Project title:	Continuation of previous work (TF 197) to determine the cost benefit of a range of thinning strategies for apple
Project number:	TF 197a
Project leader:	Gary Saunders East Malling Research
Report:	Final report, January 2013
Previous report:	Annual report, September 2012
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AUTHENTICATION

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

Gary M Saunders
Horticultural Services (Science) Manager
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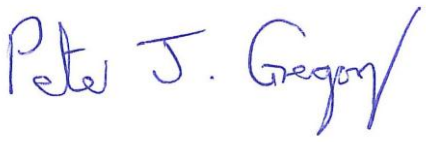
Signature ..... Date 28 March 2013

Report authorised by:

Professor Peter J Gregory
Chief Executive
East Malling Research



Signature ..... Date 28 March 2013

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GROWER SUMMARY

Headline

- Depending on the season and the crop load, fruit thinning may not always lead to increased returns in apple orchards.

Background and expected deliverables

Tree fruit growers are keen to develop chemical and/or mechanical methods of fruit thinning to reduce reliance upon expensive hand thinning operations. Indeed the HDC Tree Fruit Panel considers this to be a high priority in its research strategy.

Apple trees often set excessive numbers of fruit in relation to tree size resulting in the production of large numbers of small fruit. Thinning or removing a proportion of these fruit enables the remaining fruit to reach a larger size, and these are easier and cheaper to pick. This enables growers to produce fruit in the desired size range for market requirements. In addition to increasing fruit size, thinning can also be carried out to increase fruit quality, for instance, when damaged fruit is removed from the tree. Thinning is also carried out to prevent over cropping, as in some varieties this can lead to biennial bearing.

There have been recent developments in both chemical and mechanical fruit thinning techniques. If effective, such developments could reduce or remove the cost of the hand thinning operation. This project investigated such alternative thinning techniques for Gala apple.

Summary of the project and main conclusions

The treatments applied in 2011 were as follows:

1. Untreated
2. Hand thinning at 12-15 mm according to agronomists' recommendations
3. Exilis applied at 8-12 mm fruit size at 7.5 l/ha in a water volume of 500 l/ha, when temperature is forecasted to be above 15^{o}C for the two days following application
4. Ammonium thiosulphate (ATS) applied at open flower at a rate of 2% applied as 500 l/ha
5. ATS applied at open flower at a rate of 2% applied as 500 l/ha + Exilis applied at 8-12 mm fruit size at 7.5 l/ha, when temperature is forecasted to be above 15^{o}C for the two

days following application, in a water volume of 500 l/ha

6. Cerone (0.75 l/ha in a water volume of 500 l/ha) applied at petal fall
7. Cerone (0.75 l/ha in a water volume of 500 l/ha) applied at petal fall + Exilis applied at 8-12 mm fruit size at 7.5 l/ha, when temperature is forecasted to be above 15^{o}C for the two days following application, in a water volume of 500 l/ha
8. Mechanical blossom thinning using the Fruit-Tec Darwin thinner

The treatments applied in 2012 were as follows:

1. Untreated
2. Hand thinning to doubles per cluster at 12-15mm
3. Hand thin all small, under-developed fruit per cluster at 12-15mm
4. Exilis applied at 8-12mm fruit size at 7.0 l/ha, in a water volume of 1000 l/ha with 0.5% Li-700, when temperature was forecasted to be above 15^{o}C for the two days following application
5. Exilis applied at 8-12mm fruit size at 7.0 l/ha, with 0.175 l/ha Tipoff and 0.5% Li-700, when temperature was forecasted to be above 15^{o}C for the two days following application, in a water volume of 1000 l/ha

Treatments applied in 2011 at bloom were ineffective at reducing crop load; however reports from growers suggest that ATS (ammonium thiosulphate) and the Darwin mechanical blossom thinner are feasible alternatives to hand thinning.

Post-blossom alternatives, such as Exilis (6-benzyladenine), to hand thinning, have been shown to be effective at reducing crop load. Exilis reduced crop load by 48% in 2011 and 19% in 2012, the difference between years being attributable to cooler temperatures immediately post application in 2012. It has also been shown that hand thinning can have little effect on fruit number at harvest if the level of thinning is insufficient for the crop load on the tree. In 2012, fruit was thinned to two fruit per cluster and this had no significant effect on fruit numbers at harvest, whereas in 2011 fruit was thinned to a single fruit per cluster and here the fruit number at harvest was significantly reduced.

In 2011 a greater thinning effect was observed than in 2012, and in 2011 it was shown that by reducing crop load, fruit size increased. There were greater returns for fruit in the larger size classes, but the reduction in fruit number outweighed this increase in return per apple, resulting in a reduction in income per tree.

In 2012 there were no significant differences between the treatments and the un-thinned control for return per tree. However there was a difference between hand thinning all small fruit and the Exilis application, with a greater return achieved from the Exilis application. The Exilis application gave a greater proportion of larger fruit than the 'hand thinning small fruit' treatment, where a greater price was achieved for the larger fruit. In addition to this, the thinning cost for the Exilis application was less per tree than the cost of hand thinning the small fruit.

Applications of Exilis in 2011 showed no adverse effects on return bloom compared to the control.

Before drawing any major conclusions from this trial, it should be remembered that it was only carried out over a two-year period and that in the second year of the project, fruit set was poor due to the wet spring conditions.

Conclusions from this work

1. Alternatives to conventional hand thinning exist.
2. Thinning clusters to two fruit may not reduce the number of fruit at harvest compared to an un-thinned crop.*
3. Thinning a crop may not result in the greatest potential profit.**
4. Careful consideration is required when making decisions on thinning.

*This was for data from a year where there was a very poor fruit set due to wet weather conditions in spring.

** Thinning may have benefits on preventing biennial cropping and increasing brix levels.

Financial benefits

Reducing crop load and increasing fruit size may not necessarily lead to an increased return. In 2011 the lowest return per tree was achieved from the greatest thinning effect, ATS + Exilis (£12.33), whereas the un-thinned treatment returned £18.68 per tree. This is of course information for one year from one orchard. In 2012 there was no significant effect on financial return for any of the treatments compared to the control.

In 2012, hand thinning fruit to doubles per cluster did not significantly reduce fruit number compared to the control, nor was there a significant change in return per tree. However, the effect of carrying out this exercise would be to spend more money producing the crop which, although it would be recouped on the sale of the crop, would have an impact on cash flow during the growing season.

Action points for growers

- Decisions on the level of thinning required need to be based on initial crop load, and potential return for each size class.

- If the prices are known for each size class, an informed decision can be made on the level of thinning required.

- If thinning is required to increase crop size, Exilis can be used as an alternative to hand thinning.

SCIENCE SECTION

Introduction

Effective fruit thinning and increasing fruit size through the use of chemicals or mechanical methods, whilst reducing or removing the cost of hand-thinning, is seen as a high research priority. In 2012, this project made use of 6-benzyladenine, 1-napthylacetic acid and hand thinning to develop commercially appropriate methods of thinning that potentially have an overall cost benefit to the crop. The aim of the project was to determine the effectiveness and cost benefit of a range of thinning strategies for cv. Gala apple. The specific objectives were:

1. To apply five treatments including an un-thinned control
2. To determine the time taken and cost for each treatment method
3. To determine yield in each size category at harvest for each treatment
4. To determine the cost benefit of each treatment

Materials and methods

The trial was conducted on Gala apple in Plot number EE191 at East Malling Research, East Malling, Kent. This is a 1.25ha plot of alternate rows of Mondial Gala and Queen Cox, both on M9 planted in 1999. The trial was laid out in a statistically randomized block design, approved by the EMR biometrician, data was analysed by Anova, Genstat. Weather data was collected during the trial from an on-site weather station.

The treatments applied were as follows:

1. Untreated
2. Hand thinning to doubles per cluster at 12-15mm
3. Hand thinning of all small fruit per cluster at 12-15mm
4. Exilis (6-benzyladenine) applied at 8-12mm fruit size at 7.0 l/ha with 0.5% Li-700 (blend of methylacetic acid, processed lecithin – surfactant/wetter/spreader) when temperature was forecasted to be above 15°C for the two days following application in a water volume of 1000 l/ha
5. Exilis applied at 8-12mm fruit size at 7.0 l/ha with 0.175 l/ha Tipoff (1-naphthylacetic acid) and 0.5% Li-700 when temperature was forecasted to be above 15°C for the two

days following application in a water volume of 1000 l/ha

Hand thinning was carried out on 06/06/12 when the fruit was between 12 and 15mm diameter. Treatment 2 consisted of thinning fruit in the cluster down to two good fruit. This was achieved by initially removing small, under developed fruit followed by the king fruit and finally removing developing fruit until just two fruit per cluster were left. Treatment 3 was applied by the removal of all small under developed fruit which left all developing fruit in the cluster. Chemical treatments 4 and 5 were applied on 29/05/12 when the fruit was between 8 and 12mm fruit size and the weather was predicted to be above 15^{o}C for the two days following application.

At pink bud flower clusters per tree were assessed and fruit number was determined prior to and post June-drop. At harvest, fruit number and weight was determined for each size class for each tree.

Costs of chemicals used, time taken for application, time taken for hand thinning operations and for harvest were determined for each plot, along with commercially achieved price per fruit category, to enable a simple cost benefit to be determined for each thinning strategy.

This calculation consisted of income minus costs. Income was calculated on yield of each size class multiplied by return to the grower for each size class. For the purposes of this experiment, 2012 prices for fruit were as follows:

- 70p/kg for <60mm fruit
- 80p/kg for 60-70mm fruit
- 84p/kg for >70mm fruit.

Net costs were calculated as cost of the thinning operation plus cost of harvest labour (time taken). The hourly rates used in the calculation were £6.84 / hour for casual staff thinning and picking and £32.00 / hour for a spray operator with tractor.

Results

Fruit number and weight per tree and mean fruit weight

Treatments 3, 4 and 5 showed a significant reduction in mean total fruit number per tree compared to the un-thinned control. However, for total fruit weight no individual treatment

showed a significant difference from the untreated control. Mean fruit weight increased in treatments 2 and 4 compared to the untreated control (treatment 1). Results are shown in Table 1.

Table 1. Mean total fruit number per tree, mean total fruit weight per tree and mean individual fruit weight

Treatment		Total fruit number	Total fruit weight (kg)	Mean fruit weight (g)
1	Untreated	391.8	33.26	86.2
2	Hand thin to doubles	353.7	33.68	98.0
3	Hand thin all small fruit	303.7	27.46	95.7
4	Exilis	316.1	32.54	104.8
5	Exilis + Tipoff	338.1	31.38	95.9
	F-prob	0.020	0.217	0.031
	SED (16 df)	24.56	2.783	5.02
	LSD	52.06	5.900	10.64

Fruit size distribution

All treatments show a significant reduction in the number of small (<60mm) fruit compared to the control. However, for fruit in the 60-70mm range no individual treatment showed a significant difference in fruit number from the untreated control. No individual treatment showed a significant difference from the untreated control in the number of fruit >70mm. Results are shown in Table 2.

Table 2. Fruit number per tree by size class

Treatment		Fruit number <60mm	Fruit number 60-70mm	Fruit number >70mm
1	Untreated	243.8	148.4	7.7
2	Hand thin to doubles	196.1	150.9	7.0
3	Hand thin all small fruit	161.7	133.3	7.5
4	Exilis	135.5	171.8	13.7
5	Exilis + Tipoff	177.4	154.1	6.5
	F-prob	0.002	0.429	0.358
	SED (16 df)	21.89	19.33	3.87
	LSD	46.41	40.97	8.21

Fruit weight per tree by class

Treatments 3, 4 and 5 showed a significant reduction in weight for fruit less than 60mm compared to the control. However, no individual treatment showed a significant difference

in fruit weight from the untreated control for the size range 60-70mm. Treatment 4 showed an increase in in fruit weight for fruit >70mm compared to the control. Results are shown in Table 3.

Table 3. Weight of fruit per tree by size class

Treatment		Fruit weight (kg) <60mm	Fruit weight (kg) 60-70mm	Fruit weight (kg) >70mm
1	Untreated	17.13	15.59	0.68
2	Hand thin to doubles	14.92	17.33	1.44
3	Hand thin all small fruit	11.42	14.73	1.17
4	Exilis	10.99	19.52	2.39
5	Exilis + Tipoff	12.79	17.34	1.24
	F-prob	0.010	0.277	0.233
	SED (16 df)	1.658	2.208	0.702
	LSD	3.516	4.681	1.487

Cost benefit

There was no significant effect on financial return for any of the treatments compared to the control.

Table 4. Average return per tree

Treatment		Return per tree (£)
1	Untreated	29.28
2	Hand thin to doubles	29.25
3	Hand thin all small fruit	24.26
4	Exilis	30.45
5	Exilis + Tipoff	28.65
	F-prob	0.230
	SED (28 df)	2.698
	LSD	5.720

Discussion

The data presented here is for the second year of a two-year project. The Gala trees used cropped well for that orchard, but initial crop load was estimated to be less than that of many commercial orchards. Three treatments resulted in a significantly reduced mean number of fruit per tree compared to the un-thinned trees which had an average final yield of 391.8 fruit per tree. Hand thinning all undeveloped small fruit reduced fruit number by 22.5% and the application of Exilis reduced fruit number by 19.3% compared to the un-thinned control. Although three treatments resulted in significantly reduced fruit number per tree, no individual treatment resulted in significant differences in total fruit weight per tree

compared to the control. Mean individual fruit weight increased by 13.7% in the hand thinning to doubles treatment and 21.6% in the Exilis treatment compared to the control.

In each case except for the Exilis treatment, the number of fruit in the <60mm category exceeded the number of fruit in the 60-70mm category. Whereas only in the control was total fruit weight in the <60mm category greater than in the 60-70mm category, with the reverse being the case for all other treatments.

There were no significant differences between the treatments and the un-thinned control for return per tree, however there was a difference between hand thinning all small fruit and the Exilis application, with a greater return achieved from the Exilis application. Both treatments significantly reduced the number of fruit per tree compared to the control but the Exilis application gave a greater proportion of fruit in the 60-70mm size category than the <60mm category compared to the hand thinning small fruit treatment. A greater price was achieved for fruit in the 60-70mm size class than for the <60mm fruit. In addition to this the thinning cost of the Exilis application was less per tree than the cost of hand thinning the small fruit.

Thinning is, however, also used as a method to even out the crop from year to year, reducing peaks and troughs in crop load, which if left can lead to biennial bearing. Gala is a variety that is not particularly prone to biennial bearing and the project was over too short a time period for this to be investigated during the course of the project.

Thinning is also carried out to remove substandard and damaged fruit. Hand thinning provides an opportunity to do this whereas mechanical and chemical methods are either non-selective or too early (at full bloom) to remove substandard fruit.

Although not assessed in this trial, crop load can have an effect on sugar levels within fruit, which has been found to be linked to the number of leaves around a fruit cluster and the number of fruit within the cluster, as well as fruit position on the tree and light interception. This must also be borne in mind when deciding to thin as minimum brix levels are specified by the supermarkets.

Conclusions

Exilis has been shown to be an effective thinning agent when weather conditions are correct. In 2011 the application of Exilis reduced the number of fruit by 48% and in 2012 the crop was thinned by 19%, day time temperatures were similar post application in both years

but in 2012 night time temperatures were cooler, resulting in less of a thinning effect. Applications of Exilis in 2011 had no detrimental effect on return bloom.

In 2012 hand thinning all small fruit was also shown to be an effective method of reducing fruit number, as was hand thinning to single fruit in 2011. Hand thinning to two fruit per flower bud cluster in 2012 did not significantly affect the crop load at harvest.

Hand thinning fruit to doubles per cluster did not significantly reduce fruit number compared to the control, nor was there a significant change in return per tree. The effect of carrying out this exercise would be to spend more money producing the crop, which although this could be recouped on the sale of the crop, would have an impact on cash flow during the growing season.

It has been seen that reducing crop load and increasing fruit size may not lead to an increased return as a smaller number of large fruit may generate a greater income than a larger number of small fruit.

Decisions on the level of thinning required need to be based on initial crop load, and potential return for each size class. If the prices are known for each size class an informed decision can be made on the level of thinning required, which if weather conditions are correct, can be effectively achieved by chemical methods.

Care must be taken when extrapolating the data to other varieties as other varieties may well behave quite differently to Gala. In addition this project was only conducted over two years, with differing treatments in each of the years, and in the second year of the project, pollination was extremely poor due to the unusually wet spring weather conditions.

Knowledge and Technology Transfer

- Presentation at HDC Agronomists day 6 March 2012
- HDC *Tree Fruit Review* 2013

Appendix 1 – Statistical analyses

Analysis of variance

Variate: total_number_ of_fruit

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	4	168192.	42048.	9.30	
block.treatment stratum					
treatment	4	71420.	17855.	3.95	0.020
Residual	16	72377.	4524.	0.84	
block.treatment.*Units* stratum	50	268581.	5372.		
Total	74	580570.			

Message: the following units have large residuals.

block 4 treatment 3	-69.3	s.e.	31.1
block 1 treatment 3 *units* 2	-147.7	s.e.	59.8

Tables of means

Variate: total_number_of_fruit

Grand mean 340.7

treatment	1	2	3	4	5
	391.8	353.7	303.7	316.1	338.1

Standard errors of differences of means

Table	treatment
rep.	15
d.f.	16
s.e.d.	24.56

Least significant differences of means (5% level)

Table	treatment
rep.	15
d.f.	16
l.s.d.	52.06

Analysis of variance

Variate: Total_Fruit_wt_kg

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	4	375.82	93.95	1.62	
block.treatment stratum					
treatment	4	377.56	94.39	1.62	0.217
Residual	16	929.54	58.10	1.40	
block.treatment.*Units* stratum	50	2068.25	41.36		
Total	74	3751.16			

Message: the following units have large residuals.

block 4 treatment 2	10.44	s.e.	3.52
block 4 treatment 3	-9.12	s.e.	3.52
block 4 treatment 4 *units* 2	20.52	s.e.	5.25
block 4 treatment 4 *units* 3	-22.98	s.e.	5.25

Tables of means

Variate: Total_Fruit_wt_kg

Grand mean 31.66

treatment	1	2	3	4	5
	33.26	33.68	27.46	32.54	31.38

Standard errors of differences of means

Table	treatment
rep.	15
d.f.	16
s.e.d.	2.783

Least significant differences of means (5% level)

Table	treatment
rep.	15
d.f.	16
l.s.d.	5.900

Analysis of variance

Variate: Income

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	4	174.15	43.54	0.80	
block.treatment stratum					
treatment	4	343.50	85.87	1.57	0.230
Residual	16	873.71	54.61	1.66	
block.treatment.*Units* stratum	50	1644.46	32.89		
Total	74	3035.82			

Message: the following units have large residuals.

block 4 treatment 2	9.91	s.e.	3.41
block 4 treatment 3	-9.01	s.e.	3.41
block 4 treatment 4 *units* 2	19.31	s.e.	4.68
block 4 treatment 4 *units* 3	-20.96	s.e.	4.68

Tables of means

Variate: Income

Grand mean 28.38

treatment	1	2	3	4	5
	29.28	29.25	24.26	30.45	28.65

Standard errors of differences of means

Table	treatment
rep.	15
d.f.	16
s.e.d.	2.698

Least significant differences of means (5% level)

Table	treatment
rep.	15
d.f.	16
l.s.d.	5.720

Analysis of variance

Variate: Weight_Small

Source of variation	d.f.	(m.v.)	s.s.	m.s.	v.r.	F pr.
block stratum	4		768.13	192.03	9.31	
block.treatment stratum						
treatment	4		394.66	98.66	4.78	0.010
Residual	16		330.04	20.63	0.63	
block.treatment.*Units* stratum	47	(3)	1541.35	32.79		
Total	71	(3)	3011.04			

Message: the following units have large residuals.

block 5 treatment 1 *units* 3 -13.18 s.e. 4.53

Tables of means

Variate: Weight_Small

Grand mean 13.45

treatment	1	2	3	4	5
	17.13	14.92	11.42	10.99	12.79

Standard errors of differences of means

Table	treatment
rep.	15
d.f.	16
s.e.d.	1.658

(Not adjusted for missing values)

Least significant differences of means (5% level)

Table	treatment
rep.	15
d.f.	16
l.s.d.	3.516

(Not adjusted for missing values)

Analysis of variance

Variate: Weight_Medium

Source of variation	d.f.	(m.v.)	s.s.	m.s.	v.r.	F pr.
block stratum	4		196.39	49.10	1.34	
block.treatment stratum						
treatment	4		205.35	51.34	1.40	0.277
Residual	16		585.11	36.57	1.40	
block.treatment.*Units* stratum						
	49	(1)	1278.98	26.10		
Total	73	(1)	2260.56			

Message: the following units have large residuals.

block 4 treatment 2	7.07	s.e.	2.79
block 4 treatment 3	-6.31	s.e.	2.79
block 5 treatment 2	-5.80	s.e.	2.79
block 4 treatment 4 *units* 2	12.10	s.e.	4.13
block 4 treatment 4 *units* 3	-13.36	s.e.	4.13

Tables of means

Variate: Weight_Medium

Grand mean 16.90

treatment	1	2	3	4	5
	15.59	17.33	14.73	19.52	17.34

Standard errors of differences of means

Table	treatment
rep.	15
d.f.	16
s.e.d.	2.208

(Not adjusted for missing values)

Least significant differences of means (5% level)

Table	treatment
rep.	15
d.f.	16
l.s.d.	4.681

(Not adjusted for missing values)

Analysis of variance

Variate: Weight_Large

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	4	25.483	6.371	1.73	
block.treatment stratum					
treatment	4	23.593	5.898	1.60	0.223
Residual	16	59.061	3.691	0.99	
block.treatment.*Units* stratum	50	185.545	3.711		
Total	74	293.681			

Message: the following units have large residuals.

block 1 treatment 3	2.07	s.e.	0.89
block 4 treatment 3	-1.82	s.e.	0.89
block 1 treatment 3 *units* 2	4.88	s.e.	1.57
block 2 treatment 4 *units* 3	-3.79	s.e.	1.57
block 4 treatment 4 *units* 2	4.44	s.e.	1.57

Tables of means

Variate: Weight_Large

Grand mean 1.38

treatment	1	2	3	4	5
	0.68	1.44	1.17	2.39	1.24

Standard errors of differences of means

Table	treatment
rep.	15
d.f.	16
s.e.d.	0.702

Least significant differences of means (5% level)

Table	treatment
rep.	15
d.f.	16
l.s.d.	1.487

Analysis of variance

Variate: Number_Large

Source of variation	d.f.	(m.v.)	s.s.	m.s.	v.r.	F pr.
block stratum	4		1050.1	262.5	2.33	
block.treatment stratum						
treatment	4		529.6	132.4	1.18	0.358
Residual	16		1801.1	112.6	0.79	
block.treatment.*Units* stratum						
	42	(8)	5982.7	142.4		
Total	66	(8)	9300.1			

Message: the following units have large residuals.

block 1 treatment 3	11.9	s.e.	4.9
block 1 treatment 3 *units* 2	32.3	s.e.	8.9
block 1 treatment 3 *units* 3	-23.7	s.e.	8.9
block 2 treatment 4 *units* 1	24.3	s.e.	8.9
block 2 treatment 4 *units* 3	-25.7	s.e.	8.9

Tables of means

Variate: Number_Large

Grand mean 8.5

treatment	1	2	3	4	5
	7.7	7.0	7.5	13.7	6.5

Standard errors of differences of means

Table	treatment
rep.	15
d.f.	16
s.e.d.	3.87

(Not adjusted for missing values)

Least significant differences of means (5% level)

Table	treatment
rep.	15
d.f.	16
l.s.d.	8.21

(Not adjusted for missing values)

Analysis of variance

Variate: Number_Medium

Source of variation	d.f.	(m.v.)	s.s.	m.s.	v.r.	F pr.
block stratum	4		23605.	5901.	2.11	
block.treatment stratum						
treatment	4		11378.	2844.	1.02	0.429
Residual	16		44820.	2801.	1.62	
block.treatment.*Units* stratum	49	(1)	84826.	1731.		
Total	73	(1)	163641.			

Message: the following units have large residuals.

block 4 treatment 2	57.0	s.e.	24.4
block 4 treatment 3	-54.4	s.e.	24.4
block 1 treatment 3 *units* 1	82.3	s.e.	33.6
block 3 treatment 4 *units* 1	85.7	s.e.	33.6
block 4 treatment 4 *units* 2	84.0	s.e.	33.6
block 4 treatment 4 *units* 3	-85.0	s.e.	33.6

Tables of means

Variate: Number_Medium

Grand mean 151.7

treatment	1	2	3	4	5
	148.4	150.9	133.3	171.8	154.1

Standard errors of differences of means

Table	treatment
rep.	15
d.f.	16
s.e.d.	19.33

(Not adjusted for missing values)

Least significant differences of means (5% level)

Table	treatment
rep.	15
d.f.	16
l.s.d.	40.97

(Not adjusted for missing values)

Analysis of variance

Variate: Number_Small

Source of variation	d.f.	(m.v.)	s.s.	m.s.	v.r.	F pr.
block stratum	4		160148.	40037.	11.14	
block.treatment stratum						
treatment	4		99285.	24821.	6.91	0.002
Residual	16		57509.	3594.	0.49	
block.treatment.*Units* stratum						
	47	(3)	345514.	7351.		
Total	71	(3)	658470.			

Message: the following units have large residuals.

block 5 treatment 2	67.6	s.e.	27.7
block 1 treatment 3 *units* 3	189.7	s.e.	67.9
block 5 treatment 1 *units* 3	-200.7	s.e.	67.9

Tables of means

Variate: Number_Small

Grand mean 182.9

treatment	1	2	3	4	5
	243.8	196.1	161.7	135.5	177.4

Standard errors of differences of means

Table	treatment
rep.	15
d.f.	16
s.e.d.	21.89

(Not adjusted for missing values)

Least significant differences of means (5% level)

Table	treatment
rep.	15
d.f.	16
l.s.d.	46.41

(Not adjusted for missing values)

Analysis of variance

Variate: Av_apple_wt

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
block stratum	4	0.0135026	0.0033757	17.85	
block.treatment stratum					
treatment	4	0.0026500	0.0006625	3.50	0.031
Residual	16	0.0030252	0.0001891	0.72	
block.treatment.*Units* stratum					
	50	0.0132052	0.0002641		
Total	74	0.0323830			

Message: the following units have large residuals.

block 4 treatment 1	-0.0141	s.e.	0.0064
block 1 treatment 3 *units* 3	-0.0321	s.e.	0.0133
block 1 treatment 4 *units* 3	0.0342	s.e.	0.0133
block 4 treatment 4 *units* 3	-0.0377	s.e.	0.0133

Tables of means

Variate: Av_apple_wt

Grand mean 0.0961

treatment	1	2	3	4	5
	0.0862	0.0980	0.0957	0.1048	0.0959

Standard errors of differences of means

Table	treatment
rep.	15
d.f.	16
s.e.d.	0.00502

Least significant differences of means (5% level)

Table	treatment
rep.	15
d.f.	16
l.s.d.	0.01064

Appendix 2 - Weather Data

DATE	TEMP_MAX	TEMP_MIN	RAINFALL
	°C	°C	mm
01/01/2012	12.8	3.9	8.8
02/01/2012	11.4	4.4	2.6
03/01/2012	12.3	5.2	8
04/01/2012	12.4	5.4	2.8
05/01/2012	10.7	3.8	0.2
06/01/2012	10.9	4.5	0
07/01/2012	10.3	7	0
08/01/2012	9.7	7.4	0
09/01/2012	12.1	8	0
10/01/2012	11.9	6	0
11/01/2012	12	6	0
12/01/2012	12.5	0.2	0.2
13/01/2012	6.3	-4.7	0
14/01/2012	7.6	-2.9	0.2
15/01/2012	6.6	-5.1	0.2
16/01/2012	7.6	-5.3	0
17/01/2012	7.5	-2.5	0.4
18/01/2012	11.6	7.5	1
19/01/2012	11.5	5.2	1.8
20/01/2012	11.8	7.3	0
21/01/2012	12.6	4.9	0
22/01/2012	12.3	4.9	0
23/01/2012	8	-0.3	0.4
24/01/2012	8.9	2.9	4.6
25/01/2012	9.5	6	2.6
26/01/2012	8.6	0.1	1.6
27/01/2012	9.2	-0.3	0
28/01/2012	5.7	0.9	0.4
29/01/2012	4.1	-0.9	0.2
30/01/2012	3.4	-0.2	0.2
31/01/2012	2.2	-0.2	0.4
01/02/2012	2.9	-0.8	0.2
02/02/2012	1.3	-1.9	0
03/02/2012	1.5	-2.5	0
04/02/2012	0	-1.8	0
05/02/2012	0.8	-1.5	2.8
06/02/2012	4.2	-1.8	5.6
07/02/2012	0.8	-2.9	0
08/02/2012	0.9	-1.1	0
09/02/2012	3.2	-1.3	0
10/02/2012	0.9	-10.1	0.2
11/02/2012	1	-8.9	0

12/02/2012	3.8	-3.1	0.6
13/02/2012	5.8	2.6	0.6
14/02/2012	7.8	4.4	0
15/02/2012	10.1	6.2	0
16/02/2012	10.1	5.7	0.2
17/02/2012	10.3	7.3	0
18/02/2012	10.9	1.8	2.2
19/02/2012	6	-5.4	0
20/02/2012	8	0.1	0
21/02/2012	11.4	5.1	0
22/02/2012	12.7	7	0.2
23/02/2012	18.2	7.2	0
24/02/2012	15.3	6.7	0
25/02/2012	12	1.6	0
26/02/2012	12.3	4.4	0.4
27/02/2012	10.5	7.2	0
28/02/2012	14.9	8.5	0
29/02/2012	14.6	2.8	0.2
01/03/2012	15.1	2.7	0
02/03/2012	8.9	5.5	0.4
03/03/2012	12.2	5.3	1
04/03/2012	8.7	3.4	8.4
05/03/2012	7.5	3.2	2.8
06/03/2012	8.5	2.5	0
07/03/2012	10.9	2.4	5
08/03/2012	12	3.6	0
09/03/2012	11.4	6.7	0
10/03/2012	15.3	7	0
11/03/2012	15.1	1.7	0.2
12/03/2012	11	6	0
13/03/2012	8.2	5.3	0
14/03/2012	12.6	-0.3	0
15/03/2012	17.8	4.4	0
16/03/2012	10.1	5.8	0.2
17/03/2012	11	3.3	3.2
18/03/2012	11.3	-0.1	0.2
19/03/2012	13.5	0.2	0
20/03/2012	15.1	4.7	0
21/03/2012	15.4	2.5	0
22/03/2012	15.8	3.9	0.2
23/03/2012	19.5	3.7	0
24/03/2012	17.2	3.5	0.2
25/03/2012	10.9	3.4	0
26/03/2012	17.1	1.7	0
27/03/2012	16.3	1.8	0
28/03/2012	20.2	1.7	0

29/03/2012	19.3	3.3	0
30/03/2012	16.9	3	0
31/03/2012	11.1	-0.9	0
01/04/2012	12.8	0	0
02/04/2012	15.9	1.9	0
03/04/2012	14	3.3	1.6
04/04/2012	11.3	6.1	0.2
05/04/2012	8.2	-1.8	0
06/04/2012	13.1	5.6	0
07/04/2012	9.7	1.1	0.2
08/04/2012	12.5	7.3	1
09/04/2012	10.5	5.6	4.4
10/04/2012	13.6	0.5	1
11/04/2012	11.5	0.9	7.6
12/04/2012	11.6	0.1	3.4
13/04/2012	13	2	0.2
14/04/2012	11.5	2.7	2
15/04/2012	9.8	-0.7	0.4
16/04/2012	9.9	2.2	0.4
17/04/2012	14.5	5.1	8
18/04/2012	9.9	6.4	7.6
19/04/2012	10.6	4.2	1.2
20/04/2012	13.9	4.7	1.6
21/04/2012	13.2	3.7	1
22/04/2012	14.7	5.1	0.6
23/04/2012	10.3	6.7	11.2
24/04/2012	11.7	5.2	8.8
25/04/2012	13.8	7.1	16.4
26/04/2012	14	8.9	0.2
27/04/2012	15.4	8.3	2.2
28/04/2012	9.6	6.6	19.6
29/04/2012	16	8.8	2.6
30/04/2012	18	10.8	10
01/05/2012	17.4	7.4	0
02/05/2012	13.2	8.2	3.8
03/05/2012	8.9	7.2	2
04/05/2012	10	5.8	0.4
05/05/2012	8.9	5	1.6
06/05/2012	11.3	3.6	0.2
07/05/2012	14.8	10	9
08/05/2012	16.8	10.5	1.6
09/05/2012	16.6	14	3.6
10/05/2012	17.8	11.6	3
11/05/2012	16.2	5.1	3
12/05/2012	14.8	1.8	3
13/05/2012	15.4	6.2	3

14/05/2012	13.3	4.6	3
15/05/2012	12.4	2.7	4.6
16/05/2012	13.8	5.7	0
17/05/2012	14.1	9	0
18/05/2012	16.3	10.9	0
19/05/2012	18.5	8.7	0
20/05/2012	15	9.1	0
21/05/2012	15.5	11.1	0
22/05/2012	23.5	13	0
23/05/2012	24.7	13	0
24/05/2012	23.4	14.4	0
25/05/2012	22.8	13.9	0
26/05/2012	22.8	10.7	0
27/05/2012	24.8	10.4	0
28/05/2012	26.2	14.1	0
29/05/2012	21.9	9.9	5
30/05/2012	24.3	11.9	5
31/05/2012	20.6	11.7	5
01/06/2012	20.2	11.6	5
02/06/2012	17.9	10.5	11.4
03/06/2012	13	7.4	8
04/06/2012	13.9	4.3	0.2
05/06/2012	15.8	11.2	6.4
06/06/2012	18.4	11.1	6
07/06/2012	18.3	12.3	9.8
08/06/2012	16.6	10.4	0
09/06/2012	18.3	7.5	0
10/06/2012	16.6	11.7	20.2
11/06/2012	15.5	10.3	16.6
12/06/2012	13.9	5.1	2.2
13/06/2012	17	4.3	0
14/06/2012	18.1	12	4
15/06/2012	18.6	11.9	0.2
16/06/2012	17.4	11.6	0.8
17/06/2012	18.8	11.3	1.8
18/06/2012	18.5	6.3	0
19/06/2012	20	7.8	0
20/06/2012	20.1	13.2	3.8
21/06/2012	20.6	11.1	0.6
22/06/2012	18.1	10.3	1.8
23/06/2012	18.4	11.5	7.4
24/06/2012	19.7	10.6	1
25/06/2012	21.6	11.3	0
26/06/2012	22.4	16.4	0
27/06/2012	22.9	15.6	0
28/06/2012	26.6	12.3	0

29/06/2012	20.1	14.8	0.6
30/06/2012	19.6	10.7	0
01/07/2012	18	10.3	2.4
02/07/2012	19	15.2	4.8
03/07/2012	18.4	15.7	4.4
04/07/2012	22.8	15	0
05/07/2012	22.1	13.9	0.8
06/07/2012	20.1	10	0.6
07/07/2012	18.7	13.5	21.6
08/07/2012	20.1	13.8	9.6
09/07/2012	18.1	12.5	0
10/07/2012	17.9	11.1	9.4
11/07/2012	19.1	9.6	23.2
12/07/2012	18.9	12.2	0.8
13/07/2012	19	12.8	5
14/07/2012	18.7	11.3	5.2
15/07/2012	19.4	11.5	7.4
16/07/2012	18.5	13.7	1
17/07/2012	22.9	14.2	0
18/07/2012	18.9	13.1	1.6
19/07/2012	20.2	10.4	0
20/07/2012	18.9	9.6	1
21/07/2012	20	8.8	0
22/07/2012	21.9	9.3	0
23/07/2012	25.7	11	0
24/07/2012	27.9	11.3	1.2
25/07/2012	28.9	13.6	0
26/07/2012	24.3	13.2	0
27/07/2012	24.7	13.6	0.2
28/07/2012	21.4	9.3	0
29/07/2012	19.9	8.3	1.4
30/07/2012	20	12.4	0.6
31/07/2012	21.1	11.8	0.2
01/08/2012	23.1	13.5	2.4
02/08/2012	20.9	10.9	0.2
03/08/2012	20.9	13.3	3
04/08/2012	20.8	11	0.2
05/08/2012	21.5	13.4	2.2
06/08/2012	21.9	10.7	5.2
07/08/2012	19.9	14.4	0
08/08/2012	23.3	11.1	0
09/08/2012	24.2	10.1	0
10/08/2012	25.3	10.2	0.2
11/08/2012	22.9	11	0
12/08/2012	25.4	13.4	0
13/08/2012	22.6	15.8	15.8

14/08/2012	24	13.5	0
15/08/2012	23.7	14.6	0.4
16/08/2012	21.9	16.5	0
17/08/2012	26.3	17.2	0
18/08/2012	30.2	15.6	0
19/08/2012	27.9	14.1	0
20/08/2012	24.5	13.7	0
21/08/2012	23.2	12.5	0.2
22/08/2012	21.8	11.1	0
23/08/2012	21.7	11.9	0
24/08/2012	21.1	15.3	3
25/08/2012	20.1	14.5	2.6
26/08/2012	21.5	8.4	0.2
27/08/2012	21.8	15.1	1
28/08/2012	21.9	11.3	0.2
29/08/2012	20.3	12.8	1.6
30/08/2012	18.4	7.7	0.8
31/08/2012	18.1	11.6	0
01/09/2012	19.2	11.3	0
02/09/2012	19.8	15.8	0
03/09/2012	24.2	10	0.2
04/09/2012	25.3	11.4	0
05/09/2012	19.8	4.7	0
06/09/2012	21.1	8.4	0.2
07/09/2012	25.8	6.6	0
08/09/2012	26.8	6.7	0.2
09/09/2012	27.8	15.7	0
10/09/2012	21.9	13.9	0.6
11/09/2012	18.7	5.6	0
12/09/2012	18.3	8.3	3.6
13/09/2012	18.3	11.7	0
14/09/2012	21.4	7.8	0
15/09/2012	21.4	10.7	0.2
16/09/2012	18	10.7	0
17/09/2012	19.4	10.7	0.2
18/09/2012	17.8	6.3	0
19/09/2012	16.9	5.7	0
20/09/2012	17.5	7.1	0
21/09/2012	16.2	5.3	0.2
22/09/2012	15.5	4.3	0
23/09/2012	15.8	10.2	30.8
24/09/2012	16.2	9	6.6
25/09/2012	15.3	10	11.4
26/09/2012	15.1	7.3	5.6
27/09/2012	16.8	6.4	0
28/09/2012	17.7	7.8	1

29/09/2012	16.2	2.7	0.2
30/09/2012	16.2	10.8	0.2
01/10/2012	16.5	7.5	4.4
02/10/2012	16.8	10.3	6.2
03/10/2012	15.6	5.6	0.2
04/10/2012	16.4	10.4	10.4
05/10/2012	16.4	7.4	18.8
06/10/2012	14.9	1.2	0.2
07/10/2012	15.7	7	1
08/10/2012	12.5	9.6	25.6
09/10/2012	13.7	5.2	0
10/10/2012	15.4	3.6	0
11/10/2012	15.2	10.2	3
12/10/2012	14.2	4.7	0.6
13/10/2012	13	0.4	0.4
14/10/2012	12.6	0.4	0.2
15/10/2012	14.9	6.6	1.6
16/10/2012	15.2	5.1	4.8
17/10/2012	16.8	12.2	1.4
18/10/2012	15.3	11.5	4.2
19/10/2012	16	10	6.8
20/10/2012	14.1	9.9	10.6
21/10/2012	14.2	11.1	1.4
22/10/2012	15.3	12.4	0.2
23/10/2012	14.5	12.2	0
24/10/2012	16.6	12.6	0
25/10/2012	13.8	8.3	0.6
26/10/2012	8.4	2.2	1.6
27/10/2012	6.8	-0.2	1.4
28/10/2012	8.9	4.1	1.4
29/10/2012	13.2	3.9	1.8
30/10/2012	10.9	3.4	0.4
31/10/2012	12.3	6.5	24.2
01/11/2012	10	2.2	1.8
02/11/2012	11.1	-0.6	1.4
03/11/2012	10.4	-0.8	7.6
04/11/2012	9.4	-0.5	3
05/11/2012	10	-0.6	0.2
06/11/2012	10.1	4.6	0
07/11/2012	11	5.9	0
08/11/2012	12.6	6.7	0
09/11/2012	12.7	6.4	2.4
10/11/2012	9.6	-1	1.2
11/11/2012	10.6	1.3	0.2
12/11/2012	12.2	5.3	2.2
13/11/2012	16	8.3	0.2

14/11/2012	13.6	3.1	0.2
15/11/2012	10.3	5.7	0
16/11/2012	12.4	6.5	0
17/11/2012	13.8	0.3	0.6
18/11/2012	10.3	-2.2	0
19/11/2012	11.9	8.3	0.6
20/11/2012	12.9	8.9	1.6
21/11/2012	11.7	4.3	2.4
22/11/2012	13.5	5.3	8.4
23/11/2012	10.9	0.2	0.2
24/11/2012	13	3.1	7.6
25/11/2012	12.3	7.9	6.4
26/11/2012	9.8	6.7	4.2
27/11/2012	8.5	5	2.6
28/11/2012	6.7	2.5	0
29/11/2012	5.9	-3	0
30/11/2012	5.8	-3.9	0.2
01/12/2012	6.6	-0.7	0.2
02/12/2012	9.6	-1.5	5
05/12/2012	3	-4.3	0.2
06/12/2012	6.1	-2	11.8
07/12/2012	6.3	2.6	1
08/12/2012	7.3	1.7	0.2
09/12/2012	9	2.8	0
10/12/2012	5.7	-1.5	0.2
11/12/2012	3.6	-6.6	0
12/12/2012	2.4	-4.8	0.2
13/12/2012	6.7	-3.6	0.4
14/12/2012	11.4	6.5	12.6
15/12/2012	10.5	2.8	1
16/12/2012	10.2	3.3	2.2
17/12/2012	9.6	2.8	0
18/12/2012	8	-1.1	0.2
19/12/2012	8.4	5.9	12.6
20/12/2012	10.1	6	3.2
21/12/2012	10.1	3.3	10.6
22/12/2012	13	7.8	7
23/12/2012	12.1	7.1	3.2
24/12/2012	12.5	6.9	12.8
25/12/2012	9.7	2.7	2.6
26/12/2012	10.4	4.4	6.2
27/12/2012	8.6	4.6	4.6
28/12/2012	12.1	8.4	1.2
29/12/2012	11.5	4.5	2.6
30/12/2012	11	6.1	0.2
31/12/2012	11.7	4.3	5.2

Appendix 3 - Fruit Number

treatment	block	Tree	<55mm number of fruit	55-60mm number of fruit	60-65mm number of fruit	65-70mm number of fruit	70-75mm number of fruit	75-80mm number of fruit	total number of fruit
1	1	18	104	154	135	28			421
1	1	19	45	102	158	79	8		392
1	1	20	82	153	165	41			441
1	2	23	24	62	93	81	21		281
1	2	24		207	95	13			315
1	2	25	314	9	101	38	2		464
1	3	8	123	147	112	10			392
1	3	9	84	126	109	22			341
1	3	10	131	116	114	19	7	2	389
1	4	3	96	96	98	28	4		322
1	4	4	140	86	95	20	1		342
1	4	5	218	157	51				426
1	5	23	198	243	74	9			524
1	5	24	162	187	149	14	1		513
1	5	25	24	70	137	69	12	2	314
2	1	23	91	81	113	31	2		318
2	1	24	85	120	144	37			386
2	1	25	48	113	156	71	7		395
2	2	8	42	96	131	65	8		342
2	2	9	19	32	74	93	25	2	245
2	2	10	83	102	118	58	5		366
2	3	3	82	127	103	22	5		339
2	3	4	102	117	76	17			312
2	3	5	17	50	50	72	14		203
2	4	18	79	39	68	76	14	1	277
2	4	20	107	109	146	34			396
2	4	21	34	101	160	66	14		375
2	5	3	193	193	94	11			491
2	5	4	107	130	111	19	3		370
2	5	5	310	133	47	1			491
3	1	8	19	65	140	110	14	1	349
3	1	9	2	11	45	73	48	8	187

3	1	10	119	214	114	21			468
3	2	3	208		127	36	1		372
3	2	4	133	159	109	25			426
3	2	5	76	10	110	55	19		270
3	3	13	59	88	147	33	3		330
3	3	14	43	88	131	35	3		300
3	3	15	67	80	94	35	5		281
3	4	13	56	66	62	13			197
3	4	14	31	46	36	12			125
3	4	15	95	55	35	5			190
3	5	18	183	130	108	19			440
3	5	19	30	94	110	48	10		292
3	5	20	107	110	89	23			329
4	1	3	16	63	117	109	26		331
4	1	4	80	135	108	41	3		367
4	1	5	10	22	18	147	34	2	233
4	2	13	50		85	125	48	2	310
4	2	14	19	47	100	91	26	1	284
4	2	15	56	126	125	49			356
4	3	23	63	89	187	67	4		410
4	3	24	64	101	119	27			311
4	3	25	11	11	51	54	30	1	158
4	4	8	47	77	101	51	2		278
4	4	9	33	69	152	83	24		361
4	4	10	23	45	43	23	3		137
4	5	13	83	162	143	27			415
4	5	14	87	162	127	45			421
4	5	15	134	73	150	12			369
5	1	13	99	118	69	12			298
5	1	14	35	86	129	76	14		340
5	1	15	74	89	109	37	4		313
5	2	18	93	115	133	56	7		404
5	2	19	92	85	102	27	1		307
5	2	20	79	107	152	58	5		401
5	3	18	89	72	99	27	3		290
5	3	20	148	105	120	51	3		427
5	3	21	11	34	81	76	22	2	226
5	4	23	23	74	75	67	15		254

5	4	24	54	71	97	37	3	1	263
5	4	25	61	35	73	30	12		211
5	5	8	166	153	114	13			446
5	5	9	79	129	146	51	3		408
5	5	10	87	198	158	37	3		483

Appendix 4 - Fruit Weight

treatment	block	Tree	<55mm number of fruit	55-60mm number of fruit	60-65mm number of fruit	65-70mm number of fruit	70-75mm number of fruit	75-80mm number of fruit	total number of fruit
1	1	18	104	154	135	28			421
1	1	19	45	102	158	79	8		392
1	1	20	82	153	165	41			441
1	2	23	24	62	93	81	21		281
1	2	24		207	95	13			315
1	2	25	314	9	101	38	2		464
1	3	8	123	147	112	10			392
1	3	9	84	126	109	22			341
1	3	10	131	116	114	19	7	2	389
1	4	3	96	96	98	28	4		322
1	4	4	140	86	95	20	1		342
1	4	5	218	157	51				426
1	5	23	198	243	74	9			524
1	5	24	162	187	149	14	1		513
1	5	25	24	70	137	69	12	2	314
2	1	23	91	81	113	31	2		318
2	1	24	85	120	144	37			386
2	1	25	48	113	156	71	7		395
2	2	8	42	96	131	65	8		342
2	2	9	19	32	74	93	25	2	245
2	2	10	83	102	118	58	5		366
2	3	3	82	127	103	22	5		339
2	3	4	102	117	76	17			312
2	3	5	17	50	50	72	14		203
2	4	18	79	39	68	76	14	1	277
2	4	20	107	109	146	34			396
2	4	21	34	101	160	66	14		375
2	5	3	193	193	94	11			491
2	5	4	107	130	111	19	3		370
2	5	5	310	133	47	1			491
3	1	8	19	65	140	110	14	1	349
3	1	9	2	11	45	73	48	8	187
3	1	10	119	214	114	21			468

3	2	3	208		127	36	1		372
3	2	4	133	159	109	25			426
3	2	5	76	10	110	55	19		270
3	3	13	59	88	147	33	3		330
3	3	14	43	88	131	35	3		300
3	3	15	67	80	94	35	5		281
3	4	13	56	66	62	13			197
3	4	14	31	46	36	12			125
3	4	15	95	55	35	5			190
3	5	18	183	130	108	19			440
3	5	19	30	94	110	48	10		292
3	5	20	107	110	89	23			329
4	1	3	16	63	117	109	26		331
4	1	4	80	135	108	41	3		367
4	1	5	10	22	18	147	34	2	233
4	2	13	50		85	125	48	2	310
4	2	14	19	47	100	91	26	1	284
4	2	15	56	126	125	49			356
4	3	23	63	89	187	67	4		410
4	3	24	64	101	119	27			311
4	3	25	11	11	51	54	30	1	158
4	4	8	47	77	101	51	2		278
4	4	9	33	69	152	83	24		361
4	4	10	23	45	43	23	3		137
4	5	13	83	162	143	27			415
4	5	14	87	162	127	45			421
4	5	15	134	73	150	12			369
5	1	13	99	118	69	12			298
5	1	14	35	86	129	76	14		340
5	1	15	74	89	109	37	4		313
5	2	18	93	115	133	56	7		404
5	2	19	92	85	102	27	1		307
5	2	20	79	107	152	58	5		401
5	3	18	89	72	99	27	3		290
5	3	20	148	105	120	51	3		427
5	3	21	11	34	81	76	22	2	226
5	4	23	23	74	75	67	15		254
5	4	24	54	71	97	37	3	1	263

5	4	25	61	35	73	30	12	211
5	5	8	166	153	114	13		446
5	5	9	79	129	146	51	3	408
5	5	10	87	198	158	37	3	483