRICE
1	LARGE	2	60	3.61	1300	3.42	21.67
2	NO 1	6	720	43.37	16540	43.52	22.97
3	MEDIUM	6	596	35.90	14792	38.92	24.82
4	SMALLMEDIUM	4	132	7.95	2636	6.94	19.97
5	SMALL	3	92	5.54	1656	4.36	18.00
7	NO 2	3	60	3.61	1080	2.84	18.00

DATA BY MARKET

CODE	NAME	NO SALES	QUANTITY	PER CENT	VALUE	PER CENT	AV PRICE
2	RADLEY	8	580	34.94	11100	29.21	19.14
10	RADCH	2	96	5.78	2712	7.14	28.25
25	ARLIDGE	14	984	59.28	24192	63.66	24.59

2	RADLEY	MEAN PRICE	19.14	STD DEV	4.19
10	RADCH	MEAN PRICE	28.25	STD DEV	1.46
25	ARLIDGE	MEAN PRICE	24.59	STD DEV	5.69

WEEK SUMMARY

NO SALES 24 QUANTITY 1660 LBS VALUE 38004 MEAN PRICE 22.89 STD DEV 5.62

DEPARTMENT OF HORTICULTURE BULLETINS

1.	THIELE, G.F.	Fruitgrowers' Short Course May 1967
2.	THIELE, G.F.	Advice to Prospective Horticultural Students Commencing Practical Work
3.	CROWDER, R.A.	Extensive Vegetable Production. Also C.C.C. Agricultural Bulletin No. 464
4.	CROWDER, R.A.	Development of Machine Methods for Extensive Crop Production - Onions. Also Lincoln College Miscellaneous Reprint No. 26
5.	CROWDER, R.A.	Preliminary Investigations into Large-scale Intensive Production of Tomato
6.	THIELE, G.F.	Horticultural Management Handbook
7.	MORRISON, T.M. ed.	Economics and Management of Fruit-growing. Proceedings of a Short Course, May 1968
8.	MORRISON, T.M. ed.	Proceedings of a Short Course on Economics and Management of Vegetable Growing. 1969.
9.		NOT AVAILABLE FOR DISTRIBUTION
10.	THIELE, G.F.	Berryfruit Management. 1969
11.	MORRISON, T.M. ed.	Horticultural Marketing with Special Reference to Stone-fruit 1970
12.	THIELE, G.F. ed.	The Production, Management and Marketing of Berryfruits. 1971
13.	THIELE, G.F.	Labour Management in Horticulture and Agriculture. 1972
14.	TAYLOR, J.O. ed	Parks Management: A report of the Proceedings of a Seminar covering several aspects of management of Parks held at Lincoln College, Canterbury on Aug. 25th & 26th 1972
15.	JACKSON, D.I.	Temperate and Sub-tropical Fruit Production. 1974
16.	TAYLOR, J.O.	National Parks Authority: Rangers and Chief Rangers' Block Course