Results from a Survey of Organic Kiwifruit Growers: Problems and Practices that affect Production

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Purpose and overall aim

- The purpose of this research was to identify factors involved in organic kiwifruit production that either positively or negatively impact upon production.

- The overall aim was to enable steps towards the improvement of the productivity of organic kiwifruit production in New Zealand.

Method

- The research utilised data that was gathered by survey using a self-completed questionnaire. Relevant data was also sourced from a comprehensive database maintained by Zespri. The survey gained 80 respondents from a possible 220 growers.

- The questionnaire contained a range of questions investigating the topic areas of crop protection, orchard management, advice and decision-making and strategies for the future.

- The data was subjected to statistical analysis to explore relationships between items and measures of productivity.

Key findings

- Owners gain more Kiwistart premium than managers.
- Owners, compared to managers, produce smaller fruit when measured as average fruit size.
- Te Puke outperforms Tauranga in terms of receipt of both the Kiwistart and Taste Zespri premiums.
- The Pergola structure leads to the production of larger fruit when compared to the T-bar structure.
- Orchards with more canopy hectares tend to produce larger fruit when measured as average fruit size.
- There was no evidence that organic production improves in terms of key production outputs over time.
- Those who gain a Kiwistart premium also tended to gain a Taste Zespri premium.
- Armillaria is associated with fewer trays of larger fruit.
- Those who identify the problem of Fuller's rose weevil gain more of the Taste Zespri premium.
- The recognition and treatment of Scale is associated with more trays per hectare, the production of trays of larger fruit and a greater tendency to receive the Taste Zespri premium.
- Banding for Fuller's rose weevil produces larger fruit in terms of average fruit size, more trays of larger fruit and more trays of fruit per hectare.
- Applying sprays other than specified in the spray diary is associated with poorer production in terms of average fruit size, the gaining of Kiwistart premium and the production of trays of larger fruit.

- Growers who mow their orchards more often, which is presumably an indication of more intensive management, tend to have better average fruit size and produce trays of larger fruit.
- Underplanting is associated with smaller average fruit size.
- Growers with KPA registration receive less Kiwistart premium.
- Hive inspections are associated with receiving more of the Taste Zespri premium.
- Growers using artificial pollination have a disadvantage in terms of receiving the Taste Zespri premium.
- The use of conventional pruning over strong leader pruning leads to smaller fruit when measured as average fruit size and fewer trays of larger fruit.
- Frost damage is associated with an increase in receipt of the Taste Zespri premium.
- Growers who intend to decrease their growing area receive more of the Taste Zespri premium.
- Growers that had do well in terms of average fruit size estimate higher costs than other growers.

Policy recommendations

- Owners and managers have different production outcomes. This means that the tailoring of policies to the needs of these two distinct groups may be more rewarding than simply providing blanket policies for growers as a whole.
- Productivity differences between growing areas suggest the dissemination of information about favourable and unfavourable growing areas would enable better choices regarding the location of orchards.
- To encourage the production of larger fruit the Pergola rather than the T-bar should be the preferred structure for organic kiwifruit production.
- The finding of no evidence of improvement in production over time suggests that new growers are not disadvantaged and that productive output can be gained in a reasonably short time. This could encourage new growers and those considering organic kiwifruit production.
- Armillaria is common and detrimental and efforts should be targeted to avoid or address this problem.
- Banding for Fuller's rose weevil improves productivity and should be supported and encouraged.
- Applying sprays other than specified in the spray diary is either counter productive or being undertaken by those already experiencing serious production problems. This practice should be discouraged.
- Hive inspection is rewarding in terms of gaining the Taste Zespri premium and should be encouraged.
- Growers resorting to artificial pollination have a disadvantage in terms of receiving the Taste Zespri premium. If possible the practice should be avoided.
- Where practicable, strong leader pruning should be used instead of conventional pruning to improve fruit size.
- To improve net profit, the costs associated with gaining the Taste Zespri premium need to be plainly presented to growers.
- Promoting a realistic projection of costs would also improve net profitability regarding the implementation of measures to improve fruit size. Growers producing larger fruit are projecting greater costs than other growers.

Chapter 1
Introduction

1.1 Introduction

This is a report of an investigation of the practices and problems of organic kiwifruit fruit production. The practices and problems are examined to better understand factors related to productivity with the general aim of improving productivity. The investigation is based on the analysis of a survey of organic kiwifruit growers.

This report has two results sections presenting detailed analysis of the survey data. To assist those not familiar with such analyses, each of the two results sections are followed by a summary. The summary for the first section of results is provided on pages 35 to 36 (Section 2.22) and the summary for the second section is provided on pages 50 and 51 (Section 3.20). In addition, discussion and conclusions from the study (see Chapter 4, pages 52 to 55) are more plainly set out in terms of how the results apply to the production of organic kiwifruit. These conclusions are also provided in the summary at the beginning of the report (pages 1 and 2)

The presentation of the results of the data analysis begins in the next chapter. There are two chapters of results. First, descriptive results for the survey data are provided. The descriptive results are followed by the investigation of productivity through examination of relationships between the survey data and productivity data drawn from the Zespri database. In conclusion, the results are discussed with attention given to implications for policy, limitations of the research and recommendations for further research.

1.2 Purpose of the research

The purpose of the research was to identify factors involved in organic kiwifruit production that either positively or negatively impact upon production. The identification of these factors is necessarily towards the improvement of the organic production of kiwifruit. This may occur directly through growers addressing the factors identified as significant in this investigation or indirectly through further investigation of these factors. It is nevertheless an explicit aim of this research to enable steps towards the improvement of the productivity of organic kiwifruit production in New Zealand.

1.3 Method

Data about the practices and problems of organic kiwifruit growers was gathered by survey using a self-completed questionnaire. The surveys were completed between July and October 2003 and refer to the growing year preceeding July 2003. Some supplementary relevant data were also sourced from a comprehensive database maintained by Zespri. The survey gained 80 respondents and the database contained information from 220 growers. The identification of database data pertaining to the survey respondents was facilitated by the respondents providing their KPIN code number. Seventy-eight of the respondents provided this number.

The questionnaire was distributed to organic Zespri growers. The questionnaire contained a range of questions pertinent to the production of organic kiwifruit. Topic areas covered in the questionnaire were: crop protection, orchard management, advice and decision-making and

strategies for the future. Questions included enquiries regarding current problems and practices as well as future prospects and strategies.

The questionnaire was longer than would have been desirable for a public survey with 14 pages and a total of 297 separate items or variables. In addition, while it is apparent that attention had been given to gathering relevant information, attention to the use of common format and measurement scales would have been an improvement. In addition, while an appropriate method, the gathering of written responses to open questions would have further burdened the respondents. However, because the respondents belonged to the group that would immediately benefit from the research, the negative effects of a long survey on response and completion rates may have been offset.

Two hundred and twenty organic kiwifruit orchards from the Zespri database were invited to participate in the study by completing a questionnaire. Eighty subsequently completed and returned the questionnaire giving a response rate of 36 per cent. Tests for representativeness comparing the sample of 80 with the 220 found an indication that the sample contained growers that produced slightly more trays of larger fruit on average. There was, however, no significant difference in terms of number of trays per hectare, receipt of the Taste Zespri premium and receipt of the Kiwistart premium. Overall, those answering the questionnaire had produced slightly larger fruit, but other production outcomes were effectively no different. This suggests that the survey results are a reasonable representation of the problems and practices of organic growers.

Chapter 2
Descriptive Results

2.1 Introduction

This chapter presents the descriptive results in order to provide an improved understanding of how organic kiwifruit orchards are managed. While the results are present in a necessary technical manner the results are summarised in plainer language on pages 32 and 33 (Section 2.22).

The mean or average, standard error (indicating how broad was the range of responses) and number of responses (n) are provided for interval measures and frequency per response category is reported for nominal data. Written responses are presented in summary form. The order of presentation of items corresponds with the order in which they were presented to the respondents.

Because some questionnaires did not have responses for every item, the number of responses to each item is reported. There were 80 respondents overall, however, the Hayward variety (n = 70) and the Hort16A variety (n = 10) are known to differ in their management and output and are consequently reported separately.

A summary of the descriptive results is provided at the end of this chapter. Overall this chapter lays an important foundation for subsequent analysis.

2.2 General information

The 80 owner, manager or lessors of kiwifruit orchards that chose to complete the questionnaire were all registered as organic growers at the time of the survey. With the exception of two orchards, all provided their current KPIN number. In terms of the relationship of the person who completed the survey and his or her orchard (shown in Table 1) most were the owner, some were the manager and a small number was the lessor. When asked whether he or she managed the day-to-day running of the orchard, as shown in Table 2, 76 of the 79 who responded indicated they were the day-to-day manager.

Table 1: Relationship to the orchard

	Hayward	Hort 16A	Total
Owner	51	7	56
Manager	13		13
Lessor	5	2	7
Total	69	9	78

Table 2: Day-to-day management

	Hayward	Hort 16A	Total
Yes	67	9	76
No	2	1	3
Total	69	10	79

To further describe the survey sample, the supply region for the orchards is shown in Table 3. As can be seen, the majority of the orchards were located at Tauranga and Te Puke in the Bay

of Plenty. The other orchards were isolated examples from other regions, for example, one orchard was located in Kerikeri in Northland and another orchard was in Hawkes Bay.

Table 3: Orchard supply region

	Hayward	Hort 16A	Total
Coromandel	2		2
Hawkes Bay	1		1
Katikati	4	1	5
Kerikeri	1		1
Opotiki	1		1
Taranaki	1		1
Tauranga	35	3	38
Te Puke	19	6	25
Waikato	5		5
Whakatane	1		1
Total	70	10	80

Further general information about the growers and their orchards was also gathered. Table 4 shows that most of the orchards used a Pergola structure, while fewer had a T-bar structure. Both Pergola and T-bar were used on eight of 79 orchards.

Table 4: The structure used on the orchard

	Hayward	Hort 16A	Total
T-bar	15	2	17
Pergola	47	7	54
Both	7	1	8
Total	69	10	79

In general, the canopy hectares (Table 5) were slightly larger for the Hayward variety than Hort 16A. Overall, the length of time the orchard had been organic (Table 6) ranged between two and 17 years with the average length of time being between seven and eight years.

Table 5: Canopy hectares

	n	Mean	s.e.	Range
Hayward	68	3.31	.31	0.3 -12
Hort16A	10	3.26	.82	0.44 - 8

Table 6: How long organic?

	n	Mean	Range
Hayward	70	7.30	2 - 17
Hort16a	10	7.80	2 - 13
Total	80	7.36	2 - 17

2.3 Output of the orchard

The output or performance of the orchards was measured by gathering information about average size and output in terms of yield per hectare (Trays/Hectare). Average size refers to the average number of fruit per tray, which means that a higher figure indicates a poor output being comprised of smaller fruit and a lower number indicates a better output comprising larger fruit.

To add further depth this measure was sought for the previous three years[1]. A point to note is that a number of respondents failed to provide this information; for example, 35 per cent did not provide yield per hectare information for 2001.

2.3.1 Average fruit size

As can be seen in Table 7, in terms of the average fruit size across all orchards there was little difference between the three years. The better performing orchards, in terms of fruit size, were averaging approximately 30 fruit per tray whereas the poorer output sizes were approaching 40 fruit per tray.

Table 7: Average fruit size

		Average fruit size 2001	Average fruit size 2002	Average fruit size 2003
Hayward	n	54	65	65
	Mean	35.01	36.17	35.46
	Std. Error	.20	.16	.21
	Minimum	30.60	33.30	31.66
	Maximum	38.30	39.00	39.01
Hort16a	n	6	9	9
	Mean	35.43	33.23	34.56
	Std. Error	.38	.71	.69
	Minimum	33.90	29.40	31.40
	Maximum	36.30	36.00	37.90

2.3.2 Yield per hectare

Fewer growers provided yield per hectare information in comparison with information provided about average fruit size. Table 8 shows that only 35 of the Hayward respondents (51 per cent) provided their yield per hectare for 2001, with 42 (61 per cent) providing the yield per hectare for 2002 and 2003.

Table 8: Yield per hectare (Trays/hectare)

		Yield per hectare (trays/ha) 2001	Yield per hectare (trays/ha) 2002	Yield per hectare (trays/ha) 2003
Hayward	n	35	42	42
	Mean	5155	4546	4739
	Std. Error	237	218	222
	Minimum	1210	589	1184
	Maximum	7750	7000	7100
Hort16a	n	3	4	4
	Mean	4765	6647	5511
	Std. Error	495	740	661
	Minimum	4060	5500	4537
	Maximum	5721	8824	7414

[1] The use of year as opposed to growing season follows the use of year in the questionnaire. Where the year is referred to (e.g., 2000) it is the 1999 to 2000 growing season.

2.4 Limitations and Problems of Production

The following is a summary of limitations and problems for all respondents regardless of whether they were Hayward and Hort 16A growers. The comments were of a general nature and could not readily be divided between the two cultivars. In addition, the general nature of the responses as well as their length and complexity prevented any meaningful categorisation or ordering of the responses. The following summary is therefore a general description while classifications in the form of headings are provided for the purpose of presenting the responses in an intelligible manner.

2.4.1 Soil fertility and plant nutrition

The problem reported most often was the management of soil fertility, which in turn relates to the vitality of vines and the production of fruit. This problem was mentioned along with general comments about the vitality of vines and fruit production by 49 respondents. There were also complaints about the inability to use chemical fertilisers and reliance on compost. Respondents were concerned about the availability and the quality of inputs, for example, composts. Some felt they needed some more information on what to use and gave a range of products including foliar feeding, worm casts, compost teas, and seaweed and fish fertilisers, about which it was felt there was little quality information. Soils were described as lacking in potassium, and nitrogen, and one grower mentioned a lack of magnesium and manganese.

The problem of low soil fertility was related to a loss of vitality and vigour in the vines with the production of low strength fruiting wood, slow growth and difficult establishment of new vines, loss of production in older vines, difficulty in getting a full canopy rapidly in spring, maintaining healthy leaf cover, getting enough flowers on good wood (bud numbers) (as use of Hydrogen cianamide is not allowed under organic protocols), and ultimately adversely affected fruit size.

It was suggested that more research providing “credible statistics and scientific analysis” was needed on the organic farming of Kiwifruit and one person suggested some sort of mentoring programme and/or advisory service for knowledge transfer would be very useful.

2.4.2 Weather

Fifty-two respondents felt that weather had limited their kiwifruit production in many ways, the most common of which was the impact of mild winters (16 responses), as chilling was necessary for bud production, and they were not able to use Hydrogen cianamide. However, cold spring weather and particularly frosts were a problem. Others mentioned wind and hail, the impact of the weather at pollination time, spray time, and early cane blowout. There was an implication that because growers were not able to use some of the usual grower techniques and technologies that the actual growing season was shorter for organic compared with conventional growers. Some mentioned the variability or changeable nature of the weather with its deleterious effects on pest management.

2.4.3 Site of farm attributes

Some of the orchard site attributes were also related to weather conditions. In particular 11 respondents felt that they had weather problems (lower temperatures, cool spring weather) because of the altitude at which they farmed (between 190m to 275m above sea level). Two respondents mentioned they had problems with lack of shelter and four with drainage. Three mentioned their land was contoured and that this produced a problem with soil fertility.

2.4.4 Bud burst/break

Twenty-three respondents mentioned they felt their production was limited by problems with buds and flowering. The issues mentioned included the initiation of bud burst (breaking winter dormancy) and uneven, variable, inconsistent flowering (through not being able to control bud burst and therefore reducing the length of the growing season). Overlong period of bud burst and flowering was also mentioned as a further related problem.

2.4.5 Pollination

Most of the 15 respondents who mentioned pollination as a limitation did not elaborate any further. Some mentioned the problem was related to the long flowering period, the weather, and bees. Pollination was also sometimes related to issues to do with a lack of male vines and concerns about inter-planting and distance.

2.4.6 Production

Many respondents (22) expressed concern about production limitations. These concerns included the low number of trays per hectare, the lack of consistency of, or fluctuations in, production, fruit size and the inability to boost fruit size with particular products. Misshapen fruit, and dry matter content were also mentioned.

2.4.7 Pest, disease and weed management

Thirty-two respondents mentioned pests as a limitation to their production and scale was mentioned by 21 respondents. Others mentioned leaf roller, birds and Fuller's rose weevil. Achieving pest free status was seen as a limitation by one person. Armillaria was by far the most common disease mentioned with sooty mould, bud rot and sclerotinia were also mentioned. Three respondents mentioned weed problems with privet, blackberry and gorse.

2.4.8 Vine/canopy management

Most responses under this heading were concerned with "filling the canopy with good canes", finding enough canes to fill the canopy and growing good replacement canes. Others were concerned about pruning issues such as reducing clusters of old growth, thinning and the relationship to fruit size. Also the cost (one Hort 16A grower wrote that pruning was four times the cost of conventional Hayward pruning) and particularly how labour intensive it was to maintain the summer canopy. Six respondents were concerned about the use of T-bars and three of those thought Pergolas would increase fruit size and production.

2.4.9 Economic issues

Eight people expressed concerns related to the return made on their investment, its reliability, it marginality, transport costs and the cost of certification being unrelated to orchard size.

2.4.10 Other issues

There were a few complaints about Biogro (fees, small grower focus, not commercially product oriented, bureaucratic) and Zespri (lack of confidence in future, lack of commitment to organic marketing, unrealistic standards for organic fruit). Many other things were mentioned by only one person and could not be tied together in common themes. For example, the same person wrote that each year there were new problems but that he was also bored. One mentioned lack of time was a problem, another mentioned bookwork. Unskilled workers, soil compaction, the impact of fumigation on fruit, and sward management were also mentioned.

2.5 Premiums

Table 9 lists four premiums that could have been received by respondents over the last four years. As shown in the table, the storage premium was the most common having been received by more growers than the other premiums.

Table 9: Number of orchards receiving premiums by year

Hayward	2000	2001	2002	2003
Storage premium	30	30	35	24
Kiwistart premium	7	7	8	12
Taste Zespri premium	1	2	19	25
Pest free premium	2	5	16	15
Hort 16A	**2000**	**2001**	**2002**	**2003**
Storage premium	0	1	2	2
Kiwistart premium	0	0	1	2
Taste Zespri premium	1	0	1	1
Pest free premium	0	0	2	1

2.6 Production problems

In addition to the written answers about production problems and issues presented in the previous page, information about specific production problems over four growing seasons was provided by the growers and is shown in Table 10. As can be seen in the table, scale was a persistent problem and was reported as occurring on 17 or more Hayward orchards per growing season. Armillaria was also relatively common with 28 to 36 Hayward orchards experiencing this problem. Sclerotinia, botrytis, sunken pitting and storage rots on average occurred on five or less of the 69 Hayward orchards per year. The low occurrence of these problems is also particularly noticeable in the 2003 growing season with only sclerotinia reported as being a problem on one orchard.

Table 10: Number of orchards suffering production problems

Hayward	2000	2001	2002	2003
Scale	17	27	28	23
Passion-vine hopper	22	13	7	6
Leafroller	10	8	7	7
Fuller's rose weevil	6	8	6	6
Armillaria	28	32	37	36
Sclerotinia	4	3	5	1
Botrytis	1	1	3	0
Sunken pitting	1	2	2	0
Storage rots	0	0	3	0
Hort 16A	**2000**	**2001**	**2002**	**2003**
Scale	3	4	5	5
Passion-vine hopper	3	3	2	1
Leafroller	1	4	2	1
Fuller's rose weevil	2	3	2	2
Armillaria	1	1	2	2
Sclerotinia	1	1	1	0
Botrytis	0	0	0	0
Sunken pitting	1	2	2	0
Storage rots	1	0	3	0

2.7 Control of pests and diseases

A number of questions were asked to gain further information about the control of pests and diseases. As a general measure of the success of control measures the growers were asked "Can you currently control pests and diseases?" The answers, recorded on a five-point scale anchored by adequate (1) and inadequate (5) with three meaning neutral. Table 11 shows that in general growers considered their control measures to be adequate For the Hayward growers, given 3 is the neutral response then, 2, or somewhat adequate, was the most common answer. Fifteen Hayward growers reported their control of pests and weeds to be inadequate and four Hort 16A growers reported their control to be somewhat inadequate.

Table 11: Control of pests and diseases

Hayward (mean 2.20, s.e. .11)	**Frequency**
1 = adequate	15
2	28
3	16
4	6
5 = inadequate	15
Total (n)	65
Hort 16A (mean 2.90, s.e. .33)	**Frequency**
1 = adequate	0
2	5
3	1
4	4
5 = inadequate	0
Total (n)	10

In answering questions about spraying most Hayward growers indicated they had done their own spraying (Table 12). In contrast, banding for Fuller's rose weevil (Table 13) was undertaken, by 28 of 66 Hayward growers. With regard to the effectiveness of the banding (Table 14), most indicated it was worthwhile and four growers indicated it had been effective in some seasons. Only five Hayward growers indicated they used sprays other than those listed on their spray diary (Table 15). Only two growers specified these other sprays, which were biodynamic peppers to combat Fuller's rose weevil and scale.

Table 12: Does own spraying

	n	Yes	No	Sometimes
Hayward	68	43	23	2
Hort 16A	10	5	5	

Table 13: Banding for Fuller's rose weevil

	n	Yes	No
Hayward	66	28	38
Hort 16A	9	4	5

Table 14: Effectiveness of banding

	n	Yes	No	In some seasons	Unsure
Hayward	30	16	7	4	3
Hort 16A	4	4			

Table 15: Application of other sprays

	n	Yes	No
Hayward	66	5	61
Hort 16A	9		9

2.8 Orchard management

The management of the orchard in terms of the physical inputs in the production process was assessed using two sets of questions. The first set specified five particular applications, these were compost, compost tea to leaves, compost tea to ground, mulch and manure. Each category required details including the name of the product, rate of application, the timing, number of applications and the reason for use. Similarly, products not captured by these general classifications were gathered by asking for details of "other products applied to the orchard".

2.8.1 Compost

Table 16 shows the applications of compost reported by the growers. In total, 74 growers reported applying compost to their orchards. Revital was the most common followed by compost made by the growers themselves. The rates and units of measurement varied widely for compost made by the growers themselves, preventing a meaningful summary of this information. Manufactured compost was generally applied between June and October. Compost made by growers was applied at various times of the year and had been applied twice a year by two growers. A number of general reasons for applying compost were noted. In summary these comments referred to the adding of organic matter, improvement of soil fertility and nourishment, and encouragement of fungi.

Table 16: Applications of compost

Compost	Hayward	Hort 16A	Rate/amount	Timing	Number per year	Reason
Revital	41	2	1-20 tonnes per hectare	June, August, September	Once	Add organic matter Improve soil Fertility Increase fungi
Own	14	6	Various	Various	16 once 2 twice	Add organic matter Improve soil Fertility
Living earth	4		7.5-10 cubic metres per hectare	June, August, October	Once	Fertility
Hamilton organic	2	1	10 tonnes per hectare	June	Once	Increase fungi
Agrich	1		40 tonnes per hectare		Once	Improve soil
Groganic	1		10 tonnes per hectare	August	Once	Add organic matter

2.8.2 Compost tea

Information about the application of compost tea to leaves is provided in Table 17. Unlike the use of compost detailed above, only nine growers reported applying compost tea to leaves. Five growers reported making the compost tea themselves and a range of application rates were reported by these growers. Compost tea made by the growers themselves was applied once in either October or November. The remaining four growers had applied a manufactured product. Seeka was applied at a rate and at a time of year similar to the product made by the growers themselves. Eco was reported as being applied in April.

Table 17: Application of compost tea

Compost tea to leaves	Hayward	Hort 16A	Rate/amount	Timing	Number	Reason
Own	3	2	20, 100, 150 cubic metres per hectare	October November	1	Crop nutrition
Seeka	4		50 cubic metres per hectare	Nov	1, 2	Vine health
Eco	1		100 cubic metres per hectare	April	1	Promote biological activity

2.8.3 Compost tea to ground

The application of compost tea to the ground, shown in Table 18, was undertaken by 11 growers. Two of the 11 growers made their own compost tea for this purpose. Graham Reid and Seeka were only applied once per year. A different frequency had been used for Bio sea blue and the Compost tea company product with four applications per year reported for these two products. Where provided by respondents, application dates differed widely with one application reported for May and one for January. Various general reasons for the use of the application were provided.

Table 18: Compost tea to ground

Compost tea to ground	Hayward	Hort 16A	Rate/amount	Timing	Number	Reason
Graham Reid	1	2	60, 250, 250 cubic metres per hectare	May or June	1	Feed fungi
Seeka	3		100, 100, 50 cubic metres per hectare	September	1	Feed food web, Vine Health
Own	3		100, 150 cubic metres per hectare	January	1, 2	Nutrition

2.8.4 Other applications

The growers also volunteered a range of products other than compost, tea preparations, mulch and manure (see Table 19). As a general summary, Patent Kali and Vitec fish were common commercial products used to add nutrition and nutrients. Seaweed, was another common preparation. Unlike Patent kali and Vitec fish, which were applied in spring, seaweed was, in general, applied more frequently at various times of the year and in smaller applications. Of note, Ocean Organics was also applied in small amounts and with greater frequency. A range of other products had been applied. These included boron, phosphate, dolomite and lime for nutrient and deficiency problems. In addition, worm and fish products were also applied. One grower had applied comfrey and one grower had applied a humus-based preparation.

Table 19: Other products applied to the orchard

Name of product	Hayward	Hort 16A	Rate/amount	Timing	Number of applications	Reason
Patent kali	22	2	200 to 500 kgs per hectare	September October	1 and 2	Nutrition
Vitec fish	21	2	67, 40 to 150 cubic metres per hectare	August, September	1 to 3	Nutrients
Seaweed	10	1	22, 10-40 cubic metres per hectare	Various	1 to 4	Various
Ocean organics	8	1	10 to 12 cubic metres per hectare	Summer	2 to 5	Nutrients
Boron	7		25 to 30 kilos per hectare	Winter or September	1	Nutrition, plant health
Phosphate	5	1	.65 tonnes, .5 to 1.5 tonnes	Winter	1 to 3	Deficiency
Fish liquid	6		2500 to 10000 cubic metres per hectare	August, September	1	Nitrogen, Improve soil
Worm liquid	2		20 cubic metres per hectare	Spring and summer	3 and 4	Fertility
Vitec Kelp	2	2	6 cubic metres per hectare	February and March	2	Nutrition
Lime	3	1	1, 0.5, 1.5, 1 tonnes per hectare	September October,	1	P. H.
Organic 100	4	1	40, 40, 50, 50 cubic metres per hectare	Winter and winter and summer	1 and 2	Add fish and kelp. Assist breakdown of prunings.
Dolomite	2		300 kgs per hectare	September		Add essential elements
Vitec seabase	1	1	50 cubic metres per hectare		3	Activate soil
Moana fish	2		20 cubic metres per hectare	October	1 and 5	Trace elements
Vitec combo	3	1	6 cubic metres per hectare	December and June	2	Nutrition and fruit size
RPR	3		0.5 to 1.5 tonnes per hectare	June or August	1	Help after hail strike, Plant nutrition
Humusol	1		5 cubic metres per hectare	December	1	Fungal stimulant
Bio sea blue	1		30 cubic metres per hectare		4	Recommended by soil tests
Compost tea company	1		200 cubic metres per hectare		4	Microbe stimulation
Manuka Attwoods	1		10 cubic metres per hectare	July	1	Feed fungi
Vitec combo	1		20 cubic metres per hectare		9	
Ravensdown	1		20 cubic metres per hectare	August	2	Shortage of potash
Comfrey	1		20 cubic metres per hectare	Spring and summer	4	

2.9 Changes made to orchard practice

A series of questions were designed to assess changes made and their effectiveness. The first of nine enquires were about the initiation of change to encourage higher dry matter content. As shown in Table 20, 34 Hayward growers had sought to initiate a change in this area of which 12 reported success with eight unsure of the outcome of their efforts. As noted in the table, these changes included harder pruning, opening of the canopy and thinning.

Efforts by Hayward growers to encourage larger fruit size were reported in greater numbers than any other change. More than half of the Hayward orchards surveyed had undertaken a wide range of practices to initiate a change. Efforts towards larger fruit size were reported as being successful by a good proportion of these growers. Twenty-five (68 per cent) of those who initiated a change, indicated the change was successful.

Twenty-one Hayward growers reported making changes aimed at improving yield. Ten of these were reported as successful. A variety of changes were used, including thinning and pruning as well as compost applications and a report of more intensive treatment to combat a problem with scale.

Actions to encourage less variable dry matter were tried by a small number of Hayward growers. Only 11 had attempted to make improvements in this area and of these only one reported success. Pruning, thinning and opening of the canopy were used to encourage less variable dry matter.

Efforts to have more pest free fruit were undertaken by 29 of the Hayward growers. Twenty-one reported success and a variety of actions were employed towards this end including pruning, banding and applications of pre blossom oil.

Changes towards encouraging less variable colour, less variable maturity and to address issues regarding long storage were initiated by few growers. It appears that growers either did not consider these targets to be important or did not believe the means to make improvement or address a problem were available or effective. Only one grower reported success in addressing the problem of less variable maturity, but the way this had been done was not provided.

Changes to orchard practice undertaken by Hort 16A growers appeared to be different from those of the Hayward growers. Although the numbers are too small for any definitive comparison it would seem that, unlike the Hayward growers, these growers were not as concerned about changing high dry matter but were concerned with increasing yield, fruit size and the production of pest free fruit.

Table 20: Changes to orchard practice (Hayward)

Higher dry matter	**Yes**	**No**	**Unsure**
Changes made	34	12	
Successful change	12	14	8
What was changed	Harder pruning Open canopy Thinned	More fish fertiliser Zespri criteria	
Larger fruit size	**Yes**	**No**	**Unsure**
Changes made	37	5	
Successful change	25	8	3
What was changed	Harder pruning Open canopy Thinned More fish fertiliser Artificial pollination	Tea compost Banding Pruning Girdling	
Larger yield	**Yes**	**No**	**Unsure**
Changes made	21	7	
Successful change	10	4	6
What was changed	Harder pruning Tea compost Thinned	Compost Spray for scale	
Less variable dry matter	**Yes**	**No**	**Unsure**
Changes made	11	7	1
Successful change	1	6	5
What was changed	Harder pruning Open canopy	Thinned	
Pest free fruit	**Yes**	**No**	**Unsure**
Changes made	29	3	
Successful change	21	2	5
What was changed	Pre blossom oil Open canopy Thinned Pruning	Removed shelter belts Banding Monitored for pests	
Less variable colour	**Yes**	**No**	**Unsure**
Changes made	2	7	9
Successful change			1
What was changed	Thinned		
Less variable maturity	**Yes**	**No**	**Unsure**
Changes made	1	7	
Successful change	0	1	
What was changed			
Long storage	**Yes**	**No**	**Unsure**
Changes made	2	6	
Successful change	1	1	
What was changed	More compost		

Table 21: Changes to orchard practice (Hort 16A)

Higher dry matter	**Yes**	**No**	**Unsure**
Changes made	1	1	
Successful change			1
What was changed	Harder pruning		
Larger fruit size	**Yes**	**No**	**Unsure**
Changes made	6		
Successful change	3	1	2
What was changed	Open canopy Compost	Girdling	
Larger yield	**Yes**	**No**	**Unsure**
Changes made	6		
Successful change	2		3
What was changed	Tea compost	Compost	
Less variable dry matter	**Yes**	**No**	**Unsure**
Changes made	2		
Successful change	2		1
What was changed	Harder pruning Open canopy	Thinned	
Pest free fruit	**Yes**	**No**	**Unsure**
Changes made	7		
Successful change	1	2	1
What was changed	Pre blossom oil	Banding	
Less variable colour	**Yes**	**No**	**Unsure**
Changes made	1	1	
Successful change			
What was changed			
Less variable maturity	**Yes**	**No**	**Unsure**
Changes made	3		
Successful change	1		
What was changed			
Long storage	**Yes**	**No**	**Unsure**
Changes made	2		
Successful change			1
What was changed	More compost		

2.10 Comments on changes to orchard management

Comments about changes were mainly aimed at achieving greater consistency of larger fruit, higher yields, higher dry matter and pest free fruit.

Twenty growers made some reference to pruning with comments about the need to allow more light into the summer canopy. This practice was associated with girdling, 'leaders' or 'tying down', or the removal of tall trees. One grower wrote about having installed alternate rows of Pergolas and T-bar systems in order to allow more light into the summer canopy. It was related that openness of the canopy was expected to increase dry matter, although one grower mentioned it had not been successful on their orchard. However, another grower mentioned that it had "improved fruit across the board". Girdling, according to eight growers, had successfully increased fruit size. Also, one grower mentioned the use of reflective cloth as probably the most dramatic change they had made.

Consistency was also associated with culling or thinning. It was related that this was done after budding, after late flowering, or after the fruit had set. One grower wrote of the success of thinning fruit three times. Another wrote that thinning had not been successful in increasing dry matter content.

Changes were made to obtain pest free fruit. Eight growers mentioned the use of banding for Fuller's rose weevil. Many wrote of the winter and spring application of oil to reduce scale. One mentioned the success of three sprayings before pollination and none after. Another implied that spraying was pre-blossom. Others wrote of increasing the number of sprayings, spraying at a heavier rate, and spraying the shelter as well. Green tip oil was found to be unsuccessful by one grower, and one had no success with an increase in spraying. Peppers for passionvine hopper and Fuller's rose weevil and biodynamic spray as well as foliar spraying were also mentioned. The removal of weeds, sward mulching (for PVH nymphs at New Year) and hard pruning were given as ways of reducing pest breeding grounds. A new sprayer was also attributed to success in controlling pests.

Nine growers wrote about changes they had made to soil nutrition with compost tea being related to higher yield, and fertiliser application related to larger fruit size. One grower mentioned applying fish fertiliser while it was raining, and another used liquid fish fertiliser. Another raised nitrogen levels too high and found the resultant fruit did not keep. Another was using more compost. One wrote that the conversion to a Pergola system allowed for compost applications after bud burst. Two wrote of reducing competition by the removal of weeds.

Issues to do with changes to improve pollination were increasing the number of male plants, the addition of Chieftain vines, obtaining larger fruit through artificial pollination, and high bee numbers. Also, one person raised the importance of timeliness.

Further general comments were made by five growers who related that they were always trying to do things better than last year. One wrote, "… continually fine tuning to maximise the value of the product." In contrast, several wrote that most of the attributes of fruit were beyond their control. One wrote, "I can't improve on God's work. Can you?" Another wrote, "Good practices don't need changing." It was evident that for some that the economics of too much intervention were an issue.

2.11 Soil and leaf tests

In response to the question, "Are nutrition decisions based on soil and leaf tests?" of the Hayward and Hort 16A growers only one Hayward grower indicated their decisions were not based these tests.

Further enquiry asking for the type of tests that had been employed, produced two types of answer. Twenty-seven growers stated they had employed a soil test and another 21 stated they had employed both soil and leaf tests. Other answers detailed the test facility rather than the type of test. As shown in Table 22, tests were reported as being done by Brookvale, Hill labs and one grower reported that MAF had done the testing on their property.

Overall 69 of the eighty respondents (86.3 per cent) indicated that tests had been performed.

Table 22: Type of test

Type of test	Hayward	Hort 16A
Soil test	23	4
Soil and leaf	19	2
Brookvale	11	2
Hill labs	6	1
MAF	1	
Total	60	9

2.12 Mowing and weed control

The number of times per year the orchard was mown is shown in Table 23. All of the orchards were mown at least twice per year. Most growers (21) reported mowing four times per year. Two growers reported mowing their orchards 12 times per year.

Table 23: How often mown

Number of times mown per year	Hayward	Hort 16A
2	3	
3	18	1
4	21	1
5	9	2
6	5	
8	2	1
12	2	

Forty growers used weed control methods other than mowing on their orchards (shown in Table 24). When asked to specify these methods 34 Hayward and Hort 16A growers reported removing weeds by hand or by using a spade, one Hort 16A grower described the hand removal of blackberry and five Hayward growers indicated they used grazing as an additional control measure.

As shown in Table 25, 14 growers reported some form of underplanting. Of the 14 who provided detail of their underplanting seven related that they simply let the natural grasses grow. Eight had cultivated comfrey, five had grown herbs and two had grown perennials.

Table 24: Weed control other than mowing

Type of activity	Hayward	Hort 16A
Grazing	5	
Removing blackberry		1
Removing by hand or using a spade	30	4

Table 25: Underplanting

Type of underplanting	Hayward	Hort 16A
Comfrey	8	
Herbs	5	
Perennials	1	1

2.13 Style of pruning and pruning strategy

To investigate pruning strategy growers were first invited to answer a question to ascertain the degree to which strong leader pruning was used compared to conventional pruning. It can be seen from the responses shown in Table 26 that most Hayward growers indicated their practice was mid-way between conventional pruning and strong leader pruning. The results from the Hort 16A growers could suggest conventional pruning was more common amongst these growers.

Table 26: Style of pruning

Style of pruning	Hayward	Hort 16A
1 = Strong leader pruning	1	
2	2	
3	10	2
4	21	1
5	6	1
6	3	3
7 = Conventional	14	
Total (n)	57	7

2.14 Pruning strategy

2.14.1 Winter pruning

The general aims of winter pruning were evident from the written description given by growers of their pruning strategy. There was a general aims to fill the canopy and to ensure full cane. A common response was that the aim was to "fill the canopy with the best canes available". This decision appeared to be made mainly on grounds of age of the growth to be used with further detail of age considerations provide in Table 27. Most preferred to use new cane, but supplemented this with second year growth if there was no new cane available. A second criterion was the vigour of the possible replacement cane. Some also mentioned the colour of the wood and some wrote about the need to consider the use of spur wood.

Table 27: Choice of age of growth

Age	Number of responses
1 year/new/cane replacement	23
Preferably the above but use 2nd year growth to fill the canopy if necessary	20
Mix of new cane, 2nd and 3rd year wood	3

One grower mentioned that they used more second year wood for Pergolas than for their T-bar system. In addition, one Hort 16A grower had observed larger fruit growing on new canes and as a result was changing their pruning strategy. The choice of cane by vigour seemed mainly to relate to the use of second and third year wood. Seven growers wrote they would only use strong or thick wood, while one was emphatic that they would not use strong wood. Four wrote that they would use moderate or medium diameter wood. Three wrote they would use low vigour wood, while one wrote that they would not use low vigour wood.

A few growers mentioned using "well lit", "suntanned" or "sun-ripened" wood. Another preferred self-terminating laterals. Others mentioned that the choice was to do with whether the lateral had "fruit buds" or "mature buds". Another wrote they would take cane from inside the second wire if possible, and another that they would keep any strong cane within

the first wire. One grower wrote that if low chilling was a problem they would "lay down more canes than normal".

A few growers made individual comments such as they "spur pruned", or left "spurs where necessary", or that they maintained "fruiting spurs close to the leader". One Hort 16A grower mentioned that fruit stalks were a problem because of passion vine hopper. They harboured scale, and damaged new fruit. It was added by one grower that they were "Using more replacement cane and less spur wood as plants mature". Other jobs mentioned were "…clean off old bark on leaders to encourage new bud sites" and "Remove old and crossed over horns of unsuitable bud sites".

2.14.2 Summer pruning

Two aims were apparent in the responses concerning summer pruning. These were to have an open canopy to satisfy light requirements and to give good air movement for disease control. In addition, there were also comments about preparation for next season.

Light requirements seemed to have two linked factors. First, getting sun to the right places, and second, having the right amount of leaf. Comments about sunlight included "retain light along the leaders as far as possible", "trying to keep sun on fruiting laterals and leaves", "ensure light gets to fruiting trusses" and "retain scattered light on the orchard floor". Some comments about leaf area were " have maximum leaf area without shading" and "stop overshading of fruiting canopy consistent with plenty of productive leaf"

In consideration of how often growers pruned, this appeared to range from those who pruned "on demand for light interception" and maintained an "open canopy", to those who were more definite. For example, one grower wrote "2 rounds pre-December, 2 rounds post leader pruning" and others wrote "January to April, usually 3 weekly" and "4-6 week canopy rounds".

There were also a variety of different responses about what was pruned. These included the "shortening fruiting wood as necessary for light" and "maintain leaves on fruiting shoots". More selectively, one grower described tip and leader pruning "to try only to grow leaf that is needed". Another wrote about the removal of mature leaf and another grower wrote about retaining as much growth as is practical along sides.

Preparation for next season involved the removal of "all surplus cane" and "water shoots", "all strong growth and almost all new canes". Other similar comments were the "prompt removal of new growth that will not be required come winter pruning", "all unfruitful canes from second wire removed (early summer)", and "only early season growth kept if possible". There was one comment that there was a need to be careful not to overdo it with the warning that "wind damage can be a problem".

In addition to comments about winter and summer pruning one Hort 16A grower mentioned that "no tangles were permitted" while another grower wrote there was "limited removal of tangles". Another wanted to "encourage openness about the leader". Tipping water shoots, removing new growth in early summer, and crushing the tip early in the season were also mentioned. Four Hort 16A growers mentioned stubbing in November, one wrote that they stubbed canes in the first season, but did not think they would continue doing it and one mentioned they did not stub.

Not many growers mentioned leader pruning. Some of these growers pruned all leaders and one grower wrote that they were "working towards stronger leader pruning". Another grower

wrote that their leader pruning varied from year to year and two indicated they did not do any leader pruning at all.

2.15 Grazing

Two questions sought information about the grazing of animals in the orchard. Twenty-one of the seventy-one Hayward and Hort 16A growers who responded indicated they grazed an animal of some kind. Twenty-two subsequently specified the type of animal grazed on their orchard. Sheep were the most common (11) followed by chooks (5) and cattle (6), and one grower indicated that geese had been grazed. One grower reported grazing pukeko, deer, rabbits and possums.

2.16 Bees and pollination

Information about the use of bees to assist in pollination was sought using five questions. The frequency distribution for the reported number of hives per orchard per hectare is shown in Table 28. Eight hives per orchard was most common having been reported by 21 of 76 growers. Of note, there were 48 orchards with six to eight hives per hectare constituting 72 per cent of growers who reported their hive numbers.

Table 28: Number of hives per hectare

Number of hives per orchard	Hayward	Hort 16A
0	2	0
1	2	0
3	1	0
4	2	0
5	2	0
6	12	1
7	14	0
8	17	4
9	5	0
10	6	3
11	1	0
12	0	1
16	1	0
Total	65	9

With regard to the enquiry of KPA registration of beekeepers, for both Hayward and Hort 16A growers of the 76 who replied 57 (72 per cent) indicated that the hives used on their property were registered and 11 were unsure. A further enquiry about hive inspection regarding those who indicated KPA registration was somewhat confounded by an apparent misreading of the question. Only those with KPA registration were instructed to reply ("If 'Yes' were they inspected?), but some without registration also replied. Nevertheless, by removal of these unwanted responses it is evident that of the 57 with KPA registered hives 18 were inspected, 21 were not inspected and 17 were unsure.

Enquiry about the number of times hives were delivered to the orchard found the use of hives on a single occasion to be most common (40) though a similar number (32) had used hives twice. Few (3) reported a greater frequency.

The feeding of hives was a relatively common practice. All the ten Hort 16A growers reported feeding their hives. In addition, 59 of the 66 Hayward growers who answered reported feeding their hives.

Artificial pollination, to supplement the activity of bees, was used on 20 of the orchards, with three of these growing the Hort 16A variety. Fifteen of the 20 subsequently reported the type of artificial pollination that had been used. As shown in Table 29, a range of products and techniques were employed. Liquid spray was the most common. Organic polly rolls and Bee force were also reported as having been used, but only by one or two growers.

Table 29: Type of artificial pollination

Type of artificial pollination	Hayward	Hort 16A
Liquid spray	8	3
Hand	1	
Organic polly rolls	2	
Bee force	1	
Total (n)	12	3

2.17 Fruit thinning

All ten Hort 16A growers and all Hayward growers except for one reported doing fruit thinning. Frequency of thinning, measured in terms of the number of times thinning was done per season, was reported by 73 growers. As can be seen in Table 30, most growers thinned twice per season and a few thinned more than three times per season.

Table 30: Thinning of fruit

Number of times thinned per year	Hayward	Hort 16A
1	11	1
2	28	6
3	19	2
4	5	
5	1	
Total	64	9

Information about the target fruit number per square metre was also sought, but only 30 growers provided this information. As can be seen in Table 31, the target number ranged from 25 to 40.

Table 31: Target fruit number (fruit/square metre)

Fruit size	Hayward	Hort 16A
25	4	1
26	2	
28	1	
30	4	1
32	2	
35	5	3
36	1	
40	4	2
Total	23	7

2.18 Frost damage and frost protection

The growers reported the incidence of frost damage for the four years from 2000 to 2003. As can be seen in Table 32, the number of growers suffering damage ranged from 4 in 2000 to 17 in 2003. The orchards that experienced frost damage in more than one year are shown in Table 33. Of the 23 orchards reporting frost damage 15 had suffered damage in at least two years. For four orchards the problem was persistent with frost damage reported for three or more years.

Table 32: Frost damage

	Suffered frost damage 2000	Suffered frost damage 2001	Suffered frost damage 2002	Suffered frost damage 2003
Hayward	1	6	12	11
Hort 16A	3	2	3	6

Table 33: Number of years of frost damage

	1of 4	2 of 4	3 of 4	4 years
Hayward	4	10	2	0
Hort 16A	3	2	1	1

Growers' comments about frost protection are summarised in Table 34. Twelve growers said they had used frost protection of one sort or another (totals to 14 because one grower had used different protection in different years).

One grower mentioned the use of helicopters one year but still suffered frost damage. Others had wind machines on order or would buy them when finances allowed and another was installing a sprinkler system at the time of the survey.

Table 34: Type of frost protection

Type of frost protection	Number presently using	Number to use in the future
Frost fan	4	2
Sprinkler system	3	1
Helicopters	4	1
BD Preparation/Thermomax	2	1
Smoke	1	

2.19 Advice and decision-making

An extensive enquiry was made regarding sources of advice or information for decision making, the results of which are shown in Table 35 for Hayward growers and Table 36 for Hort 16A growers. To summarise the Hayward results, starting at the left of the table, consultants were reported as having been used by 51 growers for assisting with nutrition or fertiliser choices. Consultant advice was used by fewer growers for the other activities with only two taking consultant advice on pruning. Unlike the use of a consultant, 39 growers had sought advice on pest and disease control from PMC, in addition PMC advice was used by 32 growers regarding the timing of spray applications. Advice from packhouse reps was taken on a broad range of issues. In addition to advice on pest and disease control and timing of spray applications, some growers also took packhouse reps advice on pruning and fruit thinning. Fifteen growers took advice from spray contractors for pest and disease control, timing of sprays and pruning. Zespri was utilised for advice by growers on pest and disease control and timing of spray applications. Few growers indicated they did not seek any advice about pest and disease control or nutrition and fertiliser choices. However, more than 25 per cent did not seek any external advice about the remaining orchard activities of pruning, pollination, fruit thinning and frost protection.

A few Hayward growers indicated they took advice from sources other than those presented in the questionnaire and a proportion of these specified the source. Four growers took advice from Hortresearch regarding pest and disease control and two growers took their advice on spray timing. Other growers were mentioned as another source of information for nutrition or fertiliser choices (4), spray timing (2), pruning (1), and pollination (2). In addition, suppliers were mentioned as advisors for spray timing (3) and fruit thinning (1).

Regarding advice and decision making for Hort 16A growers (Table 44) all of the Hort 16A growers had used PMC for advice on pest and disease control. Zespri was also used by six of the nine growers for advice on pest and disease control and the timing of spray applications.

Table 35: Sources of advice and decision-making - Hayward

	Consultant	PMC	Packhouse tech. rep.	Spray contractor	ZESPRI	Don't seek any	Other
Pest and disease control	8	39	29	15	23	6	2
Nutrition/ fertiliser choices	51	3	10	2	3	7	4
Timing of spray applications	5	32	19	12	24	13	7
Pruning	5	0	17	9	10	21	2
Pollination	7	0	6	1	6	21	2
Fruit thinning	1	1	14	4	6	21	2
Frost protection	8	3	4	1	2	20	0

Table 36: Sources of advice and decision-making – Hort 16A

	Consultant	PMC	Packhouse tech. rep.	Spray contractor	ZESPRI	Don't seek any	Other
Pest and disease control	5	9	5	1	6	0	2
Nutrition/ fertiliser choices	6	1	1	0	1	0	0
Timing of spray applications	2	6	3	2	6	0	2
Pruning	3	0	1	1	4	1	0
Pollination	2	0	0	0	1	3	0
Fruit thinning	1	0	2	1	2	1	0
Frost protection	1	0	0	0	1	1	0

Like the enquiry regarding advice and decision making a comprehensive enquiry was made regarding sources for informing day-to-day decisions. The results are provided in Table 37. In summary of the Hayward results, a consultant was employed for everyday decision-making regarding nutrition and fertilisers by just over half the growers surveyed, but a

consultant was not as involved in other decision areas. PMC was reported as being used for everyday decision making with regard to pest and disease control and timing of spray applications, but not at all in other areas except for the nutrition and fertiliser choices of one grower. Like PMC, packhouse reps were more involved in decisions about pest and disease control and timing of spray applications than in other areas. Spray contractors were logically used for the timing of spray applications, but only 11 growers used them for this purpose. Orchard managers were not involved to a great extent in decision-making. The growers volunteered few others as being important in the making of day-to-day decisions.

Table 37: Sources for Day-to-Day decisions – Hayward

	Self	Consultant	PMC	Packhouse tech. rep.	Spray contractor	Orchard manager	Other
Pest and disease control	58	2	24	10	6	8	1
Nutrition/ fertiliser choices	51	37	1	8	1	7	0
Timing of spray applications	54	2	22	10	11	8	1
Pruning	59	1	0	4	4	8	1
Pollination	58	1	0	4	4	8	1
Fruit thinning	57	0	0	4	2	7	0
Frost protection	35	0	0	2	0	4	0

Of note regarding the day-to-day decisions of Hort 16A growers (Table 38), one third used PMC for pest and disease control advice. One third also used PMC for the timing of spray applications and a third used a consultant for nitrogen/fertiliser choices.

Table 38: Sources for Day-to-Day decisions – Hort 16A

	Self	Consultant	PMC	Packhouse tech. rep.	Spray contractor	Orchard manager	Other
Pest and disease control	9	0	3	0	1	0	0
Nutrition/ fertiliser choices	7	3	0	0	0	0	0
Timing of spray applications	9	0	3	0	1	0	1
Pruning	9	0	0	0	1	0	0
Pollination	9	0	0	0	0	0	0
Fruit thinning	9	0	0	0	1	0	0
Frost protection	7	0	0	0	0	0	0

2.20 Proposals for change in size and cost estimates

Overall 71 growers provided their plans for changing the size of their kiwifruit operation in the next five years. As can be seen in Table 39, most of the growers (33 overall) indicated a decrease in size, some expected the size to stay the same and a smaller proportion was planning to increase the size of their orchard.

Table 39: Plans for a Change in Size

Change in size	Hayward	Hort 16A
Increase	10	1
Decrease	30	3
Stay the same	20	5
Unsure	3	1
Total (n)	63	10

Only 45 of the Hayward growers and two of the Hort 16A growers provided an estimate of the total direct cost (excluding picking) to grow a hectare of kiwifruit. Overall, the Hayward growers estimated the average cost for growing the Hayward variety to be $11,419 (n = 45, s. e. 448, range $3500 to $20000). The average cost estimate for Hort 16A growers to grow thier variety was $15,650 (n = 6, s. e. 1325, range $12000 to $19500).

2.21 Further comments

Thirty-three growers took the opportunity to make comments at the end of the survey. Some growers provided positive comment and a few provided critical comments. All comments have been summarised but these do not necessarily represent the opinion of growers as a whole. These can be separated into three basic topics. The first was to do with growers wanting to receive more information and have more research done on organic kiwifruit growing. The second was about earning a living from this work, and the third was to do with the growing and marketing of organic kiwifruit being controlled by an organisation focused on the growing and marketing of conventionally grown kiwifruit.

2.21.1 Need for information, research and communication

Many growers supported the need for more information and further research on the growing of organic kiwifruit. As one respondent wrote: "Need help in sorting out the wheat from the chaff". Another wrote that they supported any move towards developing research in "assisting and enhancing natural processes". Some feel more information should be collected from growers and reported back to them on an ongoing basis and one of these growers was concerned about the time involved in such record keeping. Two wrote that such research required an "holistic" approach and wrote that the aim was to achieve a sustainable agricultural system.

One respondent suggested that a standardised form, which recorded all relevant activities, could be filled in as the activities happened. It was suggested that this could also be made available on a website for ready access by researchers and growers. It was pointed out that this would help growers when filling out forms and surveys.

Another respondent suggested that it would be a mistake to duplicate research already done by other researchers and suggested that Zespri should, for example, liase with HortResearch, It was also commented that "with Biogro now acting as policeman we have lost the major source of advice and technical assistance ... Should Kiwitech take over?"

Another wrote that research trials should be large enough to be statistically valid and that the budget should be related to the likely benefit of the trial. This person gave advice to future researchers: "Be careful not to waste money researching compost teas. Stick to products and techniques that can be applied consistently".

2.21.2 What needs to be researched?

One respondent suggested that there could be a focus on successful growers to answer questions such as; "what do they use?" "when?" and "how much?". This grower was concerned that there were so many products on the market it was hard to know what to choose.

The following is a list of research issues that the growers suggested should be addressed:

- Soil and plant nutrition, lack of vigour
- Better fertilisers, composting, methods of fertiliser and compost application
- Pruning
- Pests and diseases, e.g., armillaria and scale control
- Impact of frost on following years[2]

[2] Are organically grown vines more affected by frost than conventionally grown vines? There is also the relationship between the cost of frost control in each farming system because of the returns/ha involved.

- Enhancing bud break, substitute for Hydrogen cianamide, effect of winter chill on yields, girdling, ground hog, winter snapping
- Impact of global warming, e.g., warmer winters
- How to achieve high dry matter content
- How to establish an organic orchard
- The feasibility of changing from Hayward Green to organic Hort 16A. Issues include costs, practicalities, income potential, site suitability

2.21.3 Issues to do with the economic sustainability of growing organically

Ten respondents were concerned that the premiums they gained from growing organically have declined in the past few years to the extent that their likelihood of converting back to conventional methods was "dependent on the price differential Zespri attains", and on their being able "to increase yield and fruit size". One person wrote, "The philosophy is fine but it doesn't feed you," and another, "Organic has run out of steam – gone out of fashion". One person was in a dilemma because they wrote that they could never return to conventional growing practices but did not want to exit the industry. There were many comments about what the rate of return should be. For example, "Orchard gate return has to be similar per hectare (not per tray) for growers to stay organic", and "premiums need to be based on dollars/ha".

Two respondents focused particularly on Kiwi Gold, one saying that organic fruit just couldn't compete with the conventionally grown and another saying, "I am struggling with organic Hort 16A" and "unless the prices lift considerably ($2.00 to $2.50/tray premium) I will probably opt out of the organic programme for both green and gold". In addition, one grower felt that Biogro was continually upgrading the standards required for organic growing and this was a "negative incentive for new growers to convert".

A few growers also expressed views on the cross subsidisation of organic kiwifruit by the conventionally grown kiwifruit. The views expressed varied from the suggestion that there should be no cross subsidisation to there being no subsidisation. One grower suggested that if Zespri can not obtain reasonable premium then they should market organic fruit independently. Another grower wrote that the subsidisation of organic fruit was a "big cock-up", that it resulted in "much grievance from green conventional [growers] and fair enough", and suggested that funding be taken from the pooled returns and be called a "promotional levy".

2.21.4 Cultural clashes

There were two direct references to a clash between those who are 'into' organics and those who are more oriented to conventional growing. For example, one respondent wrote that the notion of 'Pest free' was a misnomer when applied to organic management, which is about keeping "pests to a minimum because I don't believe we will ever be 'Pest free' ". Another respondent was able to articulate this more fully. They felt that Zespri was applying the criteria of conventional growing to organics when it did not fit. In their words:

> "… organic fruit is a 'stand alone' product not a subsidiary of Green or Gold. It should not matter what shape or size the fruit is, the growing method is what is important. By suggesting that only a certain criteria is acceptable [Zespri] is forcing ORGANIC[3] growers to move away from 'true' ORGANIC growing. Nature does not grow in straight lines or produce a perfect shape … Organic growing is not so much about making top dollars as being in touch with your own vines and being able to produce a truly naturally grown healthy food for the consumer. This is what most of us do,

[3] Capitals as written in the questionnaire response.

> but feel we are let down by people on very large salaries being unwilling to really work and sell for the ORGANIC producers."

There were some negative feelings expressed about some of the Zespri innovations. For example, one respondent wrote, "Throw out [the] Taste Zespri nonsense except possibly for early season fruit". Another felt that the premiums paid by Zespri for Kiwistart, pest free and Taste Zespri were for qualities that were beyond the control of the grower and more to do with "climate, location and topography" and so it seemed unreasonable to reward growers for something that had occurred by chance rather than design.

One respondent did, however, write, "It's a great way to farm".

2.22 Summary of descriptive results

The survey represented a sample of owners, managers and lessees of organic kiwifruit orchards with almost all of these being involved in the day-to-day management of their respective orchards. Most of the orchards were of the Hayward variety, most were in the supply regions of Tauranga and Te Puke and most used a Pergola structure. Canopy hectares varied widely with the smallest being merely 0.3 of a hectare and the largest covering 12 hectares.

Based on the information about yield per hectare from those who had provided it, there was little variation over the previous three years. Like yield per hectare, the average fruit size varied little between the three seasons. Overall the output measures showed only minor variations between the three seasons.

Comments provided by growers about limitations and problems were of a general nature. For example, problems of soils and plant nutrition, the weather, and the geographic location of the orchard were mentioned. Practical problems associated with buds and flowering as well as pests, diseases and vine and canopy management were also reported.

Regarding production problems, scale was common and persistent and armillaria was also a common problem. Sclerotinia, botrytis, sunken pitting and storage rots were not common and of these problems only sclerotinia was reported as being a problem on one orchard in 2003.

Growers generally considered their control of pests and diseases to be adequate. More than half did their own spraying and just under half banded for Fuller's rose weevil. Few applied sprays other than specified in their spray diary.

Orchard management in terms of the physical inputs into the production process were many and varied. Almost all applied compost with fewer applying compost tea. There were a wide variety of other products applied in varying amounts and for various purposes.

Initiated changes to gain high dry matter, increase in fruit size and yield were common as were changes towards pest free fruit. Changes to improve colour, maturity and long storage were only undertaken by one or two growers. Success was reported for more than half of the initiated changes that had attempted to improve fruit size and to produce pest free fruit. In comments about changes, most growers reported an aim to achieve consistency of larger fruit, higher yields, higher dry matter and pest free fruit.

Almost all growers undertook soil or leaf tests and most mowed their orchards four times per year. Forty growers used weed control methods other than mowing and 26 reported some form of underplanting.

The pruning strategy tended to favour conventional over leader pruning. In comment, the aims of winter pruning were to fill the canopy and ensure full cane replacement. There was concern over the potential for vigour of replacement cane and the choice over second or third year wood. The two main aims of summer pruning were to satisfy light requirements and to provide good air movement. There was some uncertainty about what should be pruned in the summer. Of note, only a few growers mentioned leader pruning.

Twenty-one of seventy-one growers indicated they grazed an animal of some kind.

With regard to the use of bees, 72 per cent used six to eight hives per hectare of which most were KPA registered. Hive inspection was not undertaken by all of these growers. Feeding hives was common and few used hives more than once. Artificial pollination was used by 20 growers, with pollen aid and liquid spray being the most common method.

All except for one grower reported doing fruit thinning and most growers thinned twice per season. The target fruit size ranged from 25 to 40 but was not reported by all the growers.

Those suffering frost damage ranged from four in 2000 to 17 in 2003. Fifteen had suffered damage in at least two of the four years that were surveyed and three had suffered damage for three or more years. Twelve growers had used frost protection measures.

With regard to sources of advice, in summary it was common to use consultants for nutrition/fertiliser choices. PMC was used for advice on pest and disease control, as was Zespri who was also used for advice on the timing of spray applications. For day-to-day decisions reliance on self was most common as well as consultant advice for nutrition/fertiliser choices and some advice from PMC on pest and disease control and the timing of spray applications.

Enquiry about changes in size resulted in few projecting an increase in comparison to those projecting a decrease or staying the same size. Projections for cost averaged $11,419 for the Hayward variety and $15,650 for Hort16A.

In further comments growers took the opportunity to voice the need for information, research and better communication. A number of information needs were also mentioned towards improving productivity with many of these reflecting the lines of inquiry taken in the questionnaire they had just answered. Economic sustainability issues were mentioned.

Chapter 3
Investigation of productivity

3.1 Introduction

Data for eight dependent variables drawn from the Zespri database was used to investigate factors that lead to eight productivity outcomes. These productivity data were used rather than yield per hectare and fruit size from the survey because the survey data was not as complete as the database data. In addition, the database offered a number of additional measures of productivity that were amenable for identifying important factors in production. While the results are present in a necessary technical manner the results are summarised in plainer language on pages 47 and 48 (Section 3.20).

The investigation utilised correlation techniques to analyse relationships between interval or ratio data. Differences between interval or ratio data when grouped on a nominal or ordinal scale were analysed using t-tests (unequal variances assumed). A good deal of the data presented difficulties for analysis because of the low numbers of respondent answers. Because it is nonsensical to analyse such data t tests were not performed on data where a category had less than five responses. In addition, while the standard significance level is used ($p < 0.05$) less stringent levels are reported (e.g. $p < 0.08$).

3.2 Measures of productivity

Details of the productivity variables are provided in Table 40. The first variable in the table is average size. This average size data is substantially equivalent to the survey data ($r = .97$, $p < 0.001$) but pertains to 68 growers whereas the survey data had only 65 growers.

The second variable is the percentage of output that gained a Kiwistart premium and the third is the percentage of output that gained a Taste Zespri premium per hectare. Output in terms of the number of trays per hectare is the fourth measure of productivity. The margin of more or less than 36 items of fruit per tray (termed larger fruit and smaller fruit) form the next two variables, which are measured as proportionate to an orchard hectare. For these variables a higher number of smaller fruit indicates a poorer output and a higher number of larger fruit indicates a better output.

The last two variables shown in the table are measures of productivity based on the number of fruit attaining a Kiwistart premium per orchard hectare and the number of fruit attaining a Taste Zespri premium per orchard hectare.

Table 40: Measures of productivity

	N	Minimum	Maximum	Mean	Std. Error
Average size	68	31.60	38.70	35.31	.19
Kiwistart %	68	0	100	11.19	3.53
Taste Zespri %	68	0	100	40.19	5.26
Trays/ha	65	641	7756	4592	207
Larger fruit	65	238	3382	1709	115
Smaller fruit	65	193	5531	2777	148
Kiwistart/ha	65	0	7756	459	161
Taste Zespri/ha	65	0	7753	1939	289

The interrelationships between the productivity variables are shown in the correlations presented in Table 41. As would be expected a number of the productivity variables are related to each other. However, while correspondence between some variables approaches 0.9 there remain some differences between the measures, which warrant their treatment as independent measures. As would be expected the average size is correlated with the larger fruit and smaller fruit measures. Also Kiwistart percentage and Kiwistart per hectare as well as Taste Zespri percentage and Taste Zespri per hectare closely correspond.

Of further interest, the correlations in Table 41 also show that the number of trays per hectare tended to increase with an increase in the production of larger fruit shown. This means that those producing larger fruit are also producing more trays per hectare. This is possible because bigger fruit means that less are needed to fill a tray so that more trays are produced.

Of note, the Taste Zespri premium is also apparently related to the number of trays per hectare as well as having a larger number of trays per hectare and smaller fruit. These results merely show that more trays per hectare result in more gains of the premium.

Table 41: Correlations between productivity variables

		Kiwistart %	Taste Zespri %	Trays/ha	Larger fruit	Smaller fruit	Kiwistart/ha	Taste Zespri/ha
Average size	**r**	0.07	0.09	0.00	-0.66***	0.51***	0.11	0.09
	n	68	68	65	65	65	65	65
Kiwistart %	**r**		0.19	-0.16	-0.21	-0.09	0.88***	0.11
	n		68	65	65	65	65	65
Taste Zespri %	**r**			0.07	-0.04	0.11	0.20	0.89***
	n			65	65	65	65	65
Trays/ha	**r**				0.69***	0.83***	0.06	0.39**
	n				65	65	65	65
Larger fruit	**r**					0.18	-0.11	0.18
	n					65	65	65
Smaller fruit	**r**						0.12	0.37**
	n						65	65
Kiwistart/ha	**r**							0.25*
	n							65

*** Correlation is significant at the 0.001 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

3.3 Relationship to the orchard

Whether the orchard had a manager or was run by the owner had some bearing with regard to three aspects of production. As can be seen in Table 42, owners fared less well in terms of average fruit size than managers. In contrast, however, the owner gained more Kiwistart premium in terms of both percentage and per hectare.

Table 42: Relationship to the orchard by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
Owner	Mean	35.5	13.0	43.3	4721	1687	2913	562	2161
	Std. Error	0.2	4.5	6.2	230	134	173	218	354
	n	47	47	47	44	44	44	44	44
Manager	Mean	34.6	1.8	28.8	4541	1934	2520	80	1323
	Std. Error	0.3	0.8	12.6	582	276	347	38	665
	n	13	13	13	13	13	13	13	13
Lessee	Mean	36.1	0	28.7	3861	1288	2573	0	1335
	Std. Error	0.9	0	14.7	682	439	508	0	711
	n	5	5	5	5	5	5	5	5
	T-test ($p < 0.05$)	Owner-Manager	Owner-Manager,					Owner-Manager,	

3.4 Region

Because of low numbers per region, tests for differences between regions in terms of productivity were very limited. The only comparison that could be made was between Tauranga and Te Puke. Nevertheless, this comparison, presented in Table 43, shows a difference between the orchards of these regions in terms of their gaining premiums for their produce. Clearly in terms of the percentage of produce gaining the Taste Zespri premium orchards from Te Puke had gained more than those from Tauranga. In addition, though of a lower level of significance (t test, $p < 0.07$), there is also an indication that orchards in Te Puke have gained more of the Kiwistart premium in terms of both percentage and per hectare, as well as an indication that more of the Taste Zespri premium was gained when measured as per hectare.

Table 43: Region by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
Coromandel	Mean	35.8	0.0	0.0	2592	806	1705	0	0
	Std. Error	.	.	.	.	.	.	.	.
	n	1	1	1	1	1	1	1	1
Katikati	Mean	34.9	1.8	0.0	4356	1955	2189	86	0
	Std. Error	0.7	0.9	0.0	728	722	198	35	0
	n	4	4	4	3	3	3	3	3
Kerikeri	Mean	37.5	0.0	0.0	1185	238	947	0	0
	Std. Error	.	.	.	.	.	.	.	.
	n	1	1	1	1	1	1	1	1
Opotiki	Mean	32.6	0.3	99.7	5431	3331	2100	16	5412
	Std. Error	.	.	.	.	.	.	.	.
	n	1	1	1	1	1	1	1	1
Taranaki	Mean	36.5	0.2	0.0	2234	580	1653	4	0
	Std. Error	.	.	.	.	.	.	.	.
	n	1	1	1	1	1	1	1	1
Tauranga	Mean	35.1	6.5	30.6	4756	1859	2802	198	1528
	Std. Error	0.3	3.2	6.4	258	140	189	97	341
	n	37	37	37	36	36	36	36	36
Te Puke	Mean	35.6	28.4	63.4	4789	1631	3023	1243	2966
	Std. Error	0.4	10.7	10.9	443	217	331	514	651
	n	18	18	18	18	18	18	18	18
Waikato	Mean	36.4	0.9	67.6	3999	948	2962	13	2736
	Std. Error	1.0	0.7	12.1	1053	609	780	13	1014
	n	4	4	4	3	3	3	3	3
Whakatane	Mean	36.5	0.0	89.8	4520	1177	3342	0	4057
	Std. Error	.	.	.	.	.	.	.	.
	n	1	1	1	1	1	1	1	1
	T-test ($p < 0.05$)		Tauranga-Te Puke ($p < 0.07$)	Tauranga-Te Puke				Tauranga-Te Puke ($p < 0.07$)	Tauranga-Te Puke ($p < 0.07$)

3.5 Structure

The structure used for growing kiwifruit had a measurable effect on two of the measures of production. As can be seen in Table 44, use of the T-bar structure was associated with poorer production in terms of average size. The T-bar produced more fruit per tray or smaller fruit than orchards using the Pergola structure. Similarly the T-bar was found to produce fewer trays with larger fruit per hectare than orchards using the Pergola structure.

Table 44: Structure by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
T-bar	Mean	36.0	23.2	60.0	3872	1142	2643	1238	2380
	Std. Error	0.4	12.1	12.1	558	218	415	712	738
	n	13	13	13	12	12	12	12	12
Pergola	Mean	35.1	7.5	36.5	4796	1882	2803	243	1916
	Std. Error	0.2	3.2	6.2	241	135	176	97	349
	n	48	48	48	46	46	46	46	46
Both	Mean	35.5	16.7	33.6	4855	1713	3036	631	1560
	Std. Error	0.7	16.6	17.3	283	369	291	631	766
	n	6	6	6	6	6	6	6	6
	T-test ($p < 0.05$)	T-bar-Pergola ($p < 0.06$)				T-bar-Pergola			

3.6 Canopy hectares

There was a positive relationship between canopy hectares and the production of larger fruit. As shown in Table 45, average size or the numbers of fruit per tray was negatively related to canopy hectares meaning that there was a tendency for orchards with larger canopy hectares to have a better result in terms of average size. Similarly, this result is supported further by the finding of a positive correlation, though with a less significant relationship ($p < 0.06$), between larger fruit per hectare and canopy hectares.

Table 45: Canopy hectares by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
Canopy hectares	r	-.27*	.06	-.02	.08	.25+	-.08	.03	-.01
	n	72	65	65	65	62	62	62	62

* Correlation is significant at the 0.05 level (2-tailed). + Correlation is significant at the 0.06 level (2-tailed)

3.7 How long organic

There was no evidence of any relationship between how long the grower had been involved in organic production and any of the measures of productivity.

3.8 Premiums

The gaining of premiums in relation to the measures of productivity are shown in Tables 46 to 49. There was no evidence of a relationship between the gaining of a storage premium and the productivity measures. The next two tables show that the self-reports of gaining some proportion of the respective premiums corresponded with the productivity variables drawn from the Zespri database. It is apparent that many of those who gained one of these premiums also gained the other. Of further interest, Table 49 shows that those orchards that had gained a Taste Zespri premium had also tended to gain a pest free premium.

Table 46: Storage premium by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
No premium	Mean	35.5	12.1	34.1	4565	1634	2841	546	1750
	Std. Error	0.3	4.9	6.4	260	140	186	242	353
	n	43	43	43	41	41	41	41	41
Received premium	Mean	35.0	9.7	50.7	4637	1838	2667	310	2263
	Std. Error	0.3	4.7	8.8	350	198	247	142	504
	n	25	25	25	24	24	24	24	24

Table 47: Kiwistart premium by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
No premium	Mean	35.3	1.8	35.4	4757	1782	2871	87	1821
	Std. Error	0.2	0.9	5.7	215	122	157	52	315
	n	57	57	57	54	54	54	54	54
Received premium	Mean	35.5	59.9	65.1	3779	1353	2315	2282	2520
	Std. Error	0.6	14.5	12.0	583	307	400	715	738
	n	11	11	11	11	11	11	11	11
	T-test ($p < 0.05$)		Sig. ($p < 0.05$)	Sig. ($p < 0.05$)				Sig. ($p < 0.05$)	

Table 48: Taste Zespri premium by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
No premium	Mean	35.3	6.8	16.8	4581	1726	2750	283	898
	Std. Error	0.3	3.4	5.1	241	139	175	136	277
	n	43	43	43	41	41	41	41	41
Received premium	Mean	35.4	18.7	80.4	4610	1681	2823	760	3719
	Std. Error	0.3	7.5	5.1	389	204	273	367	431
	n	25	25	25	24	24	24	24	24
	T-test ($p < 0.05$)			Sig. ($p < 0.05$)					Sig. ($p < 0.05$)

Table 49: Pest free premium by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
No premium	Mean	35.4	12.0	32.0	4621	1677	2833	504	1600
	Std. Error	0.2	4.2	5.6	237	128	167	200	317
	n	52.0	52.0	52.0	49	49	49	49	49
Received premium	Mean	34.9	8.6	66.8	4501	1808	2604	319	2978
	Std. Error	0.4	6.3	10.7	436	256	321	236	608
	n	16.0	16.0	16.0	16	16	16	16	16
	T-test ($p < 0.05$)			Sig. ($p < 0.05$)					Sig. ($p < 0.06$)

3.9 Pest and disease problems

A number of pests or diseases reported for 2003 (shown in Tables 50 to 54) were found to be associated with productivity. Of interest, orchards reporting problems with scale produced more trays per hectare and gained more of the Taste Zespri premium per hectare than other orchards. Similarly, the few orchards with a passion-vinehopper problem performed better than other orchards in terms of the percentage and per hectare measures of the Taste Zespri premium as well as trays per hectare. However, orchards with a passion-vine hopper problem also produced more smaller fruit and gained less of the Kiwistart premium per hectare than other orchards. Those affected by Fuller's rose weevil were found to have gained more Taste Zespri by percentage than other orchards. In tests showing marginal significance, those affected by armillaria produced fewer trays with larger fruit and fewer of these orchards gained a Kiwistart premium per hectare. Problems with sclerotinia, botrytis, sunken pitting and storage rots are not shown because either none or only one orchard was affected.

Table 50: Problem with scale by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
No problem	Mean	35.3	11.7	35.5	4285	1596	2602	367	1537
	Std. Error	0.3	4.5	6.3	251	139	179	146	310
	n	47	47	47	46	46	46	46	46
Scale problem	Mean	35.3	10.0	50.7	5334	1985	3201	682	2913
	Std. Error	0.3	5.5	9.5	311	192	244	428	603
	n	21	21	21	19	19	19	19	19
	T-test ($p < 0.05$)				Sig. ($p < 0.05$)		Sig. ($p < 0.06$)		Sig. ($p < 0.06$)

Table 51: Problem with passion-vine hopper by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
No problem	Mean	35.3	12.3	36.5	4482	1685	2697	496	1640
	Std. Error	0.2	3.8	5.4	215	121	155	174	279
	n	62	62	62	60	60	60	60	60
Passion-vine hopper problem	Mean	35.8	0.2	78.2	5903	1999	3741	15	5536
	Std. Error	0.3	0.1	15.7	484	356	234	8	435
	n	6	6	6	5	5	5	5	5
	T-test ($p < 0.05$)			Sig. ($p < 0.05$)	Sig. ($p < 0.05$)		Sig. ($p < 0.05$)	Sig. ($p < 0.05$)	Sig. ($p < 0.05$)

Table 52: Problem with leafroller by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
No problem	Mean	35.3	12.4	38.2	4545	1717	2721	497	1832
	Std. Error	0.2	3.9	5.6	220	123	154	174	303
	n	61	61	61	60	60	60	60	60
Leafroller problem	Mean	35.6	0.4	57.1	5153	1619	3447	1	3232
	Std. Error	0.4	0.4	16.2	530	188	510	1	876
	n	7	7	7	5	5	5	5	5

Table 53: Problem with Fuller's rose weevil by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
No problem	Mean	35.3	9.2	36.4	4637	1731	2823	383	1828
	Std. Error	0.2	3.5	5.5	216	122	156	168	307
	n	61	61	61	58	58	58	58	58
Fuller's rose weevil problem	Mean	35.1	28.2	73.2	4217	1534	2397	1089	2866
	Std. Error	0.7	14.8	14.3	735	346	475	525	836
	n	7	7	7	7	7	7	7	7
	T-test ($p < 0.05$)			Sig. ($p < 0.05$)					

Table 54: Problem with armillaria by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
No problem	Mean	35.0	15.1	37.9	4803	1949	2727	780	2234
	Std. Error	0.3	5.7	7.7	322	191	217	321	482
	n	33	33	33	30	30	30	30	30
Armillaria problem	Mean	35.6	7.5	42.4	4410	1504	2819	183	1687
	Std. Error	0.2	4.2	7.3	268	128	205	103	345
	n	35	35	35	35	35	35	35	35
	T-test ($p < 0.05$)					Sig. ($p < 0.06$)		Sig. ($p < 0.09$)	

3.10 Crop protection

No evidence of significant relationships were found between the measure of how adequate pests were being controlled and the measures of productivity. In addition, there was no

evidence of significant differences (see Table 55) between orchards that had done their own spraying and those who had not.

In terms of banding for Fuller's rose weevil Table 56 shows that those who had banded produced more larger fruit than those who had not. There was also an indication (marginal significance) that those who had done the banding performed better in terms of average fruit size and trays per hectare. There was no evidence of any difference between those who had judged banding to be effective and those who had not in terms of the productivity variables. In addition, the few orchards who had applied sprays (Table 57) other than specified in their spray diaries performed less well in terms of average size had a smaller proportion of larger fruit and had received less of the Kiwistart per hectare than other growers.

Table 55: Do own spraying by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
yes	Mean	35.4	12.4	39.4	4582	1665	2818	562	2091
	Std. Error	0.3	4.8	6.8	278	151	200	242	398
	N	41	41	41	40	40	40	40	40
no	Mean	35.2	10.7	41.6	4617	1754	2735	320	1891
	Std. Error	0.4	6.2	9.2	281	176	211	182	444
	N	23	23	23	22	22	22	22	22
sometimes	Mean	34.4	0.1	49.7	3288	1713	1558	1	398
	Std. Error	0.9	0.1	49.7	2488	1429	1077	1	398
	N	2	2	2	2	2	2	2	2

Table 56: Banded by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
yes	Mean	34.9	10.7	49.9	4887	1961	2825	543	2381
	Std. Error	0.3	5.2	7.7	292	168	235	306	440
	N	28	28	28	28	28	28	28	28
no	Mean	35.7	11.8	31.9	4144	1430	2632	350	1511
	Std. Error	0.3	5.4	7.6	297	161	206	172	396
	N	35	35	35	33	33	33	33	33
	T-test ($p < 0.05$)	Sig. ($p < 0.08$)			Sig. ($p < 0.09$)	Sig. ($p < 0.05$)			

Table 57: Applied other sprays by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
yes	Mean	36.7	0.2	76.0	5225	1252	3811	9	4069
	Std. Error	0.2	0.1	19.0	391	174	294	7	1092
	N	5	5	5	5	5	5	5	5
no	Mean	35.2	12.2	34.6	4504	1741	2679	477	1671
	Std. Error	0.2	4.1	5.5	219	127	156	181	293
	N	58	58	58	56	56	56	56	56
	T-test ($p < 0.05$)	Sig. ($p < 0.05$)	Sig. ($p < 0.05$)			Sig. ($p < 0.05$)	Sig. ($p < 0.05$)	Sig. ($p < 0.05$)	

3.11 Orchard management and soil and leaf tests

Because there were few growers using particular products no meaningful analysis of relationships between these and other growers could be undertaken. Similarly, differences in

productivity depending on whether soil and leaf tests were done could not be analysed. All but two growers stated they had used them.

3.12 Mowing of the orchard and underplanting

Weed control other than by mowing was undertaken by approximately half the orchards. Comparison been these groups, shown in Table 58, found marginal evidence that those who had used methods other than mowing had received more of the Taste Zespri premium when measured as a percentage. In a separate test, shown in Table 59, evidence was found for a relationship between the frequency of mowing and average fruit size. The correlation shows that productivity, in terms of average fruit size tended to improve with a greater frequency of mowing. Table 60 shows that those who underplanted their orchard performed less well in terms of average fruit size. However, there was a marginally significant indication that these orchards had gained more of the Taste Zespri premium per hectare than had other orchards.

Table 58: Weed control other than mowing by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
yes	Mean	35.2	12.7	48.5	4502	1652	2714	413	1969
	Std. Error	0.3	5.2	7.3	268	152	216	170	351
	N	34	34	34	33	33	33	33	33
no	Mean	35.4	10.0	30.0	4650	1784	2790	522	1796
	Std. Error	0.3	5.0	7.4	329	179	205	288	471
	N	33	33	33	31	31	31	31	31
	T-test (p < 0.05)			Sig. (p < 0.09)					

Table 59: How often mown by productivity (correlation)

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
How often mown	r	-.37**	.01	.01	.10	.31*	-.10	.01	.06
	N	58	58	58	55	55	55	55	55

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Table 60: Orchard underplanted by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
No	Mean	34.5	8.6	30.7	4524	1986	2447	257	1170
	Std. Error	0.4	8.3	11.8	430	190	325	243	430
	N	12	12	12	12	12	12	12	12
Yes	Mean	35.6	10.8	46.2	4863	1681	3055	373	2423
	Std. Error	0.3	5.5	8.4	307	178	227	189	502
	N	26	26	26	23	23	23	23	23
	T-test (p < 0.05)	Sig. (p < 0.05)							Sig. (p < 0.07)

3.13 Pruning

The style of pruning was measured on a continuum between strong leader pruning and conventional pruning. Table 61 shows that the tendency to use conventional pruning over strong leader pruning had led to lower productivity in terms of average size. Similarly, the

use of conventional rather than strong leader pruning is shown to be associated with a lower production of the desirable larger fruit classification.

Table 61: Style of pruning by productivity (correlation)

		Average size	Kiwistart %	Taste Zespri %	Trays/ha	Larger fruit	Smaller fruit	Kiwistart/ha	Taste Zespri/ha
How often mown	r	.24+	-.13	-.04	-.19	-.29*	-.03	-.11	-.07
	n	57	57	57	54	54	54	54	54

* Correlation is significant at the 0.05 level (2-tailed). + Correlation is significant at the 0.08 level (2-tailed).

3.14 Grazing of animals

There was no difference in terms of productivity between those who grazed animals and those who had not.

3.15 Use of hives and artificial pollination

No evidence was found for a relationship between the number of beehives and the productivity variables. However, Table 62 shows that the orchards that had used KPA registered hives performed less well than the seven orchards that had not in terms of Kiwistart premium per hectare. In addition, Table 63 shows that the growers who had undertaken hive inspections were performing better in terms of their receiving the Taste Zespri premium in terms of both a percentage and the per hectare measure.

Table 64 shows that artificial pollination was associated with a lower receipt of Taste Zespri premium in terms of both a percentage and the per hectare measure.

Table 62: KPA hives by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
yes	Mean	35.4	12.3	39.1	4852	1754	2982	530	2012
	Std. Error	0.2	4.3	6.0	232	133	166	205	352
	N	51	51	51	49	49	49	49	49
no	Mean	33.9	18.7	24.3	3922	1883	1958	547	962
	Std. Error	0.8	14.0	13.6	527	296	387	410	469
	N	7	7	7	7	7	7	7	7
unsure	Mean	35.9	0.0	58.6	3804	1201	2515	1	2190
	Std. Error	0.3	0.0	17.3	642	244	459	1	768
	N	8	8	8	7	7	7	7	7
	T-test ($p < 0.05$)							Yes-no	

Table 63: Hive inspection by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
yes	Mean	35.0	13.8	59.9	4767	1889	2699	396	2753
	Std. Error	0.4	7.8	9.2	367	218	237	220	522
	N	18	18	18	18	18	18	18	18
no	Mean	34.8	13.9	22.6	4563	1816	2667	537	1031
	Std. Error	0.3	6.8	8.3	370	177	275	264	441
	N	21	21	21	20	20	20	20	20
unsure	Mean	36.1	9.8	40.0	4761	1456	3215	590	2205
	Std. Error	0.3	6.2	9.8	379	204	277	414	591
	N	22	22	22	20	20	20	20	20
	T-test ($p < 0.05$)			Yes-no					Yes-no

Table 64: Artificial pollination by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
yes	Mean	35.2	14.2	13.5	4328	1684	2571	505	681
	Std. Error	0.5	8.9	8.3	484	275	319	320	432
	N	15	15	15	15	15	15	15	15
no	Mean	35.4	10.9	47.2	4781	1764	2903	470	2378
	Std. Error	0.2	4.0	6.1	226	130	170	200	353
	N	50	50	50	47	47	47	47	47
	T-test ($p < 0.05$)			Sig. ($p < 0.05$)					Sig. ($p < 0.05$)

3.16 Fruit thinning

All of the growers had undertaken fruit thinning and there was no evidence of a relationship between how often thinning was performed and the productivity variables. Similarly, there was no evidence of a relationship with target fruit number.

3.17 Advice and decision making

The results of the analysis of the advice and decision-making produced confusing results. In some comparisons it seemed that poorer performing growers had received advice and in some cases it seemed that better performing growers had received advice. It can be presumed that, for some comparisons, those needing advice had sought it out and had not yet received the benefit, whereas in other comparisons it appears that advice had been taken and productivity had improved. However, because there is no way of discerning what had actually occurred, definitive findings cannot be drawn from these results and any inferences should be treated with caution.

The large and lengthy tables associated with this analysis can be found in the appendix. In these tables significant differences (t-test, $p < 0.05$) are shown by the figures being in a bold typeface. The first eight tables are about advice and decision making in general. The first significant differences are shown in Table A1 and show that the nine growers who used a consultant for advice on pest and disease control had better productivity results in terms of average size and less production of smaller fruit than other growers. With regard to decisions regarding nutrition/fertiliser choices (Table A2) the ten growers who took advice from packhouse reps performed less well than other growers in terms of gaining the Kiwistart premium for both percentage and per hectare. There was no evidence (Table A3) that advice

from any of the sources led to any differences in production in relation to the timing of spray applications. With regard to pruning, advice from Zespri was associated with better productivity regarding average fruit size but this result was only marginally significant.

Consultant advice regarding pollination was found to have a relationship with a number of productivity variables. The seven who took this advice had gained less of the Kiwistart premium both in percentage and per hectare as well as gaining less of the Taste Zespri premium per hectare. Those who took consultant advice regarding pollination also performed less well in terms of the larger fruit classification. Also in relation to advice on pollination those who took Zespri advice also performed poorly in terms of their failure to gain the Kiwistart premium in terms of both percentage and per hectare. Advice on fruit thinning by Zespri was associated with less of the Kiwistart premium when measured in percentages.

For day-to-day decisions advice from an orchard manager about nutrition/fertiliser choices was associated with less of the Kiwistart premium when measured as a percentage. Advice from packhouse reps was associated with the better production output of fewer incidences of larger fruit. In addition, advice about fruit thinning from an orchard manager was associated with an increase in percentage of the Taste Zespri premium. Also for day-to-day decisions about frost protection the reliance on self was associated with more of the Kiwistart premium in terms of both percentage and per hectare.

3.18 Frost damage

The effect of frost damage on productivity is shown in Table 65. Those that had experienced frost damage can be seen to have received more of the Taste Zespri premium in terms of both percentage and per hectare than other growers. In addition, of marginal significance is the finding that those who had experienced frost damage had fared less well in terms of gaining the classification of Larger fruit. There was no evidence of a difference between the 11 who had used frost protection measures and other growers.

Table 65: Suffered frost damage 2003 by productivity

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
no	Mean	35.2	5.9	40.2	4739	1796	2849	298	2026
	Std. Error	0.2	3.0	5.9	227	128	167	166	330
	N	57	57	57	54	54	54	54	54
yes	Mean	35.7	38.4	40.4	3868	1286	2424	1247	1516
	Std. Error	0.5	13.1	12.0	467	219	298	440	557
	N	11	11	11	11	11	11	11	11
	T-test ($p < 0.05$)		Sig. ($p < 0.05$)			Sig. ($p < 0.06$)		Sig. ($p < 0.07$)	

3.19 Change in area

The projections made by growers regarding changing the size of their area of production is compared to the productivity measures in Table 66. Those who indicated they would decrease their growing area had received more of the Kiwistart premium than other growers. In addition, growers who wanted to decrease their growing area had gain more of the Taste Zespri premium in terms of both percentage and per hectare than those who indicated no change in the size of their orchard.

Table 66: Production by change in area

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
Increase	Mean	36.0	0.1	37.1	3657	1186	2466	2	1718
	Std. Error	0.7	0.0	14.3	619	344	500	2	727
	N	9	9	9	9	9	9	9	9
Decrease	Mean	35.2	15.8	55.1	4820	1813	2877	699	2605
	Std. Error	0.3	6.1	7.5	309	165	224	309	450
	N	31	31	31	30	30	30	30	30
No change	Mean	35.4	9.3	11.7	4702	1772	2833	342	522
	Std. Error	0.3	6.1	6.7	339	200	217	222	302
	N	18	18	18	17	17	17	17	17
Unsure	Mean	35.3	33.4	64.1	4240	1331	2756	979	2685
	Std. Error	1.8	33.3	32.0	719	372	946	977	1519
	N	3	3	3	3	3	3	3	3
	T-test ($p < 0.05$)		Increase – decrease,	Decrease-no change				Increase – decrease,	Decrease-no change

Finally the estimated cost of growing a hectare of kiwifruit per hectare (excluding picking) compared to productivity is shown in Table 67. As can be seen in the table estimated cost was negatively related to average size. This means that those growers with better productivity in terms of average size tended to estimate greater costs than other growers. The association between the larger fruit classification and costs shows a similar result. Those growers gaining more of this desirable classification estimated greater costs for production of a hectare of kiwifruit.

Table 67: Estimated cost of growing by productivity (correlation)

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Larger fruit	Smaller fruit	Kiwistart /ha	Taste Zespri/ha
cost to grow per hectare	r	-.32*	.08	.08	.18	.28+	-.01	.06	.01
	n	44	44	44	43	43	43	43	43

* Correlation is significant at the 0.05 level (2-tailed). + Correlation is significant at the 0.07 level (2-tailed).

3.20 Summary of investigation of productivity

Investigation was made of eight measures of productivity towards identifying factors affecting production. The productivity measures drawn from the Zespri database were: average fruit size derived from the average number of fruit per tray; Kiwistart premium in terms of percentage and per hectare; Taste Zespri premium in terms percentage of per hectare; number of trays per hectare; proportion of larger fruit per tray per hectare; and the proportion of larger fruit per tray per hectare.

Key results were that, in comparison with managers, owners fared less well in terms of average fruit size. However, owners gained more Kiwistart premium. In terms of geographical differences, Te Puke had a higher percentage of produce gaining the Taste Zespri premium than Tauranga. There was also some indication that Te Puke also out performed Tauranga in the gaining of the Kiwistart premium. In terms of structure, evidence was found that when compared to the Pergola the use of the T-bar structure was associated with poorer production in terms of fruit size. The T-bar was found to produce more fruit per

tray. The T-bar was also found to produce fewer trays with larger fruit per hectare than orchards using the Pergola structure.

In other general information, it was found that orchards with more canopy hectares also had a better result in terms of average fruit size. The numbers of years of involvement in organic production had no bearing on productivity.

Of interest regarding premiums, it was apparent that those who gained a Kiwistart premium also tended to gain the Taste Zespri premium. It was also found that orchards that had gained a pest free premium had also tended to gain a Taste Zespri premium.

In terms of pest and disease problems, orchards reporting problems with scale produced more trays per hectare and gained more of the Taste Zespri premium than other orchards. The few orchards with a passion-vine hopper performed better than other orchards in terms of gaining Taste Zespri premium as well as trays per hectare but also produced smaller fruit and gained less of the Kiwistart premium than had other orchards. Those affected by Fuller's rose weevil gained more Taste Zespri by percentage than other orchards and those affected by armillaria had poorer performance than other orchards.

In investigation of crop protection it was found that banding for Fuller's rose weevil produced larger fruit and there was an indication that those who had banded performed better in terms of average fruit size and trays per hectare. The few orchards who had applied sprays other than specified in their spray diaries performed less well in terms of average fruit size, had a smaller proportion of larger fruit and had received less of the Kiwistart premium per hectare.

There was some indication that growers who used methods other than mowing had received more of the Taste Zespri premium. In addition, a greater frequency of mowing improved productivity in terms of average fruit size. In complement, those who underplanted their orchard performed less well in terms of average fruit size. There was, however, some indication that these orchards had gained more of the Taste Zespri premium.

It was evident that the tendency to use conventional pruning over strong leader pruning had led to lower productivity in terms of average fruit size and this activity was associated with less production of smaller fruit.

An unexpected finding was that orchards that had used KPA registered hives performed less well than orchards that had not in terms of Kiwistart premium per hectare. However, the growers who had undertaken hive inspections were performing better in terms of their receiving the Taste Zespri premium. In similar vein, artificial pollination was associated with a lower receipt of Taste Zespri premium.

There were mixed results for associations between sources of advice and decision-making meaning that no definitive conclusions can be derived from this data.

Frost damage was associated with receipt of the Taste Zespri premium, but there was also an indication of smaller fruit size.

Those who indicated they would decrease their growing area had received more of the Kiwistart premium than other growers. In addition, growers who wanted to decrease their growing area had gained more of the Taste Zespri premium.

Hayward growers with better productivity in terms of average fruit size tended to estimate greater costs than other growers.

Chapter 4
Conclusion

4.1 Introduction

The purpose of this research was to identify factors involved in organic kiwifruit production that either positively or negatively impact upon production. The identification of these factors can facilitate the improvement of the organic production of kiwifruit. This may occur directly through addressing the factors identified as significant in this investigation or indirectly through further investigation of these factors. Overall, the aim has been to enable steps to be taken towards the improvement of the productivity of organic kiwifruit production in New Zealand. Policy implications that extend from the research findings are therefore provided towards achieving this aim.

This concluding chapter summarises the results by presenting key findings. This summary is followed by policy implications to give direction to improvement in productivity. The findings and policy implications are then qualified through presentation of the limitations of this research. In closing, recommendations are provided regarding further use of the methods employed in this research.

4.2 Summary of key findings

The survey had 80 responses from organic kiwifruit growers of which 70 reported on Hayward production and 10 reported on Hort 16A production. The low numbers of responding Hort 16A growers meant that only a description of the data relevant to these orchards was provided for these growers. Consequently the following is list of key findings that pertains to organic growers of the Hayward variety.

- Owners gain more Kiwistart premium than managers.
- Owners, compared to managers, produce smaller fruit when measured as average fruit size.
- Te Puke outperforms Tauranga in terms of receipt of both the Kiwistart and Taste Zespri premiums.
- The Pergola structure leads to the production of larger fruit when compared to the T-bar structure.
- There was no evidence that organic production improves in terms of production outcomes over time.
- Orchards with more canopy hectares tend to produce larger fruit when measured as average fruit size.
- Those who gain a Kiwistart premium also tended to gain a Taste Zespri premium.
- Armillaria is associated with fewer trays of larger fruit.
- Fuller's rose weevil is associated with gaining more of the Taste Zespri premium.
- Scale is associated with more trays per hectare, the production of trays of larger fruit and a tendency to receive the Taste Zespri premium.
- Banding for Fuller's rose weevil produces larger fruit in terms of average fruit size, more trays of larger fruit and more trays per hectare.
- Applying sprays other than specified in the spray diary is associated with poorer production in terms of average fruit size, the gaining of Kiwistart premium and the production of trays of larger fruit.

- Average fruit size and the production of trays of larger fruit is associated with greater frequency of mowing.
- Underplanting is associated with smaller average fruit size.
- Growers with KPA registration receive less Kiwistart premium.
- Growers that do hive inspections receive more of the Taste Zespri premium.
- Growers using artificial pollination have a disadvantage in terms of receiving the Taste Zespri premium.
- The use of conventional pruning over strong leader pruning leads to smaller fruit when measured as average fruit size and these growers also produce fewer trays of larger fruit.
- Frost damage is associated with an increase in receipt of the Taste Zespri premium.
- Growers who intend to decrease their growing area received more of the Taste Zespri premium.
- Growers that had do well in terms of average fruit size estimate higher future costs than other growers.

4.3 Policy recommendations

The following recommendations are made towards the general aim of improving the productivity of organic Kiwifruit in New Zealand.

The finding of differences between owners and managers suggests policies tailored to the needs of these two distinct groups would be more rewarding than simply providing blanket recommendations for growers as a whole. Although an understanding of differences between these groups is limited at present, clearly owners need assistance in improving fruit size and managers would improve with help in gaining the Kiwistart premium.

The results regarding Te Puke outperforming Tauranga are of limited value in themselves for discussing geographical differences. The results do, however, suggest that differences in location have a bearing on production. Given that similar differences can be found through studies of the geography of Kiwifruit it should be possible to isolate areas for optimal production. The promotion of optimal over sub-optimal areas should then be considered rather than simply allowing supply to find its way by trial and error. A useful policy initiative would be the provision and promotion of information that identifies favourable growing areas. This would arm potential growers with information for making better choices.

The finding of no evidence of improvement in production over time suggests that new growers are not disadvantaged and that productive output can be gained in a reasonably short time. This could encourage new growers and those considering organic kiwifruit production.

The exact reasons for different fruit sizes from the Pergola and T-bar structure have not been identified. However, the finding that the Pergola has an advantage over the T-bar indicates that the Pergola should be the preferred structure for organic kiwifruit production.

The finding that growers that gained Kiwistart premium also tended to gain a Taste Zespri premium differs from the recent findings of analysis of the Zespri database. Analysis of the database showed no relationship between the receipts of the premiums. However, the database analysis examined relationships between the proportions of each premium that growers had received whereas this research compared whether a grower had or had not received. According to the results presented in this report growers who had received one premium had tended to receive the other premium.

Regarding pests and diseases, clearly armillaria is common and detrimental and efforts should be targeted to avoid or address this problem. Banding for Fuller's rose weevil improved productivity and should be supported and encouraged.

The finding that the presence of Fuller's rose weevil and scales were each associated with better production outcomes could signify that growers that recognised and addressed these problems are succeeding. The provision of the relevant information to alert growers who are not recognising and treating these problems would be a useful tactic to improve industry productivity.

Applying sprays other than specified in the spray diary is either counter productive or being undertaken by those already experiencing serious production problems. This practice should be discouraged.

The production of larger fruit was associated with greater frequency of mowing. It is illogical that mowing itself would cause larger fruit and more likely that mowing represents a more intensive attitude towards production. This means that mowing itself will not improve productivity but rather mowing indicates a grower with a better attitude and more care to detail that has better productivity.

The reason for KPA registration being associated with less of the Kiwistart premium may become clear with further investigation. Hive inspection is rewarding and should be encouraged. Growers resorting to artificial pollination have a disadvantage in terms of receiving the Taste Zespri premium. If possible the practice should be avoided.

Where practicable, consideration should be given to the strong leader pruning instead of conventional pruning.

The co-occurrence of frost damage with gaining the Taste Zespri premium suggests some losses are incurred with this gain. Pressure to downsize is also associated with this premium. Given the prospect of balancing losses against the premium, care must be taken to balance costs over the benefits.

Growers achieving the target of better average fruit size incur greater costs and these are reflected in their estimate of future costs. This is another aspect of efficiency where the profit margin needs to be carefully estimated. Promoting a realistic projection of costs would improve net profitability. Assisting growers with their cost estimates may achieve this.

4.4 Limitations

As noted in the introduction the length of the survey and inconsistent format are likely to have unnecessarily burdened the respondents. The possibility of these factors having a detrimental effect on response and completion rates and the reliability of the measurement of the items presented to the respondents cannot be discounted. A further limitation is that, while the response rate was acceptable given the size of the target population, statistical analysis could not be performed on the low numbers from the division of responses to some questions. In addition, the limited response rate prevented investigation of differences between sub groups (e.g., between owners and managers).

4.5 Recommendations for further research

The following recommendations are directed towards further research using the methods employed in this research.

- Use standardised questions and response scales with five-point Likert type response scales and, where appropriate, straightforward single questions with no more than a yes/no response.
- The length should not exceed 100 tasks for respondents otherwise the response rate can be expected to be lower.
- Formatting of the questionnaire into a commercially printed coloured booklet.
- Include a separate personally signed letter of explanation and invitation with the questionnaire.
- Use comments from the 2003 survey to develop specific questions.
- Restrict or avoid the use of open-ended questions.
- Encourage responses by offering a prize for respondents. The prize need not exceed $500 in value and something useful for the orchard would be appropriate.
- Advertise the survey by website, e-mail lists, newsletters etc.
- Distribute the questionnaire or shorter versions of the questionnaire by website, e-mail lists, at farming events, at meetings or by other means of contact.
- Use a second postout of the questionnaire to improve response rates, as well as a polite reminder postcard after each postout.

4.6 Conclusion

Organic kiwifruit growers are a distinguishable active group in rural New Zealand. Their problems and practices are unique and this research has demonstrated the benefits of looking across this small productive group. The research has given direction to areas of further work so as to generate cogent findings and has identified factors involved in organic kiwifruit production that either positively or negatively impact upon production. In conclusion, this research has facilitated the taking of steps towards the improvement of the productivity of organic kiwifruit production.

Appendix

Table 1: Advice and decision making for pest and disease control

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
No consultant	Mean	**35.6**	10.5	41.9	4690	1672	**2915**	461	2012
	Std. Error	**0.2**	3.7	5.7	212	121	**152**	181	315
	N	**59**	59	59	56	56	**56**	56	56
Consultant	Mean	**33.5**	15.5	28.8	3978	1940	**1918**	445	1488
	Std. Error	**0.6**	10.9	13.1	709	354	**418**	320	746
	N	**9**	9	9	9	9	**9**	9	9
No PMC	Mean	35.5	12.0	38.8	4125	1471	2587	459	1720
	Std. Error	0.3	6.1	8.7	382	197	261	230	433
	N	27	27	27	26	26	26	26	26
PMC	Mean	35.2	10.7	41.1	4903	1869	2903	459	2086
	Std. Error	0.3	4.3	6.7	224	135	175	223	389
	N	41	41	41	39	39	39	39	39
No packhouse	Mean	35.3	9.3	40.7	4675	1785	2782	324	1986
	Std. Error	0.2	4.2	6.9	250	151	158	145	381
	N	41	41	41	39	39	39	39	39
Packhouse	Mean	35.4	14.1	39.5	4467	1596	2769	661	1870
	Std. Error	0.4	6.3	8.2	362	176	288	340	452
	N	27	27	27	26	26	26	26	26
No spray contractor	Mean	35.3	12.2	38.1	4544	1690	2736	507	1867
	Std. Error	0.2	4.1	5.9	246	130	168	190	331
	N	54	54	54	53	53	53	53	53
spray contractor	Mean	35.2	7.4	48.4	4800	1796	2957	245	2261
	Std. Error	0.5	7.1	11.5	289	246	311	244	587
	N	14	14	14	12	12	12	12	12
No zespri	Mean	35.5	8.7	45.2	4460	1571	2797	444	2261
	Std. Error	0.2	3.9	6.7	269	140	194	226	386
	N	44	44	44	41	41	41	41	41
Zespri	Mean	35.0	15.8	31.0	4816	1946	2742	484	1390
	Std. Error	0.4	6.9	8.3	324	191	230	210	410
	N	24	24	24	24	24	24	24	24
No advice sought	Mean	35.3	10.7	37.9	4539	1718	2714	441	1814
	Std. Error	0.2	3.6	5.4	224	122	157	168	298
	N	62	62	62	59	59	59	59	59
Advice sought	Mean	35.9	16.8	63.8	5112	1622	3395	637	3169
	Std. Error	0.6	16.6	20.2	411	338	389	629	1074
	N	6	6	6	6	6	6	6	6

Table 2: Advice and decision making for nutrition/fertilizer choices

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
No consultant	Mean	35.4	17.2	53.1	4418	1589	2707	830	2237
	Std. Error	0.4	9.0	11.6	410	230	310	481	597
	N	18	18	18	18	18	18	18	18
Consultant	Mean	35.3	9.0	35.6	4658	1756	2804	317	1825
	Std. Error	0.2	3.6	5.8	242	133	169	125	331
	N	50	50	50	47	47	47	47	47
No PMC	Mean	35.3	11.7	39.3	4623	1734	2786	481	1922
	Std. Error	0.2	3.7	5.4	213	119	152	169	297
	N	65	65	65	62	62	62	62	62
PMC	Mean	35.8	0.1	59.9	3941	1200	2596	3	2306
	Std. Error	0.3	0.0	30.2	1009	244	735	1	1554
	N	3	3	3	3	3	3	3	3
No packhouse	Mean	35.2	**13.1**	39.1	4556	1751	2691	**541**	1899
	Std. Error	0.2	**4.1**	5.9	235	127	160	**189**	328
	N	58	**58**	58	55	55	55	**55**	55
Packhouse	Mean	36.1	**0.1**	46.8	4790	1480	3252	**5**	2161
	Std. Error	0.6	**0.1**	11.5	388	265	366	**4**	562
	N	10	**10**	10	10	10	10	**10**	10
No spray contractor	Mean	35.3	11.4	39.3	4579	1715	2763	466	1888
	Std. Error	0.2	3.6	5.3	210	116	150	164	289
	N	67	67	67	64	64	64	64	64
Spray contractor	Mean	36.4	0.1	97.2	5413	1368	3697	5	5263
	Std. Error	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	1	1	1
No zespri	Mean	35.3	11.7	40.6	4550	1707	2736	480	1943
	Std. Error	0.2	3.7	5.5	214	120	151	169	301
	N	65	65	65	62	62	62	62	62
Zespri	Mean	35.7	0.2	30.9	5457	1752	3630	13	1867
	Std. Error	0.6	0.2	15.7	633	207	691	13	987
	N	3	3	3	3	3	3	3	3
No advice sought	Mean	35.2	9.2	35.6	4659	1788	2770	315	1800
	Std. Error	0.2	3.3	5.4	210	123	150	112	300
	N	61	61	61	58	58	58	58	58
Advice sought	Mean	36.2	28.6	80.4	4037	1061	2837	1649	3097
	Std. Error	0.2	18.4	13.6	854	194	630	1149	980
	N	7	7	7	7	7	7	7	7

Table 3: Advice and decision making for timing of spray applications

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
No consultant	Mean	35.3	12.1	40.0	4540	1684	2756	496	1917
	Std. Error	0.2	3.8	5.5	215	118	157	174	300
	N	63	63	63	60	60	60	60	60
Consultant	Mean	35.2	0.2	42.3	5213	2020	3022	14	2211
	Std. Error	0.6	0.1	19.1	777	496	414	8	1215
	N	5	5	5	5	5	5	5	5
No PMC	Mean	35.5	11.2	39.8	4433	1589	2739	426	1871
	Std. Error	0.3	5.0	7.7	323	173	218	189	403
	N	34	34	34	33	33	33	33	33
PMC	Mean	35.1	11.2	40.6	4755	1834	2816	493	2010
	Std. Error	0.3	5.0	7.3	259	148	203	267	422
	N	34	34	34	32	32	32	32	32
No packhouse	Mean	35.3	12.8	39.3	4699	1728	2858	524	1929
	Std. Error	0.2	4.3	6.1	235	129	171	201	338
	N	51	51	51	49	49	49	49	49
Packhouse	Mean	35.3	6.3	43.0	4262	1654	2529	259	1970
	Std. Error	0.4	5.8	10.8	439	252	299	229	575
	N	17	17	17	16	16	16	16	16
No spray contractor	Mean	35.6	11.5	43.8	4597	1626	2852	494	2126
	Std. Error	0.2	4.0	5.8	236	129	162	190	331
	N	55	55	55	53	53	53	53	53
Spray contractor	Mean	34.3	9.7	24.8	4568	2078	2444	305	1115
	Std. Error	0.5	7.8	11.6	431	222	358	246	530
	N	13	13	13	12	12	12	12	12
No zespri	Mean	35.5	9.6	48.3	4590	1636	2855	462	2421
	Std. Error	0.2	4.5	7.0	242	135	180	232	388
	N	43	43	43	41	41	41	41	41
Zespri	Mean	35.0	13.9	26.2	4595	1834	2644	453	1117
	Std. Error	0.4	5.9	7.2	387	210	259	191	371
	N	25	25	25	24	24	24	24	24
No advice sought	Mean	35.2	11.7	39.5	4593	1749	2736	488	1913
	Std. Error	0.2	3.9	5.8	240	127	173	186	326
	N	56	56	56	53	53	53	53	53
Advice sought	Mean	35.9	8.7	43.2	4587	1535	2959	330	2057
	Std. Error	0.4	8.3	13.3	388	266	255	314	649
	N	12	12	12	12	12	12	12	12

Table 4: Advice and decision making for pruning

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
No consultant	Mean	35.4	11.8	41.4	4544	1658	2778	484	2031
	Std. Error	0.2	3.7	5.4	213	115	154	171	303
	N	64	64	64	61	61	61	61	61
Consultant	Mean	34.4	1.2	20.2	5314	2496	2761	80	539
	Std. Error	0.7	1.1	20.2	929	549	608	74	539
	N	4	4	4	4	4	4	4	4
No PMC	Mean								
	Std. Error								
	N								
PMC	Mean								
	Std. Error								
	N								
No packhouse	Mean	35.3	12.3	43.1	4540	1668	2764	511	2049
	Std. Error	0.2	4.2	6.1	239	130	170	197	337
	N	53	53	53	50	50	50	50	50
Packhouse	Mean	35.2	7.3	29.8	4765	1849	2819	286	1573
	Std. Error	0.4	6.5	10.4	424	246	312	243	570
	N	15	15	15	15	15	15	15	15
No spray contractor	Mean	35.4	11.2	42.3	4568	1697	2759	478	2045
	Std. Error	0.2	3.7	5.7	227	130	155	181	318
	N	59	59	59	56	56	56	56	56
Spray contractor	Mean	34.9	11.5	26.7	4739	1785	2888	339	1283
	Std. Error	0.6	11.1	14.0	527	187	484	324	681
	N	9	9	9	9	9	9	9	9
No zespri	Mean	**35.4931***	12.4	39.1	4717	1723	2893	517	1902
	Std. Error	**0.2**	4.1	5.7	211	123	151	189	314
	N	**58**	58	58	55	55	55	55	55
Zespri	Mean	**34.3**	4.3	46.4	3902	1633	2139	136	2146
	Std. Error	**0.6**	2.6	14.6	674	320	455	78	789
	N	**10**	10	10	10	10	10	10	10
No advice sought	Mean	35.2	7.2	38.2	4454	1726	2622	246	1898
	Std. Error	0.2	3.1	6.1	255	140	174	106	338
	N	49	49	49	47	47	47	47	47
Advice sought	Mean	35.6	21.5	45.2	4951	1666	3180	1015	2049
	Std. Error	0.4	9.6	10.4	335	201	265	499	576
	N	19	19	19	18	18	18	18	18

* ($p < 0.07$)

Table 5: Advice and decision making for pollination

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
No consultant	Mean	35.4	**12.3**	42.8	4758	**1784**	2867	**509**	**2098**
	Std. Error	0.2	**3.9**	5.6	207	**123**	148	**180**	**315**
	N	61	**61**	61	58	**58**	58	**58**	**58**
Consultant	Mean	34.8	**1.9**	17.5	3211	**1090**	2032	**47**	**628**
	Std. Error	0.7	**1.1**	12.1	727	**210**	584	**25**	**406**
	N	7	**7**	7	7	**7**	7	**7**	**7**
No PMC	Mean								
	Std. Error								
	N								
PMC	Mean								
	Std. Error								
	N								
No packhouse	Mean	35.3	8.9	41.1	4571	1730	2732	379	1955
	Std. Error	0.2	3.2	5.5	220	121	152	158	302
	N	63	63	63	60	60	60	60	60
Packhouse	Mean	36.1	39.8	29.2	4839	1464	3319	1419	1758
	Std. Error	0.8	24.3	19.0	598	355	607	868	1118
	N	5	5	5	5	5	5	5	5
No spray contractor	Mean								
	Std. Error								
	N								
Spray contractor	Mean								
	Std. Error								
	N								
No zespri	Mean	35.3	**11.9**	41.2	4625	1720	2808	**493**	1976
	Std. Error	0.2	**3.8**	5.5	215	119	156	**174**	303
	N	63	**63**	63	60	60	60	**60**	60
Zespri	Mean	35.3	**1.8**	27.8	4186	1578	2407	**44**	1502
	Std. Error	0.5	**1.5**	19.1	849	481	451	**30**	1036
	N	5	**5**	5	5	5	5	**5**	5
No advice sought	Mean	35.2	11.2	41.2	4496	1723	2659	381	2006
	Std. Error	0.2	4.2	6.4	256	139	176	142	348
	N	47	47	47	45	45	45	45	45
Advice sought	Mean	35.5	11.2	38.0	4807	1678	3043	633	1790
	Std. Error	0.4	6.6	9.4	351	205	272	420	533
	N	21	21	21	20	20	20	20	20

Table 6: Advice and decision making for fruit thinning

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
No consultant	Mean	35.3	11.4	40.2	4579	1702	2774	465	1935
	Std. Error	0.2	3.6	5.3	210	116	150	164	294
	N	67	67	67	64	64	64	64	64
Consultant	Mean	34.7	0.7	41.7	5380	2165	2991	38	2245
	Std. Error	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	1	1	1
No PMC	Mean	35.3	11.4	40.8	4573	1687	2779	466	1970
	Std. Error	0.2	3.6	5.3	209	114	150	164	292
	N	67	67	67	64	64	64	64	64
PMC	Mean	33.5	0.0	0.0	5775	3141	2634	0	0
	Std. Error	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	1	1	1
No packhouse	Mean	35.3	9.4	42.6	4696	1763	2824	413	2151
	Std. Error	0.2	3.6	6.0	227	132	156	185	344
	N	54	54	54	51	51	51	51	51
Packhouse	Mean	35.4	18.3	30.9	4211	1516	2606	625	1169
	Std. Error	0.5	9.9	10.6	496	229	395	334	445
	N	14	14	14	14	14	14	14	14
No spray contractor	Mean	35.4	10.3	41.2	4657	1719	2831	439	2021
	Std. Error	0.2	3.5	5.4	214	121	150	166	303
	N	64	64	64	61	61	61	61	61
Spray contractor	Mean	34.2	25.8	23.8	3600	1563	1958	762	697
	Std. Error	1.0	24.8	23.8	760	245	679	724	697
	N	4	4	4	4	4	4	4	4
No zespri	Mean	35.4	**11.8**	41.2	4718	1745	2869	487	1963
	Std. Error	0.2	**3.8**	5.5	199	116	148	174	301
	N	63	**63**	63	60	60	60	60	60
Zespri	Mean	34.7	**3.3**	27.9	3078	1283	1673	125	1660
	Std. Error	0.9	**1.7**	19.3	1131	538	573	79	1182
	N	5	**5**	5	5	5	5	5	5
No advice sought	Mean	35.3	9.3	40.0	4394	1676	2596	313	1929
	Std. Error	0.2	3.9	6.4	268	141	180	127	347
	N	46	46	46	44	44	44	44	44
Advice sought	Mean	35.4	15.2	40.5	5005	1779	3156	765	1962
	Std. Error	0.4	7.4	9.3	296	201	245	421	535
	N	22	22	22	21	21	21	21	21

Table 7: Advice and decision making for frost protection

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
No consultant	Mean	35.4	10.4	42.6	4560	1665	2792	435	2019
	Std. Error	0.2	3.6	5.6	221	123	159	171	305
	N	61	61	61	58	58	58	58	58
Consultant	Mean	34.5	18.5	18.8	4854	2076	2651	656	1276
	Std. Error	0.6	13.8	13.1	614	281	423	512	951
	N	7	7	7	7	7	7	7	7
No PMC	Mean	35.4	11.7	40.0	4513	1658	2754	480	1890
	Std. Error	0.2	3.7	5.4	211	115	154	169	292
	N	65	65	65	62	62	62	62	62
PMC	Mean	34.4	0.4	43.6	6206	2780	3246	22	2967
	Std. Error	0.5	0.2	25.8	639	309	446	11	1955
	N	3	3	3	3	3	3	3	3
No packhouse	Mean	35.3	8.8	40.0	4610	1727	2777	372	1922
	Std. Error	0.2	3.2	5.4	212	117	155	155	295
	N	64	64	64	61	61	61	61	61
Packhouse	Mean	36.1	49.8	42.7	4316	1449	2769	1779	2211
	Std. Error	0.7	28.6	24.5	1072	565	510	1020	1566
	N	4	4	4	4	4	4	4	4
No spray contractor	Mean	35.3	11.4	39.5	4547	1689	2756	466	1866
	Std. Error	0.2	3.6	5.3	205	114	149	164	284
	N	67	67	67	64	64	64	64	64
Spray contractor	Mean	35.0	0.4	89.2	7463	3034	4113	28	6657
	Std. Error	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	1	1	1
No zespri	Mean	35.3	11.4	40.2	4579	1702	2774	465	1935
	Std. Error	0.2	3.6	5.3	210	116	150	164	294
	N	67	67	67	64	64	64	64	64
Zespri	Mean	34.7	0.7	41.7	5380	2165	2991	38	2245
	Std. Error	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	1	1	1
No advice sought	Mean	35.3	11.3	42.2	4418	1647	2655	387	2047
	Std. Error	0.2	4.1	6.2	257	136	178	140	343
	N	49	49	49	46	46	46	46	46
Advice sought	Mean	35.3	10.9	35.1	5013	1862	3071	633	1680
	Std. Error	0.4	7.2	10.2	330	213	262	443	550
	N	19	19	19	19	19	19	19	19

Table 8: Advice and decision making for day-to-day decisions about pest and disease control

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
Not self	Mean	35.2	9.3	28.9	4634	1872	2704	357	1266
	Std. Error	0.4	9.1	11.6	532	315	358	340	551
	N	11	11	11	10	10	10	10	10
Self	Mean	35.3	11.6	42.4	4584	1680	2790	477	2062
	Std. Error	0.2	3.9	5.9	227	123	164	181	326
	N	57	57	57	55	55	55	55	55
Not consultant	Mean	35.3	11.4	40.8	4573	1687	2779	466	1970
	Std. Error	0.2	3.6	5.3	209	114	150	164	292
	N	67	67	67	64	64	64	64	64
Consultant	Mean	33.5	0.0	0.0	5775	3141	2634	0	0
	Std. Error	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	1	1	1
No PMC	Mean	35.1	12.9	39.2	4433	1722	2608	562	1878
	Std. Error	0.3	4.9	6.8	269	148	194	236	363
	N	43	43	43	42	42	42	42	42
PMC	Mean	35.7	8.2	41.9	4882	1687	3085	271	2051
	Std. Error	0.3	4.7	8.3	317	182	214	148	489
	N	25	25	25	23	23	23	23	23
No packhouse rep	Mean	35.3	9.4	43.0	4610	1730	2771	392	2034
	Std. Error	0.2	3.4	5.6	223	120	155	163	311
	N	60	60	60	58	58	58	58	58
Packhouse rep	Mean	35.6	24.9	19.0	4442	1539	2823	1015	1153
	Std. Error	0.8	16.2	13.2	580	391	539	654	754
	N	8	8	8	7	7	7	7	7
No spray contractor	Mean	35.3	10.7	37.6	4631	1721	2798	456	1860
	Std. Error	0.2	3.6	5.5	225	123	158	172	312
	N	62	62	62	59	59	59	59	59
Spray contractor	Mean	35.1	16.7	67.4	4202	1595	2571	489	2720
	Std. Error	0.9	16.7	15.0	337	281	444	489	601
	N	6	6	6	6	6	6	6	6
No orchard manager	Mean	35.4	11.0	37.0	4499	1654	2740	383	1735
	Std. Error	0.2	3.7	5.5	214	121	154	129	288
	N	60	60	60	57	57	57	57	57
Orchard manager	Mean	35.0	13.0	64.4	5249	2108	3040	997	3397
	Std. Error	0.4	12.4	15.7	716	346	519	966	1072
	N	8	8	8	8	8	8	8	8

Table 9: Advice and decision making for day-to-day decisions about nutrition/fertilizer

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
Not self	Mean	35.1	14.0	39.4	4867	1976	2752	483	1927
	Std. Error	0.3	7.7	10.4	424	223	233	262	601
	N	18	18	18	17	17	17	17	17
Self	Mean	35.4	10.2	40.5	4494	1615	2786	450	1944
	Std. Error	0.3	4.0	6.2	238	132	184	199	333
	N	50	50	50	48	48	48	48	48
Not consultant	Mean	35.5	10.4	**55.1**	4591	1604	2869	503	2500
	Std. Error	0.3	5.5	**8.2**	306	163	235	295	443
	N	30	30	**30**	30	30	30	30	30
Consultant	Mean	35.2	11.8	**28.4**	4592	1800	2698	421	1459
	Std. Error	0.3	4.6	**6.3**	285	161	190	165	367
	N	38	38	**38**	35	35	35	35	35
No PMC	Mean	35.3	11.4	39.6	4632	1725	2802	466	1944
	Std. Error	0.2	3.6	5.3	206	115	148	164	294
	N	67	67	67	64	64	64	64	64
PMC	Mean	35.3	0.1	82.4	2009	719	1202	3	1656
	Std. Error	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	1	1	1
No packhouse rep	Mean	35.2	11.0	39.3	4618	1757	2746	459	1930
	Std. Error	0.2	3.7	5.7	230	122	160	174	317
	N	60	60	60	57	57	57	57	57
Packhouse rep	Mean	36.2	12.4	47.1	4406	1368	2994	461	2005
	Std. Error	0.7	12.3	14.5	418	320	403	459	691
	N	8	8	8	8	8	8	8	8
No spray contractor	Mean	35.3	11.2	40.2	4592	1709	2777	459	1939
	Std. Error	0.2	3.5	5.3	207	115	148	161	289
	N	68	68	68	65	65	65	65	65
Spray contractor	Mean								
	Std. Error								
	N								
No orchard manager	Mean	35.4	**12.4**	38.0	4556	1657	2788	510	1839
	Std. Error	0.2	**3.9**	5.5	217	119	159	180	301
	N	61	**61**	61	58	58	58	58	58
Orchard manager	Mean	34.7	**0.6**	59.4	4890	2145	2684	32	2775
	Std. Error	0.4	**0.3**	17.1	716	397	436	17	1008
	N	7	**7**	7	7	7	7	7	7

Table 10: Advice and decision making for day-to-day decisions about timing of spray applications

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
Not self	Mean	35.3	7.5	37.0	4477	1705	2722	282	1490
	Std. Error	0.4	7.0	11.7	386	241	303	261	505
	N	14	14	14	14	14	14	14	14
Self	Mean	35.3	12.2	41.0	4623	1711	2792	507	2063
	Std. Error	0.2	4.1	5.9	243	131	171	193	342
	N	54	54	54	51	51	51	51	51
Not consultant	Mean	35.3	11.5	40.0	4608	1713	2789	473	1911
	Std. Error	0.2	3.6	5.3	209	116	152	166	291
	N	66	66	66	63	63	63	63	63
Consultant	Mean	35.6	0.1	48.0	4066	1589	2401	3	2830
	Std. Error	1.0	0.1	48.0	1832	1009	748	1	2830
	N	2	2	2	2	2	2	2	2
No PMC	Mean	35.2	12.3	39.4	4558	1730	2724	534	1950
	Std. Error	0.3	4.7	6.7	268	144	189	226	367
	N	45	45	45	44	44	44	44	44
PMC	Mean	35.5	9.1	41.8	4662	1667	2888	302	1918
	Std. Error	0.3	5.0	8.7	316	192	236	161	472
	N	23	23	23	21	21	21	21	21
No packhouse rep	Mean	35.2	9.5	42.6	4757	**1815**	2828	406	2084
	Std. Error	0.2	3.4	5.7	213	**118**	155	168	320
	N	59	59	59	56	**56**	56	56	56
Packhouse rep	Mean	36.3	22.1	24.2	3564	**1053**	2458	789	1039
	Std. Error	0.6	14.6	12.7	617	**309**	477	521	591
	N	9	9	9	9	**9**	9	9	9
No spray contractor	Mean	35.4	11.5	42.3	4596	1695	2788	493	2073
	Std. Error	0.2	3.9	5.8	235	129	162	187	329
	N	57	57	57	54	54	54	54	54
Spray contractor	Mean	35.0	9.6	29.4	4571	1780	2722	289	1283
	Std. Error	0.6	9.0	12.8	436	252	382	265	549
	N	11	11	11	11	11	11	11	11
No orchard manager	Mean	35.4	11.0	37.0	4499	1654	2740	383	1735
	Std. Error	0.2	3.7	5.5	214	121	154	129	288
	N	60	60	60	57	57	57	57	57
Orchard manager	Mean	35.0	13.0	64.4	5249	2108	3040	997	3397
	Std. Error	0.4	12.4	15.7	716	346	519	966	1072
	N	8	8	8	8	8	8	8	8

Table 11: Advice and decision making for day-to-day decisions about pruning

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
Not self	Mean	35.1	20.5	35.0	4734	1886	2740	1169	1636
	Std. Error	0.3	13.2	14.5	589	290	393	816	849
	N	10	10	10	10	10	10	10	10
Self	Mean	35.4	9.6	41.1	4566	1677	2784	330	1995
	Std. Error	0.2	3.5	5.7	222	125	161	119	308
	N	58	58	58	55	55	55	55	55
Not consultant	Mean	35.3	11.4	39.3	4609	1710	2792	466	1915
	Std. Error	0.2	3.6	5.3	210	116	150	164	293
	N	67	67	67	64	64	64	64	64
Consultant	Mean	34.5	0.0	99.6	3501	1688	1812	0	3486
	Std. Error	.	.	.	.	.	.	.	.
	N	1.0	1.0	1.0	1	1	1	1	1
No PMC	Mean	35.3	11.2	40.2	4592	1709	2777	459	1939
	Std. Error	0.2	3.5	5.3	207	115	148	161	289
	N	68	68	68	65	65	65	65	65
PMC	Mean								
	Std. Error								
	N								
No packhouse rep	Mean	35.2	10.4	42.7	4643	1765	2766	429	2066
	Std. Error	0.2	3.5	5.4	212	118	150	163	301
	N	64	64	64	61	61	61	61	61
Packhouse rep	Mean	37.0	24.7	0.2	3805	869	2936	919	9
	Std. Error	0.5	24.7	0.2	990	260	831	917	8
	N	4	4	4	4	4	4	4	4
No spray contractor	Mean	35.4	10.3	41.2	4699	1733	2857	441	2021
	Std. Error	0.2	3.5	5.4	206	119	147	166	303
	N	64	64	64	61	61	61	61	61
Spray contractor	Mean	34.5	25.0	23.8	2948	1358	1562	733	697
	Std. Error	1.3	25.0	23.8	959	413	683	733	697
	N	4	4	4	4	4	4	4	4
No orchard manager	Mean	35.4	11.0	37.0	4499	1654	2740	383	1735
	Std. Error	0.2	3.7	5.5	214	121	154	129	288
	N	60	60	60	57	57	57	57	57
Orchard manager	Mean	35.0	13.0	64.4	5249	2108	3040	997	3397
	Std. Error	0.4	12.4	15.7	716	346	519	966	1072
	N	8	8	8	8	8	8	8	8

Table 12: Advice and decision making for day-to-day decisions about pollination

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
Not self	Mean	35.2	18.6	31.9	4704	1852	2754	1063	1487
	Std. Error	0.3	12.0	13.5	533	264	356	746	782
	N	11	11	11	11	11	11	11	11
Self	Mean	35.3	9.8	41.8	4569	1680	2782	336	2032
	Std. Error	0.2	3.5	5.7	227	128	164	121	312
	N	57	57	57	54	54	54	54	54
Not consultant	Mean	35.3	11.4	40.8	4571	1718	2746	466	1970
	Std. Error	0.2	3.6	5.3	209	116	147	164	292
	N	67	67	67	64	64	64	64	64
Consultant	Mean	37.2	0.1	0.0	5939	1168	4771	5	0
	Std. Error	.	.	.	.	.	.	.	.
	N	1	1	1	1	1	1	1	1
No PMC	Mean	35.3	11.2	40.2	4592	1709	2777	459	1939
	Std. Error	0.2	3.5	5.3	207	115	148	161	289
	N	68	68	68	65	65	65	65	65
PMC	Mean								
	Std. Error								
	N								
No packhouse rep	Mean	35.3	9.9	40.8	4605	1714	2784	409	1969
	Std. Error	0.2	3.3	5.3	210	116	150	156	292
	N	67	67	67	64	64	64	64	64
Packhouse rep	Mean	35.6	98.7	0.8	3720	1400	2320	3671	31
	Std. Error	.	.	.	.	.	.	.	.
	N	1.0	1.0	1.0	1	1	1	1	1
No spray contractor	Mean	35.3	11.2	40.2	4592	1709	2777	459	1939
	Std. Error	0.2	3.5	5.3	207	115	148	161	289
	N	68	68	68	65	65	65	65	65
Spray contractor	Mean								
	Std. Error								
	N								
No orchard manager	Mean	35.4	11.0	37.0	4499	1654	2740	383	1735
	Std. Error	0.2	3.7	5.5	214	121	154	129	288
	N	60	60	60	57	57	57	57	57
Orchard manager	Mean	35.0	13.0	64.4	5249	2108	3040	997	3397
	Std. Error	0.4	12.4	15.7	716	346	519	966	1072
	N	8	8	8	8	8	8	8	8

Table 13: Advice and decision making for day-to-day decisions about fruit thinning

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
Not self	Mean	35.2	17.7	29.2	4479	1752	2624	988	1363
	Std. Error	0.3	11.0	12.6	536	261	350	685	725
	N	12	12	12	12	12	12	12	12
Self	Mean	35.3	9.8	42.5	4617	1700	2812	339	2070
	Std. Error	0.2	3.6	5.8	226	129	165	123	315
	N	56	56	56	53	53	53	53	53
Not consultant	Mean	35.3	11.2	40.2	4592	1709	2777	459	1939
	Std. Error	0.2	3.5	5.3	207	115	148	161	289
	N	68	68	68	65	65	65	65	65
Consultant	Mean								
	Std. Error								
	N								
No PMC	Mean	35.3	11.2	40.2	4592	1709	2777	459	1939
	Std. Error	0.2	3.5	5.3	207	115	148	161	289
	N	68	68	68	65	65	65	65	65
PMC	Mean								
	Std. Error								
	N								
No packhouse rep	Mean	35.3	9.5	41.2	4556	1730	2716	396	1987
	Std. Error	0.2	3.4	5.5	215	121	149	161	304
	N	64	64	64	61	61	61	61	61
Packhouse rep	Mean	36.4	38.5	23.4	5130	1390	3708	1421	1221
	Std. Error	0.3	23.7	13.4	854	182	728	872	793
	N	4	4	4	4	4	4	4	4
No spray contractor	Mean	35.4	10.0	40.0	4602	1701	2794	427	1957
	Std. Error	0.2	3.4	5.3	211	118	149	161	297
	N	66	66	66	63	63	63	63	63
Spray contractor	Mean	33.7	50.0	47.6	4275	1982	2238	1466	1394
	Std. Error	2.0	50.0	47.6	1343	26	1373	1466	1394
	N	2	2	2	2	2	2	2	2
No orchard manager	Mean	35.3	10.8	**36.4**	4521	1679	2738	377	1705
	Std. Error	0.2	3.6	**5.4**	211	121	151	127	285
	N	61	61	**61**	58	58	58	58	58
Orchard manager	Mean	35.2	14.8	**73.6**	5173	1960	3098	1140	3883
	Std. Error	0.4	14.2	**14.7**	822	361	596	1103	1104
	N	7	7	**7**	7	7	7	7	7

Table 14: Advice and decision making for day-to-day decisions about frost protection

		Average size	Kiwistart %	Taste Zespri %	Trays /ha	Less36 /ha	More36 /ha	Kiwistart /ha	Taste Zespri/ha
Not self	Mean	35.1	**3.5**	34.0	4493	1737	2688	**126**	1543
	Std. Error	0.3	**2.9**	6.8	300	163	209	**111**	358
	N	34	**34**	34	33	33	33	**33**	33
Self	Mean	35.5	**18.9**	46.4	4693	1681	2869	**802**	2348
	Std. Error	0.3	**6.2**	8.0	289	164	212	**297**	452
	N	34	**34**	34	32	32	32	**32**	32
Not consultant	Mean	35.3	11.2	40.2	4592	1709	2777	459	1939
	Std. Error	0.2	3.5	5.3	207	115	148	161	289
	N	68	68	68	65	65	65	65	65
Consultant	Mean								
	Std. Error								
	N								
No PMC	Mean	35.3	11.2	40.2	4592	1709	2777	459	1939
	Std. Error	0.2	3.5	5.3	207	115	148	161	289
	N	68	68	68	65	65	65	65	65
PMC	Mean								
	Std. Error								
	N								
No packhouse rep	Mean	35.3	8.5	41.4	4624	1735	2782	361	2001
	Std. Error	0.2	3.1	5.4	212	116	153	150	295
	N	66	66	66	63	63	63	63	63
Packhouse rep	Mean	36.8	99.4	0.4	3569	910	2620	3544	16
	Std. Error	1.2	0.7	0.4	152	490	300	127	16
	N	2	2	2	2	2	2	2	2
No spray contractor	Mean	35.3	11.2	40.2	4592	1709	2777	459	1939
	Std. Error	0.2	3.5	5.3	207	115	148	161	289
	N	68	68	68	65	65	65	65	65
Spray contractor	Mean								
	Std. Error								
	N								
No orchard manager	Mean	35.3	11.9	37.4	4593	1700	2788	487	1822
	Std. Error	0.2	3.7	5.4	208	117	151	171	293
	N	64	64	64	61	61	61	61	61
Orchard manager	Mean	34.9	0.4	84.5	4569	1857	2604	24	3735
	Std. Error	0.5	0.1	14.3	1268	597	811	9	1313
	N	4	4	4	4	4	4	4	4