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Research

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Onion thrips populations: effects of post-top fall to harvest treatments Milestone 3 (part), project 2.1

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1 Executive summary

The effects of four combinations of lifting and topping treatments on the distribution and numbers of onion thrips in bulbs at harvest were studied in a small plot trial at Pukekohe Research Centre, South Auckland. Onions grown for a Vegfed lettuce trial and government (FRST) funded trial were used in this project. Two replicates of each treatment in the lettuce block had high numbers of thrips prior to top fall while the two replicates in the FRST trial had lower populations prior to top fall. The plots were one bed wide and 15 m long.

The treatments were:

- minimal exposure of base plate (onions with roots and top uncut) until harvest,
- lifted at top fall when leaves were green, tops left intact,
- lifted at top fall when leaves were green, tops cut off,
- lifted when tops 50% dry, tops left intact,
- lifted when tops 50% dry, tops cut off.

The populations of thrips in all treatments declined from about 200 thrips per plant at top fall to 0.1 thrips per bulb at harvest, and to 0.03 thrips per bulb after five weeks storage.

At top fall most thrips were on the leaves. Thrips numbers declined substantially within two days of lifting the plants. The thrips on the leaves were mostly larvae. Some may have left the plant to pupate, but it appears that the quality of leaf material was not suitable to support larval thrips.

On lifted plants at top fall, thrips were found at the root bases and in the bulbs, but most thrips were in the neck of plants or associated with split skins on the bulbs.

At 50% dry, no thrips were found on leaves. A few thrips were found at all other sites. There were no statistically significant differences between treatments in the total numbers of thrips per bulb.

The numbers of thrips per bulb were too low to detect any differences between treatments at harvest.

2 Introduction

Earlier research and observations on onion thrips found no clear link between thrips populations before top fall, post top fall treatments and subsequent infestation of, and damage to, onion bulbs by thrips. Thrips were observed to leave crops that had high numbers of thrips prior to top fall. There was some uncertainty about the parts of the onion plants the thrips were inhabiting at top fall and how this affected their ability to infest bulbs at harvest. There were also questions about the effects of the mode of topping (leaf removal), the length of neck and the timing of lifting and topping on the process of bulb infestation. An experiment was designed across areas of both high and low thrips populations on onions to compare the effect of topping and the timing of topping and lifting on the numbers and distribution of thrips in the bulbs at harvest.

The same areas of onion plants were used for the experiment to compare pre-top fall thrips populations, project 1.2.1 (milestone 1).

Methods

Onions grown at Pukekohe Research Centre for two other trials were used for this project. The two areas of onions were near each other in Ranges 12 (FRST onion bulb trial) and 14 (Vegfed onion thrips lettuce trial). The planting dates and treatments of the two lots of onions were identical (Appendix I), except that the Range 12 onions had four chlorpyrifos sprays in December and January to hold the thrips populations at a low level in that crop.

There were five treatments to compare the effect of time of topping and lifting:

- minimal exposure of base plate (onions with roots and top uncut) until harvest,
- lifted at top fall when leaves were green, tops left intact,
- lifted at top fall when leaves were green, tops cut off,
- lifted when tops 50% dry, tops left intact,
- lifted when tops 50% dry, tops cut off.

The treatments were replicated four times with two replicates in the onions with high thrips populations (lettuce blocks 1 and 3) and two replicates in onions with low thrips populations grown for bulbs in Range 12. The plots were 15 m long and one bed (five rows) wide. The green treatments were imposed on 30 January 2001 and all treatments were assessed on 1 February. The 50% dry treatments were imposed on 7 February and all treatments were harvested on

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27 February and put into sacks and stored in a shed at ambient temperature.

The tops (onion leaves) were removed with scissors to leave a long neck on each bulb. The cut bulbs were placed on or close to the cut tops.

The pre-harvest assessments were done in the field. Five plants/bulbs were randomly selected from each plot. The numbers and stages of thrips were recorded on each plant at the following locations: base of bulb, around split skins on bulb, leaves, in neck, in the bulb.

At harvest (27 February) and after storage for five weeks (2 April), 20 bulbs per plot were randomly selected, put in paper bags and examined in the laboratory. The number and stages of thrips were recorded on each bulb at the base of the onion, associated with split skins, under the dead skins and on the first live scale, and between each pair of live scales, until there was no connection from the space between the scales with the neck and to the outside of the bulb.

The data from the pre-harvest samples were summarised on a spreadsheet (Appendix II) and analysed using analysis of variance (ANOVA) to compare treatments and infested sites (Appendix III). The data were transformed using the square root transformation before ANOVA could be performed. Friedman's non-parametric test was used to compare treatments for some counts where ANOVA could not be used because its statistical assumptions were violated.

Results and discussion

4.1 Treatments applied at top-fall (green top)

There were significantly more thrips on the three treatments where the plants were still rooted than on the two treatments lifted when the tops were green (green lifted and green lifted and topped) (Fig. 1). On treatments where leaves were present, most of the thrips were larvae.

On all treatments most adults and larvae were on the leaves. The neck region had more total thrips than areas of split skins (Fig. 2), although in 50% topped and control plots there were more adult thrips associated with split skins than in the neck of plants.

Thrips were only associated with the bases of the onions and in the bulbs in the two treatments lifted when green. Adults, larvae and pupal thrips were found at the base of these onions.

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Figure 1: Mean numbers of thrips on onion plants on 1 February, two days after the 'green' treatments.



Figure 2: Mean numbers of thrips (larvae and adults) on different parts of onion plants two days after the 'green' treatments.

4.2 Treatments applied when leaves 50% dry

When the unlifted plants had leaves 50% dry, the populations of thrips in all treatments had declined substantially and there were no statistically significant differences between the numbers of thrips in each treatment (Fig. 3). There were similar numbers of adult and larval thrips.

On 8 February statistically significant differences in the numbers of thrips occurred on different positions on the onion plant/bulb. There were more thrips in the 'split' and 'neck' than in the other positions. The same was true for adult thrips, but most thrips larvae were in the 'neck'. There were no statistically significant differences among larval counts in the 'split', 'bulb' and 'base' positions, but within the control treatment there were more larval thrips in splits than in onion bulbs.



Figure 3: Mean numbers of thrips on onion plants on 8 February, 1 day after the 50% dry treatments.

4.3 Thrips populations at harvest and after storage

The raw data are summarised in Appendix II. Only 8% of bulbs were infested at harvest and less than 2.5% were infested after five weeks storage, with about 0.1 and 0.03 thrips per bulb respectively (Table 1). This is about 1.3 thrips per infested bulb. Adults and larvae were present on both occasions.

The numbers of thrips were too low for statistically significant differences between treatments to be detected.

Table 1: Mean proportion of onion bulbs infested with onion thrips and mean numbers of thrips per onion at harvest (27 February 2001) and after five weeks storage at ambient temperature (2 April 2001). Numbers of bulbs examined per treatment 80 (27 Feb), 100 (2 April).

	Mean pr infested bu	oportion of Ilbs out of 80	Mean propor bulb	tion of thrips per out of 80
Treatment	27 Feb	2 April	27 Feb	2 April
Green, lifted	0.05	0.05	0.087	0.08
Green topped	0.125	0.01	0.15	0.01
50% dry lifted	0.05	0.04	0.075	0.05
50% dry topped	0.113	0.01	0.138	0.01
Control	0.75	0.01	0.075	0.01
All treatments	0.083	0.024	0.105	0.032

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4.4 Overall trends

The overall trend in thrips populations was for numbers to decline rapidly from top fall to harvest and to continue declining during storage (Fig. 4).

Most of the thrips present at top fall were larvae. When the quality of onion leaves declines, through natural senescence or by uprooting the plants, the numbers of larvae drops rapidly. Some of this decline may be due to larvae pupating and becoming adults that migrate from the crop. However, the rapid decline during two days after green plants were lifted, suggests that some larvae walk off the plants or die when the foliage is not of good quality.

Once the base of onions dried, adult or juvenile thrips were no longer found there, even though there were apparently suitable refuges. Many dead thrips were found close to the base of the neck between the dried skins and between the live scales. The thrips appear to have been crushed when the skins tightened as they dried.



Figure 4: Mean number of thrips per onion plant/bulb from mid December to early April. This graph is the mean of all treatments and the numbers of thrips on untreated plants, i.e. at and before top fall is higher.

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5 General discussion and conclusions

While there is evidence that thrips breed on onions and can be found wherever they have access to live onion tissue, Pukekohe Long Keeper onion bulbs do not appear to be suitable for the multiplication of onion thrips. As soon as leaves were no longer of suitable quality, thrips populations declined rapidly. At 50% dry, the neck of each bulb and splits were the places of highest infestation. Both sites tend to become less suitable for onion thrips. As the scale underlying a split dries up it forms a dead skin, which no longer supports the thrips. The neck also appears to become unsuitable for thrips. Thrips need to progress through the neck to the live scale. The spaces between leaves in the neck often contain free moisture which makes movement through it difficult for thrips. When thrips reach the base of the neck, they appear to be able to breed, but the amount of feeding damage was slight and many thrips appear to have been crushed between the shrinking scale and skins.

The overall decline of thrips populations from top fall to harvest was more important than reductions in thrips populations associated with any of the lifting or topping treatments.

Acknowledgements

We thank Richard Wood for providing advice on the growing of the onions, Barry Childs for managing the crops and spraying, Lydia Huggard and Jan Elliot for technical assistance, and John Koolaard for biometric analysis of the pre harvest data.

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Appendices

Appendix I Onion thrips trials: site management diary

2.5 t /ha 15% super incorporated before sowing

26/7 sow onions (Pukekohe long keeper)

27/7 spray :	stomp @	1.5L/ha
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diazinon @ 1.5L/ha

roundup @ 4L/ha

25/8 urea @ 100kg/ha

28/9, 10/10, 13/10, 20/10

Totril @ 300ml/ha

- Tribunal @ 300 g/ha
- 15/10 urea @ 100kg/ha
- 17/10, 25/10 Manzate @ 2.5kg/ha
- 27/10 Frontier @ 1.5L/ha
- 2/11 Manzate @ 2.5kg/ha
- 10/11, 17/11 Ridomil @ 2.5kg/ha manzate @ 1.5kg/ha
 - Methamidophos @ 160 ml/100 l @ 500 l/ha
- 20/11 C.A.N. 200kg/ha
- 27/11 Acrobat @ 2.5kg/ha

Methamidophos @ 160 ml/100 l @ 500 l/ha

- 5/12, 14/12 Acrobat @ 2.5kg/ha Manzate @ 1kg/ha
 - Methamidophos @ 160 ml/100 l @ 500 l/ha
- 8/12, 12/12 Totril @ 400ml/ha

Tribunal @ 400ml/ha

23/12 , 29/12 Manzate @ 2.5kg/ha

chlorpyrifos (Lorsban 50% @ 160 ml/100l @ 500 l/ha (Range 12 only)

4/1 , 13/1 Acrobat @ 2.5kg/ha

chlorpyrifos (Lorsban 50% @ 160 ml/100l @ 500 l/ha (Range 12 only)

23/1 Manzate @ 2.5kg/ha

Appendix II Raw data

Thrips populations on onions at top fall 1.

Onion small plot trial	topfall to harvest	
Pukekohe 2001		
30-Jan-01 date treated	plants at green topfall lifted and topped	ł
1-Feb-01 date sampled	plants sampled 5	

mean thrips per plant Summary of treatments

	Thrip	os st	ages	on dif	ferent	parts of p	lant									total	thrips	5
	onio	n bas	se	split s	skin o	n bulb		leave	s	necl	٢		In bu	lb		per	plant/	bulb
	a		total	a	I	total	а]	total	a	1	total	a	1	total	a	<u> </u>	
Gt	1	0.6	1.55	1.4	3.6	5	0	0	0	5.9	13.2	19	0.2	0.3	0.5	8.4	17.7	
GI	2.3	1.6	3.9	1.4	8.4	9.75	1.6	32.3	33.9	3.8	24.5	28	0.3	1.3	1.5	9.3	68	77.3
50%t	0	0	C	4.7	6	10.65	17	173	190	4.6	32.5	37	0	0	0 0	26	212	237
50%	0	0	C	3.5	8.8	12.2	13	177	190	4.6	24.3	29	0	0	0 0	21	210	231
control	0	0	C	2.6	5.9	8.5	7.5	147	154	1.6	16.3	18	0	0.1	0.05	12	169	180

reps 1-2

reps 3-4

high thrips

low thrips

summary of	of plot	t d	ata	by tre	eatme	nt	Green top	pec	i and li	fted									
	Thr	ips	s sta	ages	on diff	erent	parts of p	lant									total	thrips	;
Rep	oni	on	bas	se	split s	kin or	n bulb		leave	s	neck	2		<u>In bu</u>	lb		per	plant/	bulb
•	a	I		total	a	I	total	a	1	total	a	l	total	a		total	a		
	1 0.	2	0	0.2	0.6	5	5.6				6.2	22	28	0	0	0	7	27	34
	2	1	2	3	3.2	8	11.2				6.2	10.6	17	0.2	0.2	0.4	11	20.8	31.4
	3 0.	4	0	0.4	1.2	0.2	1.4	1			8.4	10	18	0	0	0	10	10.2	20.2
	4 2.	2	0.4	2.6	0.6	1.2	1.8				2.6	10	13	0.6	1	1.6	6	12.6	18.6

summary of plot data by treatment Green lifted f nlont

Summary of	Thrips stages on different parts of plant total thrips																	
	Thrip	os sta	ages	on difl	erent	parts of p	lant									total	thrips	
Rep	onior	n bas	se	split s	kin ol	n bulb		leave	s	necl	٢		ln bu	lb		per	plant/	bulb
•	a	1	total	a	1	total	А	1	total	a	1	total	a	l	total	a		
1	2.2	4	6.2	2.4	28	30.4	5.4	110	115	2.8	62	65	0.2	2	2.2	13	206	219
2	4.4	2	6.4	1.4	4	5.4	1	19	20	1.2	16	17	0.2	2	2.2	8.2	43	51.2
3	0.4	0	0.4	1.2	0.2	1.4	0	0	0	8.4	10	18	0	0	0	10	10.2	20.2
	2.2	0.4	2.6	0.6	1.2	1.8	0	0	0	2.6	10	13	0.6	1	1.6	6	12.6	18.6

50 % dry topped and lifted summary of plot data by treatment

	•	Thri	ps st	ages	on	ı diff	erent	i parts	s of p	olant										total	thrips	i
Rep		onic	, n ba	se	sŗ	olit sl	kin o	n bulb)		leave	S	nec	k _		<u>In b</u>	ulb			per	plant/	bulb
	!	a	T	total	a	1	·	total		Α	[total	a		tota	la	1	to	otal	a		L
	1	(<u>, c</u>	<u>)</u> (3.2	2	<u>.</u>	5.2	15	256	271	3	5	25	5	0	0	0	22	310	332
	2	C	<u> </u>	<u> </u>	Ŧ	5.4	8	;	13.4	9.8	152	162	7	<u> </u>	0 4	7	0	0	0	22	200	222
	3	C	j C) (丅	5	7	,	12	20	142	162	4.2	2 1 9	92	3	0	0	Ō	30	168	198
	4	(() C	<u> </u>	٦t	5	7	,	12	20	142	162	4.2	2 1	9 2	3	0	0	0	30	168	198

summary of plot data by treatment	50% dry lifted
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summary of	Thring stages on different parts of plant total thrins																	
	Thri	ps st	ages	on dif	ferent	parts of p	lant									total	thrips	
Rep	onic	n ba	se	split s	skin o	n bulb		leave	s	necl	٢		In bu	lb		per	plant/l	bulb
•	a	1	total	a	1	total	А	l	total	a	I	total	a		total	a		
1			(2.8	11	13.8	2	142	144	0.8	32	33	0	0	0	5.6	185	191
2	2 (2.8	7	9.8	15	230	245	2.4	20	22	0	0	0	20	257	277
3	3 0		(5.4	7	12.4	24	202	226	10	34	44	0	0	0	40	243	283
4) () (2.8	10	12.8	12	134	146	4.8	11	16	0	0	0	20	155	175

summary of	Thrips stages on different parts of plant total thrips																	
	Thri	os sta	ages	on diff	erent	parts of p	lant									iolai	umps	
Rep	onio	n bas	se	split s	kin or	n bulb		leave	s	neck	٢		In bu	lb		per	plant/	bulb
· · · •	a	1	total	a	1	total	а	I	total	a		total	a	1	total	a	1	
1	0	0	C	1.6	3.6	5.2	4.6	122	127	1.6	12	14	0	0	0	7.8	138	145
2		Ō	C	2.6	8	10.6	9.2	196	205	0.8	13	14	0	0	0	13	217	230
		0	C	2.4	4	6.4	6.2	170	176	1.4	17	18	0	0	0	10	191	201
		0	C	3.8	8	11.8	9.8	98	108	2.4	23	25	0	0.2	0.2	16	129	145

summary of plot data by treatment control, lifted and topped at harvest

2. Onion thrips populations when tops were 50% dry

Onion small plot trial	topfall to harvest	reps 1-2	high thrips
Pukekohe 2001		reps 3-4	low thrips
7-Feb-01 date treated	plants at 50% dry lifted and topped		
8-Feb-01 date sampled	plants sampled 5		

Summary of treatments mean thrips per plant

Cummary						- F - · F ·												
	Thri	os st	ages o	on diffe	erent	parts of	plant									total	thrips	
	onio	n ba	se	split s	skin o	n bulb		leave	s	necl	<		In bu	lb		per	plant/t	oulb
	a	1	total	a	1	total	а	1	total	a	Į	total	a	l	total	a		total
Gt	0.1	0.1	0.1	0.5	0.1	0.6	0	0	0	0.6	0.15	0.8	0.1	0.1	0.15	1.3	0.35	1.6
GI	0.1	C	0.05	0.6	0.1	0.65	0	0	0	0.1	0.35	0.5	0.1	0.2	0.25	0.8	0.6	1.4
50%t	0.1	C	0.1	0.5	0.2	0.65	0	0	0	0.5	1.05	1.6	0	0.1	0.1	1.1	1.35	2.4
50%	0.1	0.2	0.25	0.2	0.4	0.55	0	0	0	0.1	0.7	0.8	0.2	0.5	0.6	0.6	1.65	2.2
control	0.1	0.1	0.1	0.2	0.4	0.55	0	0	0	0.4	0.35	0.7	0.2	0.1	0.3	0.8	0.85	1.65

summary	of	plot c	lata	by trea	atmen	t	Green	toppe	ed and	d lifted									
·		Thrip	os sta	ages o	n diffe	erent	parts of	plan	t								total	thrips	
Rep		onior	n bas	se	split s	skin o	n bulb	_	leave	es	neck	(ln bu	lb		per	plant/l	oulb
·		a		total	a	1	total	а	1	total	a	1	total	a	[total	a	<u> </u>	total
	1	0.2	0	0.2	0	0	0				0.4	0	0.4	0	0	0	0.6	0	0.6
	2	0	0.2	0.2	0.4	0	0.4				1.6	0	1.6	0	0	0	2	0.2	2.2
	3	0	0	0	0.4	0.4	0.8				0.2	0	0.2	0.4	0.2	0.6	1	0.6	1.6
	4	0	0	0	1.2	0	1.2				0.2	0.6	0.8	0	0	0	1.4	0.6	2

summary	of p	plot	data	by tre	atmen	it	Green	lifted											
•		Thri	ps st	ages o	on diffe	erent	parts of	plan	t								tota	thrips	
Rep		onio	n ba	se	split s	skin o	n bulb		leave	s	necł	<u>ر</u>		In bu	lb		per	plant/b	ouib
	ſ	a	1	total	a	1	total	a	1	total	a	1	total	a	1	total	a	1	total
	1	0.2		0.2	0.2	0	0.2		0 0	0	0	0	0	0	0.4	0.4	0.4	0.4	0.8
	2	0	C		0.4	0	0.4	. () 0	0	0	0.8	0.8	0	0	0	0.4	0.8	1.2
	3	0	C) (0.4	0.4	0.8	0	0 0	0	0.2	0	0.2	0.4	0.2	0.6	1	0.6	1.6
	4	0	0) (1.2	0	1.2		0 0	0	0.2	0.6	0.8	0	0	0	1.4	0.6	2

summary of plot data by treatment 50 % dry topped and lifted

		Thrip	os sta	iges c	on diffe	erent	parts of	plar	nt								total	thrips	
Rep		onio	n bas	e	split s	kin o	n bulb		leave	es	nec	k		In bi	ulb		per	plant/t	bulb
•	1	a		total	a	I	total	a	1	total	a_	1	total	a	1	total	a	1	total
	1	0.2	0	0.2	0.4	0.4	0.8				0.4	<u> </u>	0.4	0	0	0	1	0.4	1.4
	2	0.2	0	0.2	0.2	0.4	0.6				1.2	1.8	3	0	0.4	0.4	1.6	2.6	4.2
	3	0	0	0	0.6	0	0.6				0.2	1.2	1.4	0	0	0	0.8	1.2	2
	4	0	0	0	0.6	0	0.6				0.2	1.2	1.4	0	0	0	0.8	1.2	2

summary of plot data by treatment 50% dry lifted Thrins stages on different parts of plant

·· J																				
TI	hrips	stage	es on dif	ferent	parts	of plar	nt										total	thrips	S	
or	nion	base		split sl	kin on	bulb			leav	/es	neck			In b	ulb		per	plant/	bulb	
a		1	total	a	1	total		a	I	total	a	Ι	total	a	۱	total	a	I	total	
F	0	0	0	0.2	0		0.2	0	0	0	0.2	0	0.2	0	0	0	0.4	0	0.4	
	0.2	0	0.2	0	0		0	0	0	0	0	0	0	0	0	0	0.2	0	0.2	
	0.2	0.4	0.6	0.2	0.8		1	0	0	0	0	0.8	0.8	0	0.4	0.4	0.4	2.4	2.8	
	0	0.2	0.2	0.4	0.6		1	0	0	0	0.2	2	2.2	0.6	1.4	2	1.2	4.2	5.4	
		Thrips onion a 0.2 0.2 0.2	Thrips stage onion base a 0 0 0.2 0 0.2 0.4 0 0.2	Thrips stages on dif onion base a I 0 0 0.2 0.2 0.2 0.4 0 0.2 0.2 0.2	Thrips stages on different onion base split si a I total a 0 0 0.2 0.2 0.2 0.4 0.6 0.2 0 0.2 0.4 0.4	Thrips stages on different parts onion base split skin on a I total a I 0 0 0.2 0 0.2 0.2 0 0 0.2 0.4 0.6 0.2 0.8 0 0.2 0.2 0.4 0.6	Thrips stages on different parts of planonion basesplit skin on bulbaItotalaItotal000.2000.200.2000.20.40.60.20.800.20.20.40.6	Thrips stages on different parts of plant onion base split skin on bulb a I total a I total 0 0 0.2 0 0.2 0 0.2 0.2 0.4 0.6 0.2 0.8 1 0 0.2 0.2 0.4 0.6 1	Thrips stages on different parts of plant onion base split skin on bulb a total a total a 0 0 0.2 0 0.2 0 0.2 0 0.2 0 0 0 0 0.2 0.4 0.6 0.2 0.8 1 0 0 0.2 0.2 0.4 0.6 1 0	Thrips stages on different parts of plant onion base split skin on bulb leav a I total a I total a I 0 0 0.2 0 0.2 0 0 0 0.2 0 0.2 0 0 0 0 0 0.2 0.4 0.6 0.2 0.8 1 0 0 0 0.2 0.2 0.4 0.6 1 0 0	Thrips stages on different parts of plant onion base split skin on bulb leaves a I total a I total 0 0 0.2 0 0.2 0 0 0.2 0 0.2 0 0 0 0 0 0.2 0.4 0.6 0.2 0.8 1 0 0 0 0 0.2 0.2 0.4 0.6 1 0 0 0	Thrips stages on different parts of plant onion base split skin on bulb leaves neck a I total a I total a I total a 0 0 0.2 0 0.2 0 0 0.2 0.2 0 0.2 0 0 0 0 0 0.2 0.4 0.6 0.2 0.8 1 0 0 0 0 0.2 0.2 0.4 0.6 1 0 0 0	Thrips stages on different parts of plant onion base split skin on bulb leaves neck a I total a I total a I 0 0 0.2 0 0.2 0 0 0.2 0 0.2 0 0.2 0 0 0 0 0 0 0 0.2 0.4 0.6 0.2 0.8 1 0 0 0 0.8 0 0.2 0.2 0.4 0.6 1 0 0 0.2 2	Thrips stages on different parts of plant onion base split skin on bulb leaves neck a I total a I total a I total 0 0 0.2 0 0.2 0 0 0.2 0 0.2 0.2 0 0.2 0 0 0 0 0 0 0.2 0.4 0.6 0.2 0.8 1 0 0 0.8 0.8 0 0.2 0.4 0.6 1 0 0 0.2 2 2.2	Thrips stages on different parts of plant onion base split skin on bulb leaves neck In boll a I total a <thtoa< th=""> a I a<</thtoa<>	Thrips stages on different parts of plant onion base split skin on bulb leaves neck In bulb a I total a <thtoa< th=""> a a a<</thtoa<>	Thrips stages on different parts of plant onion base split skin on bulb leaves neck In bulb a I total a <thtoa< th=""> a a a<</thtoa<>	total total total total total a a total a total a total total a total a total total <th colsp<="" td=""><td>Thrips stages on different parts of plant total thrips onion base split skin on bulb leaves total thrips a I total a I a I</td></th>	<td>Thrips stages on different parts of plant total thrips onion base split skin on bulb leaves total thrips a I total a I a I</td>	Thrips stages on different parts of plant total thrips onion base split skin on bulb leaves total thrips a I total a I a I

control, lifted and topped at harvest summary of plot data by treatment

	Т	hrips	s stage	es on dif	iferent	parts	of plant										total	thrips	5
Rep	о	nion	base		split s	kin on	bulb		leav	/es	neck		-	In b	ulb		per	plant/	bulb
	a		1	total	a	1	total	a	1	total	а	I	total	a	I	total	a	I	total
	1	0	0	C	0.4	0	0.4	0	0	0	0.2	0.2	0.4	0	0	0	0.6	0.2	0.8
	2	0	0	C	0.4	0	0.4	0	0	0	0.8	0.2	1	0.8	0.4	1.2	2	0.6	2.6
	3	0	0.2	0.2	2 0	0.6	0.6	0	0	0	0.4	0	0.4	0	0	0	0.4	0.8	1.2
	4	0.2	0	0.2	2 0	0.8	0.8	0	0	0	0	1	1	0	0	0	0.2	1.8	2

3. Onion thrips in onion bulbs at harvest (27 Feb 2001)

Table A: Proportion of onion bulbs infested with onion thrips at harvest (27 February 2001))Number of bulbs examined per treatment; 80.

			Replic	ate	Total infested bulbs	Proportion of
Treatment	1	2	3	4		intested bulbs
Green, lifted	1	3	0	0	4	0.05
Green topped	1	6	1	2	10	0.125
50% dry lifted	0	2	0	2	4	0.05
50% dry topp	1	2	3	3	9	0.113
Control	2	0	0	4	6	0.75
total	5	13	4	11	33	0.083

Table B: Mean numbers of thrips per bulb at harvest (27 February 2001). Number of bulbs examined per treatment; 80; a = adult, l=larva.

			Repl	icate		
Treatment	1	2	3	4	Total thrips	Mean number
Green, lifted	21	4a11	0	0	7	0.087
Green topped	1 a	4a41	1 a	2 a	12	0.15
50% dry lifted	0	41	0	1a11	6	0.075
50% dry topped	1 a	1a21	3a11	1a21	11	0.138
Control	1a11	0	0	1 a 3 l	6	0.075
total	6	20	5	11	42	0.105

4. Onion thrips in onion bulbs after storage for five weeks (2 April 2001)

Table A: Proportion of onion bulbs infested with onion thrips after five weeks storage at ambient temperature(2 April 2001). Number of bulbs examined per treatment 100.

		Re	plicate		Total infested	Proportion of
Treatment	1	2	3	4	DUIDS	Intested builds
Green, lifted	0	2	0	3	5	0.05
Green topped	0	0	1	0	1	0.01
50% dry lifted	1	2	0	1	4	0.04
50% dry topped	1	0	0	0	1	0.01
Control	0	1	0	0	1	0.01
total	2	5	1	4	12	0.024

Table B: Mean numbers of thrips per bulb after five weeks storage at ambient temperatures (2 April 2001). Number of bulbs examined per treatment; 100; a = adult, l=larva.

		Rep	licate		Total	Mean number
Treatment	1	2	3	4	thrips	
Green, lifted	0	61	0	1a11	8	0.08
Green topped	0	0	1 a	0	1	0.01
50% dry lifted	11	2 a	0	21	5	0.05
50% dry topped	11	0	0	0	1	0.01
Control	0	11	0	0	1	0.01
total	2	9	1	4	16	0.032

Appendix III Analysis of onion small trial

1. Data Analysis for 30 Jan/1 Feb

1.1 Comparing positions

1.1.1 Adult Counts

ANOVA was carried out on transformed Adult counts (square root) to compare counts at various treatments and positions. Thus the associated conclusions were drawn from transformed counts, but the mean tables and graphs were based on the original counts.

On 1 Feb, treatments '50%t' '50%l' had significantly more adult insects than 'control' and 'Gt'. There were no significant differences between '50%t' and '50%l' or among 'control', 'Gt' and 'Gl'. The most adult insects were on 'leaves', and insects on 'neck' and 'split' were much more than on 'base' and 'bulb'. The variation among treatment effects mainly occurred on 'leaves'.

Comparing 'Control (i.e.'50%t', '50%l' and 'control') vs Treated ('Gt' and 'Gi')', there was no significant difference in general (i.e. over all positions), but on the 'leaves' there was a significant difference between Control and Treated.

The (back-transformed) mean tables a	nd associated graph are as follows:
--------------------------------------	-------------------------------------

**** Tables	of means	****			· · · · · · · · · · · · · · · · · · ·	
Variate: Adu	lt					
Grand mean	3.05					
Treat	50%1 4.25	50%t 5.15	control 2.32	Gl 1.86	Gt 1.68	
Position	base 0.65	bulb 0.09	leaves 7.75	neck 4.07	split 2.70	
Treat Po	sition	base	bulb	leaves	neck	
split 50%l		0.00	0.00	13.20	4.60	
3.45 50%t		0.00	0.00	16.50	4.60	
4.05 control		0.00	0.00	7.45	1.55	
2.60 Gl		2.30	0.25	1.60	3.75	
1.40 Gt 1.40		0.95	0.20	0.00	5.85	



JANUARY 30 DATA - SMALL ONIONS TRIAL ***** Analysis of variance *****

Variate: s	sqrtAdult						
Source of	variation	d.f.	s.s.	n	n.s.	v.r.	F pr.
Reps strat	cum	3	0.9351	0.3	3117	1.05	i
Reps.*Unit	s* stratum		6 7505	1		F (0	- 001
Treat		4	6.7595	1.6	0899	5.09	<.001
Green vs	others	1	3.2652	3.4	2652	10.99	0.001
Position		4	65.0379	16.2	2595	54.72	<.001
Treat.Posi	ltion	16	53.9945	3.3	31/41/	11.36	<.001
Green vs	Others.Posi	tion					
		4	48.9459	12.2	2365	41.18	<.001
Residual		72	21.3931	0.2	2971		
Total		99	148.1202				
***** Tabl	les of means	* * * * *					
Variate: s	sqrtAdult						
Grand mear	1.253						
Treat	50%1	50%t	control	Gl	(Gt	
	1.442	1.657	1.103	1.129	0.93	35	
Position	base	bulb	leaves	neck	spl:	it	
	0.463	0.145	2.192	1.900	1.50	57	
Treat	Position	base	bulb	leaves	neo	ck	split
50%1		0.000	0.000	3.408	1.96	55	1.836
50%t		0.000	0.000	4.022	2.1	19	2.146
control		0.000	0.000	2.700	1.22	23	1.594
Gl		1.424	0.417	0.831	1.82	20	1.151
Gt		0.891	0.305	0.000	2.3	73	1.108
*** Least	significant	differ	ences of me	ans (5%	level) ***	

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Table	Treat	Position	Treat Position
rep.	20	20	4
d.f.	72	72	72
1.s.d.	0.3436	0.3436	0.7684

1.1.2 Larvae Counts

ANOVA was carried out on transformed larvae counts (square root) to compare counts at various treatments and positions. Thus the associated conclusions were drawn from transformed counts, but the mean tables and graph were based on the original counts.

On 1 Feb, treatments '50%t' '50%l' and 'control' had significantly more larvae than treatments 'Gt' and 'Gl'. There was no significant difference among '50%t', '50%l' and 'control', but there was a significant difference between 'Gt' & 'Gl'. The most larvae were on 'leaves'. There were much more larvae on 'neck' and 'split' than on 'base' and 'bulb'. The variation among treatment effects mainly occurred on 'leaves'.

Comparing 'Control (i.e. '50%t', '50%l' and 'control') vs Treated ('Gt' and 'Gl')', there was significantly different counts for each, both in general, and on the 'leaves'.

**** Tables	of means	* * * * *				
Variate: La	rvae					
Grand mean	27.0					
Treat	50%1 42.0	50%t 42.3	control 33.7	Gl 13.6	Gt 3.5	
Position	base 0.4	bulb 0.3	leaves 105.7	neck 22.1	split 6.5	
Treat P	osition	base	bulb	leaves	neck	
split 50%l		0.0	0.0	177.0	24.2	
8.7 50%t		0.0	0.0	173.0	32.5	
6.0 control		0.0	0.0	146.5	16.2	
5.9 Gl		1.6	1.2	32.2	24.5	
8.3 Gt		0.6	0.3	0.0	13.1	
3.6						

The (back-transformed) mean tables and associated graph are as follows:



180 -						
160 -						
140 -			<u> </u>			-
120 -						-
100 -						
80 -						
60 -						
40 -		×		<u> </u>		
20 -	× *		X	× *	×	
0 -			· ·	(<mark>, ────Ӂ</mark> ─────	-
	50%l	50%t	control	GI	Gt	
			Treatments			

***** Analysis of var	iance **	* * *		
Variate: sqrtLarvae				
Source of variation F pr.	d.f.	s.s.	m.s.	v.r.
Reps stratum	3	23.923	7.974	4.25
Reps.*Units* stratum Treat <.001	4	133.211	33.303	17.73
Green vs Others <.001	1	113.796	113.796	60.59
Position <.001	4	926.111	231.528	123.27
Treat.Position <.001	16	486.373	30.398	16.18
Green vs Others.Post	ition	465 010	116 205	C1 00
<.001	4	465.219	116.305	61.92
Residual	72	135.232	1.878	
Total	99	1704.851		

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**** Tabl	es of means	****			
Variate: s	qrtLarvae				
Grand mean	3.16				
Treat	50%1 4.20	50%t 4.20	control 3.70	Gl 2.49	Gt 1.22
Position	base 0.30	bulb 0.29	leaves 8.39	neck 4.50	split 2.32
Treat	Position	base	bulb	leaves	neck
split 50%l		0.00	0.00	13.22	4.82
2.94 50%t		0.00	0.00	13.04	5.56
2.38 control		0.00	0.11	12.00	4.00
2.39 Gl		1.01	0.96	3.71	4.55
2.21 Gt		0.51	0.36	0.00	3.57
1.65					
*** Least	significant	differe	ences of m	eans (5%	level) ***
Table	r	Freat	Position	Tr Posit	eat
rep. d.f.		20 72	20 72	10010	4 72
1.s.d.		0.864	0.864	1.	932

1.1.3 Total counts (adult + Larvae)

ANOVA was carried out on transformed Total (adult + larvae) counts (square root transformation) to compare counts at various treatments and positions. Thus the associated conclusions were drawn from transformed counts, but the mean tables and graph were based on the original counts.

On 1 Feb, treatments '50%t' '50%l' and 'control' had significantly more Total insects on onions than the others, and there were no significant differences among '50%t' '50%l' and 'control', or between 'GI' and 'Gt'. The highest total number of insects were living on 'leaves', and insects on 'neck' and 'split' were much more than on 'base' and 'bulb'. The variation among treatment effects mainly occurred on 'leaves'. This is similar to the conclusions for larvae counts since these make up the bulk of the total count.

Comparing 'Control ('50%t' '50%l' 'control') vs Treated ('Gt' 'Gl')', there were significantly different total counts both overall and just on the 'leaves'.

S C ø ⊐ ⊐ ወ Q σ 5 Τ ø ⊐ **~**+ Ø П ο 0 ۵ ᆔ ወ S ወ g 7 o Ъ The back-transformed mean tables and associated graph are as follows:

Variate: 7	Total					
Grand mear	n 30.1					
Treat	50%1 46.2	50%t 47.4	control 36.1	Gl 15.5	Gt 5.2	
Position	base 1.1	bulb 0.4	leaves 113.5	neck 26.2	split 9.2	
Treat	Position	base	bulb	leaves	neck	
50%1		0.0	0.0	190.2	28.9	
12.2 50%t		0.0	0.0	189.5	37.1	
control		0.0	0.0	154.0	17.8	
Gl Gl		3.9	1.5	33.8	28.2	
Gt		1.5	0.5	0.0	19.0	



***** Analys:	is of va	ariance *	* * * *					
Variate: sqr	tTotal							
Source of var	riation	d.f.	s.s	. n	n.s. ·	v.r.	F pr.	
Reps stratum		3	17.599	95.	.866	3.01		
Reps.*Units*	stratur	n						
Treat		4	126.968	3 31.	742 1	6.28	<.001	
Green vs O	thers	1	105.505	5 105.	505 5	4.11	<.001	
Position		4	961.464	4 240.	366 12	3.29	<.001	
Treat.Positio	on .	16	550.305	5 34.	394 1	7.64	<.001	
Green vs O	thers.Po	osition	F07 06		017 01	1		
Desidus 1		4	527.200	5 131. - 1	050 0	/.61	<.001	
Residual		12	140.376	о <u>т</u> .	950			
Total		99	1796.713	3				
***** Tables	of mear	15 *****						
Variate: sqr	Total							
Grand mean	3.48							
Treat	50%1	50%t	control	G1	Gt 1 59			
	4.49	4.57	5.90	2.00	1.59			
Position	base	bulb	leaves	neck	split			
100202011	0.58	0.33	8.69	4.95	2.85			
Treat Pos	sition	base	bulb	leaves	neck	s	plit	
50%1		0.00	0.00	13.69	5.27		3.49	
50%t		0.00	0.00	13.67	5.98		3.22	
control		0.00	0.11	12.31	4.18		2.88	
Gl		1.82	1.06	3.80	5.01		2.59	
Gt		1.11	0.47	0.00	4.31		2.06	
*** Least sig	gnificar	nt differe	ences of me	ans (5%	level) '	* * *		
Table		Treat	Position	Tr	eat			
				Posit	ion			
rep.		20	20		4			
d.f.		72	72	_	72			
1.s.d.		0.880	0.880	1.	968			

1.2 Comparing treatment sites (areas)

On 1 Feb we find that the most number of total insects (adult+larvae) were found in the '50%t' treatment. The most effect treatment was 'Gt'. Friedman's non-parametric test was used to compare treatments.

The mean tables and associated graph are as follows:

Variate: Adul	lt				
Grand mean 1	L5.3				
Treat	50%1	50%t	control	Gl	Gt
	21.3	25.8	11.6	9.3	8.4
Variate: Larv	7ae				
Grand mean 1	L35.				
Treat	50%1	50%t	control	Gl	Gt
	210.	212.	169.	68.	18.
Variate: Tota	al				
Grand mean	150.				
mare et	F 0 9 1		a	C 1	
Treat	JUST	JUSC	CONTROL	GI	GC
	231.	237.	180.	11.	26.



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In the following 3 analyses, using Friedman's non-parametric test to compare the 5 treatment areas, we can see that there were significant differences among the areas in counts of adults, larvae, and total. The differences existed between counts from the GI and Gt (treated) areas, as compared to counts from the other areas (untreated at 1 Feb). The control area had less insects than 50% and 50% t, but this difference was not significant.

Friedman Test: Adu	ult versus Treat, Reps	
Friedman test for	Adult by Treat blocked by Reps	
S = 8.65 DF = 4	P = 0.070	
S = 9.23 DF = 4	P = 0.056 (adjusted for ties)	
	Est Sum of	
Treat N	Median Ranks	
1 4	9.08 7.5	
2 4	8.74 8.5	
3 4	25.82 19.0	
4 4	19.90 14.0	
5 4	11.96 11.0	
Grand median =	15.10	
	- · -	
Friedman Test: La	rvae versus Treat, Reps	
Friedman test for	Larvae by Treat blocked by Reps	
S = 10.00 DF = 4	P = 0.040	
S = 10.26 DF = 4	P = 0.036 (adjusted for ties)	
	Est Sum OI	
Treat N	Median Ranks	
1 4		
2 4	29.6 9.0	
3 4		
4 4	211.2 17.0	
5 4	171.2 13.0	
Grand median =	123.3	
Turi a imam Magta Ma	tal waraya Treat Pana	
Friedman test: 10	Total by Treat blocked by Reps	
FIIedillar cest tor $c = 10, 00, DE = 4$	P = 0.040	
S = 10.00 DF = 4	P = 0.040 D = 0.036 (adjusted for ties)	
5 = 10.20 DF - 4	F = 0.050 (adjusted for cres)	
	Est Sum of	
Mroat N	Median Banks	
	27.1 5.0	
	35.5 9.0	
3 /	210 5 16.0	
	227 9 17 0	
τ τ 5 /	184 1 13 0	
J 4	TOI.T T2.0	
Grand median =	137.0	

2. Data Analysis from 7/8 Feb

2.1 Comparing positions

ANOVAs were carried out on transformed counts (square root) to compare counts at various treatments and positions. Thus the associated conclusions are drawn from transformed counts, but the mean tables and graph are based on the original counts.

On 8 Feb, significant differences in counts occurred on different positions. Of the 'Adults' and Total count, more insects were in the 'split' and 'neck' than were in the other positions. Most 'Larvae' were on the 'neck'. There were no significant differences among larvae counts in the 'split', 'bulb' and 'base'; but there were significant differences between 'split' and 'control', and also between 'bulb' and 'control'.

The mean tables and associated graph are as follows:

	r				
**** Table:	s or means	****			
Variate: Ad	ult				
Grand mean	0.187				
Position	base 0.070	bulb 0.110	leaves 0.000	neck 0.330	split 0.380
Variate: La	rvae				
Grand mean	0.188				
Position	base 0.050	bulb 0.170	leaves 0.000	neck 0.520	split 0.220
Variate: To	tal				
Grand mean	0.375				
Position	base 0.120	bulb 0.280	leaves 0.000	neck 0.850	split 0.600



**** Analysis of var	iance (Feb) ****				
Variate: sqrtAdul ANA	LYSIS O	F SQUARE RO	OT OF ADU	JLT COUNTS	1	
Source of variation	d.f.	s.s.	m.	.s. v.r	. F pr.	
Reps stratum	3	0.06422	0.021	L41 0.2	8	
Reps.*Units* stratum						
Treat	4	0.18715	0.046	579 0.6	1 0.657	
Green vs Others	1	0.01935	0.019	935 0.2	5 0.617	
Position	4	4.06530	1.016	533 13.2	6 <.001	
Treat.Position	16	1.29156	0.080	072 1.0	5 0.415	
Green vs Others.Pos	ition					
	4	0.19026	0.047	756 0.6	0.649	
Residual	72	5.51983	0.076	566		
Total	99	11.12807	,			
***** Tables of means	****					
Variate: sqrtAdult						
Grand mean 0.258						
Treat 50%1	50%t	control	Gl	Gt		
0.205	0.307	0.229	0.239	0.312		
Position base	bulb	leaves	neck	split		
0.157	0.147	0.000	0.459	0.529		
Treat Position	base	bulb	leaves	neck	split	
50%1	0.224	0.194	0.000	0.224	0.382	

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		0 224	0 000	0.000	0.656	0.657
50%t		0.224	0 224	0.000	0.494	0.316
control		0.114	0.227	0 000	0.224	0.702
Gl		0.112	0.156	0.000	0.609	0 590
Gt		0.112	0.158	0.000	0.020	0.000
*** Least si	gnifican	t differe	nces of me	ans (5%	level) ***	
	J					
Table		Treat	Position	Tr	eat	
Table		11040		Posit	ion	
		20	20		4	
rep.		20	20		72	
d.f.		72	12		72	
l.s.d.		0.1745	0.1745	0.3	903	
***** Analys	is of va	riance (F	'eb) *****			
-						
Variate: sor	tLar ANA	LYSIS OF	SQUARE ROO	T OF LAR	VAE COUNTS	
ANTINCE, BAT			-			
Source of va	riation	d.f.	s.s.	n	.s. v.r	. Fpr.
Source or Va						
		b	1 0706	0.3	569 3.1	4
Reps stratum	ı	2	T.0700	0.0		
Reps.*Units*	stratum	n			ERE 1 7	0 0 249
Treat		4	0.6299	0.1	C/C	J U.240
Green vs C	thers	1	0.4729	0.4	4.1	6 0.045
Position		4	3.0382	0.7	/595 6.6	8 <.001
Treat Positi	on	16	1.1570	0.0	0.6	4 0.844
Croon us (there Pr	sition				
Green vs C	, chiera. Pt	//	0.3686	i 0.0	921 0.8	1 0.522
		70	Q 1 Q 2 Q	0 1	137	
Residual		12	0.1000	, 0.1		
			14 0704			
Total		99	14.0/94	•		
***** Tables	s of mean	ns *****				
Variate: so	rtLarvae					
varrate. by	/					
Crand man	0 226					
Grand mean	0.220					
	E 00 1	EVOT	control	<u>c1</u>	GF	
Treat	20.41	ういるだ	CONCEPT	0 1 6 0	0 115	
	0.344	0.271	0.232	0.109	0.112	
			_			
Position	base	bulb	leaves	neck	split	
	0.099	0.230	0.000	0.509	0.293	
Treat D	osition	base	bulb	leaves	neck	split
Engi		0 270	0.454	0.000	0.577	0.417
5081		0.270	0.150	0 000	0.883	0.316
50%t		0.000	0.150	0.000	0 474	0.417
control		0.112	0.158	0.000	0.4/4	0.150
Gl		0.000	0.270	0.000	0.41/	0.150
Gt		0.112	0.112	0.000	0.194	0.128
+++ + ++ -	ionifica	nt differ	ences of me	eans (5%	level) ***	k
Least S	raurtica	IL ULLEL				
			Dealbles		roat	
Table		Treat	POSICION	L. D	tion	
			-	Posi		
rep.		20	20		4	
a.f.		72	72		72	
1 5 4		0.2125	0.2125	0.	4752	_
1						

<pre>***** Analysis of variance (Feb) ***** Variate: sgrtTot ANALYSIS OF SQUARE ROOT OF TOTAL COUNTS Source of variation d.f. s.s. m.s. v.f. F pr. Reps stratum 3 0.7710 0.2570 2.22 Reps *Units* stratum Treat 4 0.1878 0.0469 0.40 0.805 Green vs Others 1 0.1421 0.1421 1.23 0.272 Position 4 9.3230 2.3307 20.10 <.001 Treat.Position 16 1.2768 0.0407 0.35 0.843 Residual 72 8.3492 0.1160 Total 99 19.9077 ***** Tables of means ***** Variate: sqrtTotal Grand mean 0.413 Treat 50%1 50%t control G1 Gt 0.449 0.474 0.409 0.358 0.377 Position base bulb leaves neck split 0.240 0.298 0.000 0.815 0.715 Treat Position base bulb leaves neck split 50%1 0.417 0.512 0.000 0.706 0.612 50%1 0.224 0.15% 0.000 0.815 0.733 G1 0.112 0.352 0.000 0.815 0.733 G1 0.224 0.194 0.000 0.816 0.733 G1 0.224 0.194 0.000 0.816 0.733 G1 0.224 0.194 0.000 0.810 0.656 **** Least significant differences of means (5% level) *** Table Treat Position Treat Position rep. 20 20 4 a.f. 72 72 72 72 I s du 0.2147 0.4400 </pre>									
Variate: sqrtTot ANALYSIS OF SQUARE ROOT OF TOTAL COUNTS Source of variation d.f. s.s. m.s. v.r. F pr. Reps stratum 3 0.7710 0.2570 2.22 Reps.*Units* stratum Treat 4 0.1878 0.0469 0.40 0.805 Green vs Others 1 0.1421 0.1421 1.23 0.272 Position 4 9.3230 2.3307 20.10 <.001	***** Analy	vsis of va	ariance (F	Seb) *****					
Source of variation d.f. s.s. m.s. v.r. F pr. Reps stratum 3 0.7710 0.2570 2.22 Reps.*Units* stratum 1 0.1878 0.0469 0.40 0.805 Green vs Others 1 0.1421 0.1421 1.23 0.272 Position 4 9.3230 2.3307 20.10 <.001	Variate: so	rtTot ANA	ALYSIS OF	SQUARE ROO	OT OF TOT	AL COUNT	S		
Reps stratum 3 0.7710 0.2570 2.22 Reps.*Units* stratum Treat 4 0.1878 0.0469 0.40 0.805 Green vs Others 1 0.1421 0.121 1.23 0.272 Position 4 9.320 2.307 20.10 < 0.01	Source of v	variation	d.f.	s.s.	. m	s. v	.r.	F pr.	
Reps.*Units* stratum Treat 4 0.1878 0.0469 0.40 0.805 Green vs Others 1 0.1421 0.1421 1.23 0.272 Position 4 9.3230 2.3307 20.10 <.001	Reps stratu	ım	3	0.7710	0.2	570 2	.22		
Treat 4 0.1878 0.0469 0.40 0.805 Green vs Others 1 0.1421 0.1421 1.23 0.272 Position 4 9.3230 2.3307 20.10 <.001	Reps.*Units	* stratu	n						
Alter 1 0.1421 0.1421 1.23 0.272 Position 4 9.3230 2.3307 20.10 <.001	Treat		4	0.1878	3 0.0	469 0	.40	0.805	
Orient vs others 1 9.3210 2.3307 20.10 <.001	Groop VS	Others	1	0 142	0.1	421 1	.23	0.272	
Position 16 1.2768 0.0798 0.69 0.796 Green vs Others.Position 4 0.1628 0.0407 0.35 0.843 Residual 72 8.3492 0.1160 0.35 0.843 Total 99 19.9077 ***** Tables of means ***** Variate: sqrtTotal Grand mean 0.413 Treat 50%1 50%t control G1 Gt 0.449 0.474 0.409 0.358 0.377 Position base bulb leaves neck split 0.240 0.298 0.000 0.815 0.715 Treat Position base bulb leaves neck split 50%t 0.224 0.158 0.000 1.183 0.805 control 0.224 0.274 0.000 0.816 0.733 G1 0.112 0.352 0.000 0.810 0.656 **** Least significant differences of means (5% level) *** Table Treat Position rep. <td></td> <td>others</td> <td>1</td> <td>9 323(</td> <td> </td> <td>307 20</td> <td>10</td> <td>< 001</td> <td></td>		others	1	9 323(307 20	10	< 001	
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Green vs Others.Position 4 0.1628 0.0407 0.35 0.843 Residual 72 8.3492 0.1160 Total 99 19.9077 ***** Tables of means ***** Variate: sqrtTotal Grand mean 0.413 Treat 50%1 50%t control Gl Gt Position base bulb leaves neck split 50%1 0.449 0.474 0.409 0.358 0.377 Position base bulb leaves neck split 0.240 0.298 0.000 0.815 0.715 Treat Position base bulb leaves neck split 50%1 0.417 0.512 0.000 0.706 0.612 50%1 0.224 0.158 0.000 1.183 0.805 control 0.224 0.274 0.000 0.816 0.733 GI 0.112 0.352 0.000 0.810 0.656 Treat Po	Treat.Posit		10	1.2/00		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		0.750	
4 0.1628 0.0407 0.35 0.843 Residual 72 8.3492 0.1160 Total 99 19.9077 ***** Tables of means ***** Variate: sqrtTotal Grand mean 0.413 Treat 50%1 50%t control G1 Gt 0.449 0.474 0.409 0.358 0.377 Position base bulb leaves neck split 0.240 0.298 0.000 0.815 0.715 Treat Position base bulb leaves neck split 50%1 0.417 0.512 0.000 0.706 0.612 50%1 0.417 0.512 0.000 0.733 0.12 50%t 0.224 0.158 0.000 0.816 0.733 G1 0.112 0.352 0.000 0.816 0.733 G1 0.124 0.194 0.000 0.810 0.656 **** Least significant differences of means (5% level) *** Table Treat	Green vs	Others.P	osition	0 1 6 0 1		407 0	75	0 042	
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***** Tables of means ***** Variate: sqrtTotal Grand mean 0.413 Treat 50%1 50%t control Gl Gt Gt 0.449 0.474 0.409 0.358 0.377 Position base bulb leaves neck split 0.240 0.298 0.000 0.815 0.715 Treat Position base bulb leaves neck split 50%1 0.417 0.512 0.000 0.706 0.612 50%t 0.224 0.158 0.000 1.183 0.805 control 0.224 0.274 0.000 0.816 0.733 Gl 0.112 0.352 0.000 0.559 0.767 Gt 0.224 0.194 0.000 0.810 0.656 **** Least significant differences of means (5% level) **** Table Treat Position Treat Position rep. 20 20 4 d.f. 72 72 72 72 ls d 0.2147 0.2400	Total		99	19.907	7				
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Position base 0.240 bulb 0.298 leaves 0.000 neck 0.815 split 0.715 Treat Position base 50%1 bulb 0.417 leaves 0.512 neck 0.706 split 0.715 50%1 0.417 0.512 0.000 0.706 0.612 50%t 0.224 0.158 0.000 1.183 0.805 control 0.224 0.274 0.000 0.816 0.733 Gl 0.112 0.352 0.000 0.559 0.767 Gt 0.224 0.194 0.000 0.810 0.656 **** Least significant differences of means (5% level) *** Table Treat Position Treat rep. 20 20 4 d.f. 72 72 72 l s d 0.2147 0.2147 0.4800	11000	0.449	0.474	0.409	0.358	0.377			
Tobicion Date Denote Denote <thdenote< th=""> Denote Denote</thdenote<>	Position	base	bulb	leaves	neck	split			
Treat Position base bulb leaves neck split 50%1 0.417 0.512 0.000 0.706 0.612 50%t 0.224 0.158 0.000 1.183 0.805 control 0.224 0.274 0.000 0.816 0.733 G1 0.112 0.352 0.000 0.559 0.767 Gt 0.224 0.194 0.000 0.810 0.656 **** Least significant differences of means (5% level) *** Table Treat Position Treat rep. 20 20 4 d.f. 72 72 72 lsd 0.2147 0.2147 0.4800	rosición	0.240	0.298	0.000	0.815	0.715			
10011001 0.417 0.512 0.000 0.706 0.612 50%1 0.224 0.158 0.000 1.183 0.805 control 0.224 0.274 0.000 0.816 0.733 G1 0.112 0.352 0.000 0.816 0.733 G1 0.224 0.194 0.000 0.810 0.656 *** Least significant differences of means (5% level) *** Table Treat Position rep. 20 20 4 d.f. 72 72 72 l s d 0.2147 0.2147 0.4800	Treat 1	Position	base	bulb	leaves	neck	S	plit	
50%t 0.224 0.158 0.000 1.183 0.805 $control$ 0.224 0.274 0.000 0.816 0.733 Gl 0.112 0.352 0.000 0.816 0.733 Gt 0.224 0.194 0.000 0.816 0.733 Gt 0.224 0.194 0.000 0.810 0.656 *** Least significant differences of means (5% level) *** Table Treat Position Treat rep. 20 20 4 d.f. 72 72 72 l s d 0.2147 0.2147 0.4800	E091	05101011	0 417	0 512	0 000	0.706	0	612	
0.224 0.136 0.000 1.105 0.005 control 0.224 0.274 0.000 0.816 0.733 Gl 0.112 0.352 0.000 0.559 0.767 Gt 0.224 0.194 0.000 0.810 0.656 *** Least significant differences of means (5% level) *** Table Treat Position rep. 20 20 4 d.f. 72 72 72 l s d 0.2147 0.2147 0.4800	20%F		0.417	0 158	0 000	1 183	0	805	
control 0.224 0.274 0.000 0.516 0.733 G1 0.112 0.352 0.000 0.559 0.767 Gt 0.224 0.194 0.000 0.810 0.656 *** Least significant differences of means (5% level) *** Table Treat Position rep. 20 20 4 d.f. 72 72 72 l s d 0.2147 0.2147 0.4800	5080		0.224	0.130	0.000	0 916	ň	.005	
G1 0.112 0.352 0.000 0.353 0.767 Gt 0.224 0.194 0.000 0.810 0.656 *** Least significant differences of means (5% level) *** Table Treat Position Treat rep. 20 20 4 d.f. 72 72 72 lsd 0.2147 0.2147 0.4800	control		0.224	0.2/4	0.000	0.810	0	755	
Gt 0.224 0.194 0.000 0.810 0.656 *** Least significant differences of means (5% level) *** Table Treat Position rep. 20 20 4 d.f. 72 72 72 l s d 0.2147 0.2147 0.4800	Gl		0.112	0.352	0.000	0.559	0	. / 6 /	
*** Least significant differences of means (5% level) *** Table Treat Position Treat Position rep. 20 20 4 d.f. 72 72 72 lsd 0.2147 0.2147 0.4800	Gt		0.224	0.194	0.000	0.810	0	.656	
TableTreatPositionTreatrep.20204d.f.727272l.s.d0.21470.21470.4800	*** Least s	significa	nt differ	ences of m	eans (5%	level) *	* *		
Position rep. 20 20 4 d.f. 72 72 72 l.s.d 0.2147 0.2147 0.4800	Table		Treat	Position	Tr	eat			
rep. 20 20 4 d.f. 72 72 72 l.s.d 0.2147 0.2147 0.4800					Posit	ion			
d.f. 72 72 72 lsd 0.2147 0.2147 0.4800	rep.		20	20		4			
1 s d 0,2147 0,2147 0,4800	d.f.		72	72		72			
	1.s.d.		0.2147	0.2147	0.4	800			

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2.2 Comparing sites (areas)

On 8 Feb we find no significant difference in counts (averaged over all positions) among the 5 treatments for either adults, larvae or both (Total). This is based on results from Friedman's non-parametric test.

The mean tables and associated graph are as follows:

Variate: Adult					
Grand mean 0.	89				
Treat	50%1 0.55	50%t 1.05	control 0.80	Gl 0.80	Gt 1.25
Variate: Larva	e				
Grand mean 0.	96				
Treat	50%1 1.65	50%t 1.35	control 0.85	Gl 0.60	Gt 0.35
Variate: Total					
Grand mean 1.	85				
Treat	50%1 2.20	50%t 2.40	control 1.65	Gl 1.40	Gt 1.60





Figure 3: Mean numbers of thrips on onion plants on 8 February, 1 day after the 50% dry treatments.

Thrips populations at harvest and after storage

The raw data are summarised in Appendix II. Only 8% of bulbs were infested at harvest and less than 2.5% were infested after five weeks storage, with about 0.1 and 0.03 thrips per bulb respectively (Table 1). This is about 1.3 thrips per infested bulb. Adults and larvae were present on both occasions.

The numbers of thrips were too low for statistically significant differences between treatments to be detected.

Table 1: Mean proportion of onion bulbs infested with onion thrips and mean numbers of thrips per onion at harvest (27 February 2001) and after five weeks storage at ambient temperature (2 April 2001). Numbers of bulbs examined per treatment 80 (27 Feb), 100 (2 April).

	Mean pr infested bu	oportion of Ilbs out of 80	Mean proportion of thrips per bulb out of 80		
Treatment	27 Feb	2 April	27 Feb	2 April	
Green, lifted	0.05	0.05	0.087	0.08	
Green topped	0.125	0.01	0.15	0.01	
50% dry lifted	0.05	0.04	0.075	0.05	
50% dry topped	0.113	0.01	0.138	0.01	
Control	0.75	0.01	0.075	0.01	
All treatments	0.083	0.024	0.105	0.032	

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Friedman Test: Adult versus Treat, Reps
Friedman test for Adult by Treat blocked by Reps (Feb total)
S = 5.35 DF = 4 P = 0.253
S = 5.78 DF = 4 P = 0.216 (adjusted for ties)
                           Sum of
                    Est
                            Ranks
              Ν
                 Median
Treat
                             17.0
                  1.1300
              4
1
                              12.5
                  0.9300
2
              Δ
                  1.0700
                              13.0
3
              4
                              7.0
4
               4
                  0.6700
                             10.5
                  0.7500
5
               4
Grand median = 0.9100
Friedman Test: Larvae versus Treat, Reps
Friedman test for Larvae by Treat blocked by Reps (Feb total)
 S = 5.20 DF = 4 P = 0.267
S = 5.47 DF = 4 P = 0.242 (adjusted for ties)
                     Est
                            Sum of
                            Ranks
                 Median
               N
 Treat
                   0.4600
                               6.5
               4
 1
                              11.5
               4
                   0.6400
 2
                   1.0800
                              16.5
 3
               4
               4
                   1.4000
                              12.5
 4
                              13.0
                   0.7200
 5
               4
 Grand median =
                   0.8600
 Friedman Test: Total versus Treat, Reps
 Friedman test for Total by Treat blocked by Reps (Feb total)
 S = 2.75 DF = 4 P = 0.600
 S = 3.24 DF = 4 P = 0.519 (adjusted for ties)
                            Sum of
                     Est
                             Ranks
               N
                   Median
 Treat
                              10.0
               4
                   1.7700
 1
                              10.5
                   1.8300
 2
               4
                   2.3900
                              16.5
               4
 3
                              12.0
                   2.2900
 4
                4
                              11.0
               ۵
                   1.7700
 5
 Grand median =
                   2.0100
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