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Onion thrips populations pre-top fall Milestone 1 (part), project 1.1

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June 2001

A report prepared for
New Zealand Onion Exporters Association

Copy 20 of 20

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Contents

1 Executive summary

The behaviour of onion thrips was compared in two blocks of onions where populations were kept low using insecticides or allowed to become high by top fall. In both areas of onions, thrips populations were kept low by spraying with methamidophos from early November until mid December. In one of the two areas the population was then kept low with four applications of chlorpyrifos from mid December to mid January. From mid December to mid January the thrips population in the unsprayed plots doubled every 4.32 days.

The numbers of thrips and their position on plants were determined six times from early November to mid January. The plants, selected using a stratified random approach, were uprooted for inspection. Numbers of larval and adult thrips were recorded as well as their presence on the bulb, base of neck, in the neck above the base, under leaf bends and on the other parts of the leaf.

While insecticides were applied to onion plants, onion thrips were concentrated in the highly protected site between the leaves in the neck region of the plant. In the absence of insecticide applications, onion thrips may move to feed on other parts of the plant.

On almost mature onion plants onion thrips populations consisted of a high proportion of juvenile stages.

On unsprayed plants, thrips were found on all aboveground parts of the plants. In the bulb area of all plants they were only found where the outer skins had split.

Data comparing thrips populations on sprayed and unsprayed onions reinforced the need for a complete cluster of insecticide applications if full benefit is be gained from the insecticide.

2 Introduction

Earlier research and observations on onion thrips found no clear between thrips populations before top fall and subsequent levels of infestation in bulbs. Thrips appeared to leave crops that had high numbers of thrips prior to top fall. There were also questions about the parts of the onion plants in which thrips were living. An experiment was designed to generate high and low thrips populations on blocks of onions and to record their location on different parts of plants from four weeks pre-top fall until harvest.

The same blocks of onions were used for small plot trials to compare post-top fall treatments on thrips populations at harvest, project 2.1 (milestone 3).

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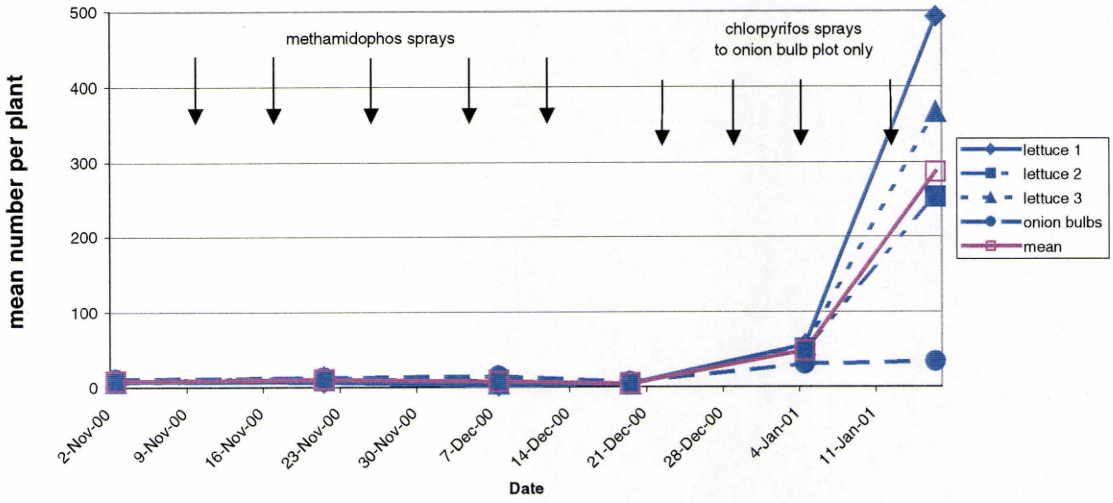


Figure 2: The mean numbers of thrips found on onion plants and the time of insecticide spray applications.

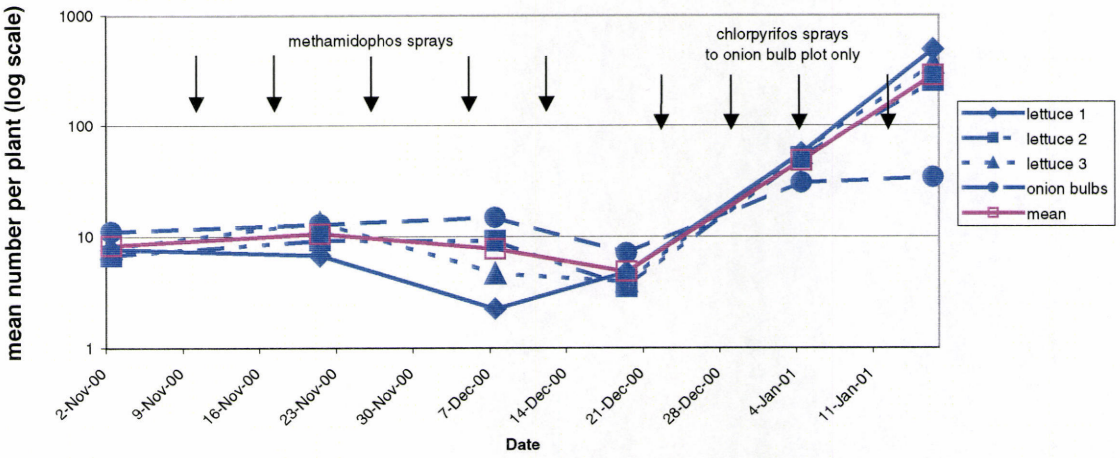


Figure 3: The mean numbers of thrips found on onion plants and the time of insecticide spray applications, log scale.

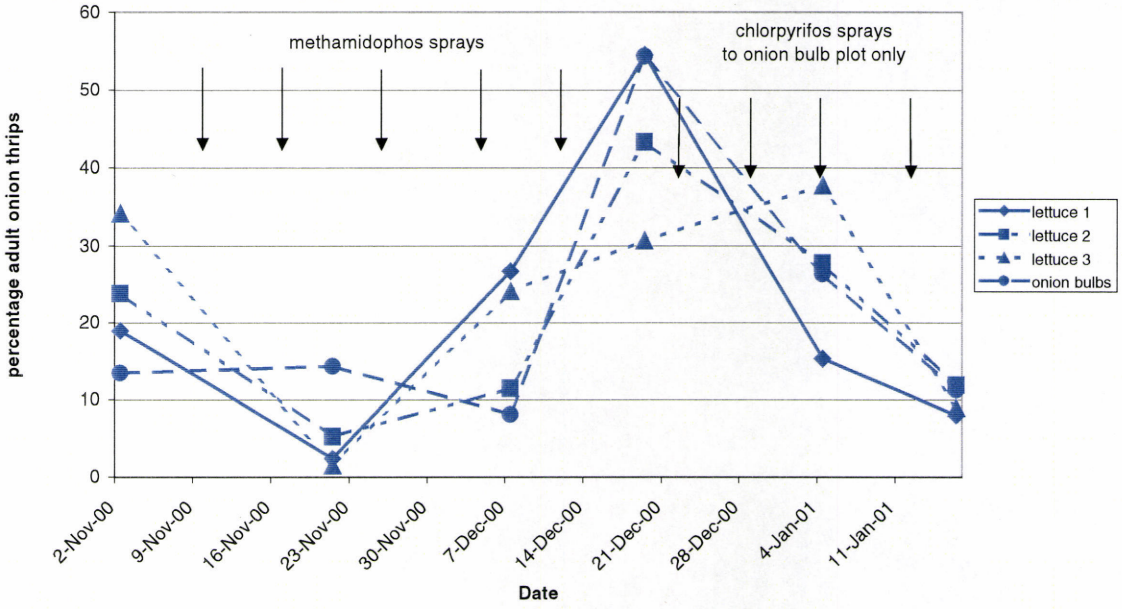


Figure 4: The percentage of adult onion thrips found on onion plants and the time of insecticide spray applications.

4.2 Response to insecticides

The methamidophos insecticides maintained static populations of thrips in early summer.

Chlorpyrifos was only applied to one of the four blocks of onions. A statistically significant decline in the population was only seen after the last of the four weekly applications (Figs 2-3). This emphasises the need to complete a full cluster of sprays to adequately control thrips.

This emphasises the need to complete a full cluster of sprays to adequately control thrips.

4.3 Distribution of thrips on onion plants

On young sprayed plants most onion thrips were found between leaves in the neck region of each plant (Table 2). However, a few larvae were found hiding in other areas as the plants grew. This suggests that the larvae will move away from the neck, but are killed either directly by insecticides or by the insecticide residues on the exposed parts of the plant.

When onion plants were being sprayed with insecticide, thrips were only found in the neck.

Table 2: The proportion of onion plants with thrips in each of five locations on the plant. The plants in the three lettuce blocks were unsprayed while the plants in the onion block were sprayed with chlorpyrifos.

All sites	4-Jan-01	16-Jan-01
lettuce 1	0.80	1.00
lettuce 2	0.79	0.99
lettuce 3	0.80	1.00
onion bulbs	0.43	0.43
neck base	4-Jan-01	16-Jan-01
lettuce 1	1	1
lettuce 2	1	1
lettuce 3	1	1
onion bulbs	1	1
above neck	4-Jan-01	16-Jan-01
lettuce 1	1	1
lettuce 2	1	1
lettuce 3	1	1
onion bulbs	0.92	0.84
leaf bend	4-Jan-01	16-Jan-01
lettuce 1	1	1
lettuce 2	1	1
lettuce 3	1	1
onion bulbs	0.16	0.36
open leaf	4-Jan-01	16-Jan-01
lettuce 1	1	1
lettuce 2	0.96	1
lettuce 3	1	1
onion bulbs	0.08	0.24
Bulb/split skins	4-Jan-01	16-Jan-01
lettuce 1	0	1
lettuce 2	0	0.96
lettuce 3	0	1
onion bulbs	0	0.44

Most thrips on the sprayed plants (onion bulb block) were between leaves at the base of the neck or just above the neck, whereas on the unsprayed onion plants (lettuce blocks) the thrips were usually found on most of the aboveground parts of each plant (Table 2). On the bulb region of the plant, thrips were only found when there was a split in the outer skins that provided shelter and exposed younger live tissue. Thrips were found in the bulb region only on 16 January.

The relatively few thrips found on open leaves, under leaf bends and on bulbs in the sprayed block suggests that the insecticide spray and its residues on plants were killing many thrips in these exposed regions and were allowing onion thrips to live and breed in the neck where it is difficult for insecticides to penetrate. This observation, plus similar observations on younger plants, indicates that juvenile thrips may frequently move out from the sheltered neck region where they are exposed to insecticide residues on leaves. If this is the case then persistent insecticide residues on leaves may be an important cause of thrips mortality and products with persistent residual action may be an important factor in successful thrips control on onions.

5 Conclusions

While insecticides are applied to onion plants, onion thrips are concentrated in the highly protected site between the leaves in the neck region of the plant. In the absence of insecticides onion thrips may move from this site to feed on other parts of the leaf.

On almost mature onion plants, onion thrips populations consisted of a high proportion of juvenile stages.

On unsprayed plants, thrips were found on all aboveground parts of the plants. In the bulb area they were only found where the outer skins had split.

Data comparing populations on sprayed and unsprayed onions reinforced the need to complete a cluster of insecticide applications if full benefit is be gained from them.

6 Acknowledgements

We thank Richard Wood for providing advice on the growing of the onions, Barry Childes 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.

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

diazinon @ 1.5L/ha

roundup @ 4L/ha

25/8 urea @ 100kg/ha

28/9, 10/10 , 13/10, 20/10 Totril @ 300ml/ha

Tribunal @ 300g/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 Summary of data from the four blocks of onions showing mean number of thrips per plant

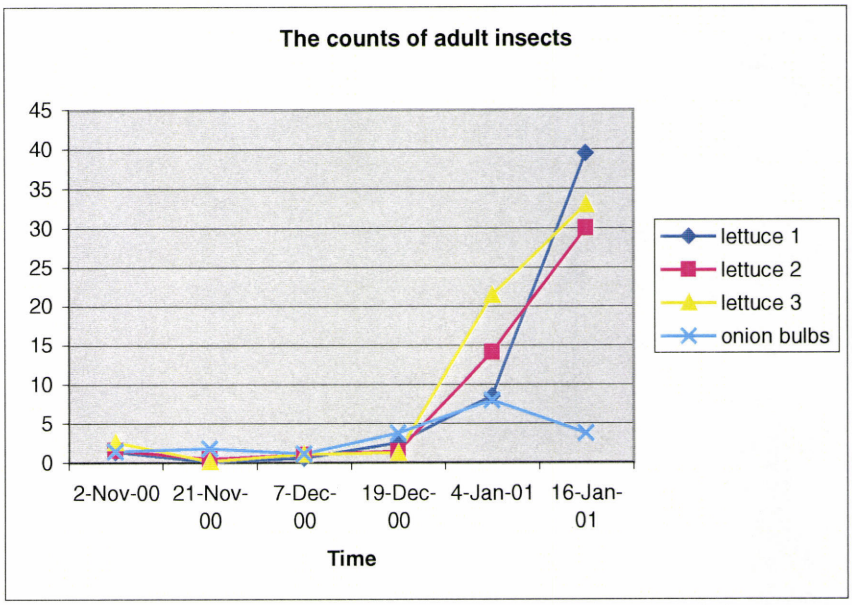
Onion thrips trials at Pukekohe Research Centre 2000-2001

Summary page

	date					
total thrips	2-Nov-00	21-Nov-00	7-Dec-00	19-Dec-00	4-Jan-01	16-Jan-01
lettuce 1	7.6	6.72	2.24	4.77	56.1	492.5
lettuce 2	6.72	9.16	9.08	3.51	50.7	253.1
lettuce 3	7.84	13.44	4.64	3.9	55.6	366.9
onion bulbs	11	12.84	14.8	7.07	30.3	33.8
mean	8.29	10.54	7.69	4.81	48.1	286.6
adults	2-Nov-00	21-Nov-00	7-Dec-00	19-Dec-00	4-Jan-01	16-Jan-01
lettuce 1	1.44	0.16	0.6	2.6	8.6	39.5
lettuce 2	1.6	0.48	1.04	1.52	14.1	30.1
lettuce 3	2.68	0.2	1.12	1.2	21	32.9
onion bulbs	1.48	1.84	1.2	3.84	8	3.8
mean	1.8	0.67	0.99	2.29	12.9	26.6
larvae	2-Nov-00	21-Nov-00	7-Dec-00	19-Dec-00	4-Jan-01	16-Jan-01
lettuce 1	6.16	6.56	1.64	2.17	47.5	453
lettuce 2	5.12	8.68	8.04	1.99	36.6	223
lettuce 3	5.16	13.24	3.52	2.7	34.6	334
onion bulbs	9.52	11	13.6	3.23	22.3	30
mean	6.49	9.87	6.7	2.52	35.2	260
% adults	2-Nov-00	21-Nov-00	7-Dec-00	19-Dec-00	4-Jan-01	16-Jan-01
lettuce 1	18.9	2.4	26.8	54.5	15.3	8.0
lettuce 2	23.8	5.2	11.5	43.3	27.8	11.9
lettuce 3	34.2	1.5	24.1	30.8	37.8	9.0
onion bulbs	13.5	14.3	8.1	54.3	26.4	11.2
mean	21.7	6.4	12.9	47.6	26.8	9.3
% larvae	2-Nov-00	21-Nov-00	7-Dec-00	19-Dec-00	4-Jan-01	16-Jan-01
lettuce 1	81.1	97.6	73.2	45.5	84.7	92.0
lettuce 2	76.2	94.8	88.5	56.7	72.2	88.1
lettuce 3	65.8	98.5	75.9	69.2	62.2	91.0
onion bulbs	86.5	85.7	91.9	45.7	73.6	88.8
mean	78.3	93.6	87.1	52.4	73.2	90.7

Appendix III Analysis of the monitoring plants data 2 Nov – 16 Jan

1. Analysis of the counts of ADULT insects at each date from 2 Nov 00 to 16 Jan 01



2 Nov 00

On 2 Nov 00 data an ANOVA was carried out and we find that the amount of adult insects in 'lettuce3' is significantly greater than for the other sites, and there are no significant differences in adult insect counts among the other sites.

```
***** Tables of means *****

Variate: Adult

Grand mean  1.80

 Treatmen lettuce1 lettuce2 lettuce3     onion
L.s.d.
              1.44      1.60      2.68      1.48     0.713
```

```
***** Analysis of variance on 2 Nov 00 *****

Variate: Adult

Source of variation          d.f.       s.s.
m.s.     v.r.  F pr.
Treatmen                        3     5.2320
1.7440     6.16  0.005
Residual                       16     4.5280
0.2830
Total                          19     9.7600
```

21 Nov 00

On 21 Nov 00 data an ANOVA was carried out on log-transformed data and we find that the adult insect count at 'onion' treatment area is significantly more than for the other areas. There are no significant differences in adult insect counts among the other areas. Here is the mean table based on the untransformed data.

```
***** Tables of means *****

Variate: Adult

Grand mean  0.67

 Treatmen lettuce1 lettuce2 lettuce3     onion
             0.16      0.48      0.20      1.84
```

```
***** Analysis of variance on 21 Nov 00 *****

Variate: log(Adu+1)

Source of variation          d.f.       s.s.
 m.s.     v.r.  F pr.
Treatmen                        3    2.22440
 0.74147    8.84  0.001
Residual                       16    1.34143
 0.08384
Total                          19    3.56583

***** Tables of means *****

Variate: logAdu

Grand mean  0.407

 Treatmen lettuce1 lettuce2 lettuce3     onion  l.s.d.
             0.130     0.355     0.177     0.966  0.3882
```

7 Dec 00

On 7 Dec 00 data a Kruskal-Wallis One-Way Analysis was carried out and we find that the number of adult insects in treatment area 'lettuce1' is significantly less than for the other treatment areas, and there are no significant differences in counts of adult insects among the other treatments. Here is the associated mean table.

```
***** Tables of means *****
Variate: Adult

Grand mean  0.990
 Treatment lettuce1 lettuce2 lettuce3    onion
             0.600    1.040    1.120    1.200
```

```
Kruskal-Wallis One-Way Analysis of Variance

 Value of H          =    6.694
 Adjusted for ties   =    6.918

  Treatment   lettuce1 lettuce2 lettuce3    onion
1.s.d.
 Mean Ranks        4.6     12.1     13.0     12.3
6.78

 Degrees of freedom =        3
 Chi-square p-value =    0.075
```

19 Dec 00

On 19 Dec 00 data a Kruskal-Wallis One-Way Analysis was carried out and we find that the amount of adult insects on 'onion' is significantly higher than on 'lettuce2' and 'lettuce3', but not 'lettuce1'. The amount of adult insects on 'lettuce1' is significantly higher than on 'lettuce3' but not 'lettuce2'. Here is the associated mean table.

```
***** Tables of means *****

Variate: Adult

Grand mean  2.29

 Treatmen lettuce1 lettuce2 lettuce3    onion
             2.60     1.52     1.20     3.84
```

```
Kruskal-Wallis One-Way Analysis of Variance

 Value of H          =    10.13
 Adjusted for ties   =    10.25

 Treatment    lettuce1 lettuce2 lettuce3    onion
1.s.d.
 Mean Ranks       12.3      8.3      5.1     16.3
5.831

 Degrees of freedom =        3
 Chi-square p-value =     0.02
```

4 Jan 01

On 4 Jan 01 data a Kruskal-Wallis One-Way Analysis was carried out and we find that the amount of adult insects on 'onion' and 'lettuce1'are significantly lower than on 'lettuce3'. Here is the associated mean table.

```
***** Tables of means *****

Variate: Adult

Grand mean  12.9

 Treatmen lettuce1 lettuce2 lettuce3     onion
              8.6      14.1      21.0       8.0
```

```
  Kruskal-Wallis One-Way Analysis of Variance

 Value of H          =     9.057
 Adjusted for ties   =     9.084

 Treatment     lettuce1 lettuce2 lettuce3     onion
1.s.d.
 Mean Ranks         8.2      11.6      16.4       5.8
6.235

 Degrees of freedom =         3
 Chi-square p-value =      0.03
```

16 Jan 01

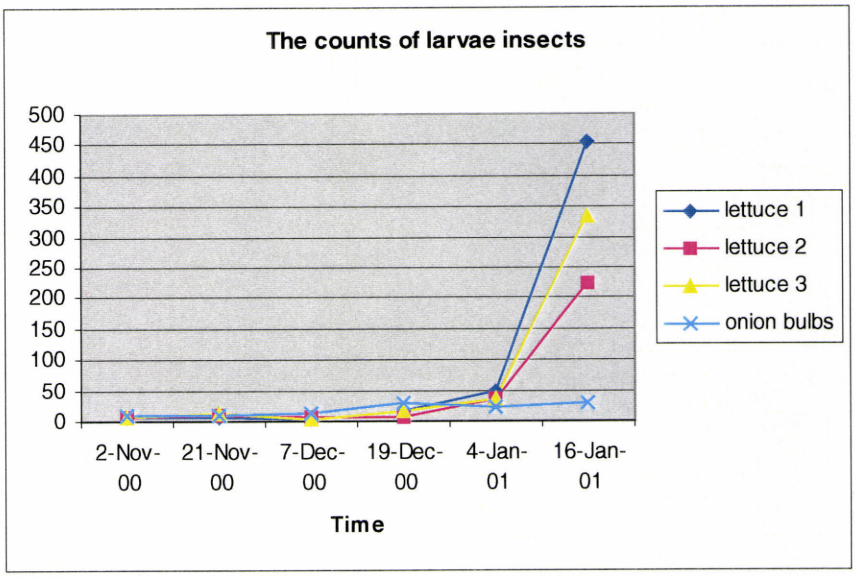
On 16 Jan 01 data an ANOVA was carried out on the square root transformed data and we find that the amount of adult insects in 'onion' is significantly less than the other areas. There are no significant differences in counts of adult insects among the other areas. Here is the mean table based on the untransformed data.

```
***** Tables of means *****

Variate: Adult

Grand mean  26.6

 Treatmen lettuce1 lettuce2 lettuce3     onion
             39.5      30.1      32.9       3.8
```

```
***** Analysis of variance on 16 Jan 01 *****

Variate: sqrtAdu

Source of variation           d.f.        s.s.
m.s.     v.r.  F pr.
Treatmen                         3     60.1869
20.0623    21.18  <.001
Residual                        16     15.1591
0.9474
```

```
Total                                19     75.3460

***** Tables of means *****

Variate: sqrtAdu

Grand mean  4.78

 Treatmen lettuce1 lettuce2 lettuce3     onion    l.s.d.
             6.19      5.44      5.66      1.81    1.305
```

2. Analysis of the counts of LARVAE at each date from 2 Nov 00 to 16 Jan 01



2 Nov 00

On 2 Nov 00 the number of larvae in the various areas are not significantly different from one another. Here is the associated mean table.

```
***** Tables of means *****

Variate: Larvae

Grand mean  6.49

 Treatmen lettuce1 lettuce2 lettuce3     onion    l.s.d.
             6.16      5.12      5.16      9.52    5.434
```

***** Analysis of variance on 2 Nov 00 *****

Variate: Larvae

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatmen	3	64.68	21.56	1.31	0.305
Residual	16	262.80	16.42		
Total	19	327.48			

21 Nov 00

On 21 Nov 00 the amount of larvae on 'lettuce3' is significantly higher than in 'lettuce1' and 'lettuce2', but not 'onion'. The number of larvae on 'onion' is significantly higher than in 'lettuce1' but not 'lettuce2'.

Here is the associated mean table.

***** Tables of means *****

Variate: Larvae

Grand mean 9.87

Treatmen	lettuce1	lettuce2	lettuce3	onion	l.s.d.
	6.56	8.68	13.24	11.00	4.366

***** Analysis of variance on 21 Nov 00 *****

Variate: Larvae

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Treatmen	3	125.03	41.68	3.93	0.028
Residual	16	169.63	10.60		
Total	19	294.66			

7 Dec 00

On 7 Dec 00 the amount of larvae in 'onion' and 'lettuce2' are significantly more than on Lettuce 1 & 3. Lettuce 1 has the lowest counts, significantly less than Lettuce 3. Here is the mean table based on the untransformed data.

***** Tables of means *****

Variate: Larvae

Grand mean 6.70

Treatmen	lettuce1	lettuce2	lettuce3	onion
	1.64	8.04	3.52	13.60

```
***** Analysis of variance 7 Dec 00 *****

Variate: logLar

Source of variation          d.f.       s.s.       m.s.
v.r.  F pr.
Treatmen                        3    15.6341     5.2114
13.94  <.001
Residual                       16     5.9828     0.3739
Total                          19    21.6168

***** Tables of means *****

Variate: logLar

Grand mean  1.48

 Treatmen lettuce1 lettuce2 lettuce3    onion   l.s.d.
             0.23      2.03      1.11     2.54    0.820
```

19 Dec 00

On 19 Dec 00 the number of larvae in treatment 'onion' is significantly more than the other treatments, but there is no significant difference among the other treatments. Here is the associated mean table.

```
***** Tables of means *****

Variate: logLar

Grand mean  2.52

 Treatmen lettuce1 lettuce2 lettuce3    onion
             2.17      1.99      2.70     3.23
```

```
Kruskal-Wallis One-Way Analysis of Variance

 Value of H          =     7.526

  Treatmen     lettuce1 lettuce2 lettuce3    onion    l.s.d.
 Mean Ranks         8.8      5.8      11.8     15.6     6.717

 Degrees of freedom =         3
 Chi-square p-value =      0.06
```

4 Jan 01

On 4 Jan 01 there are no significant differences in larvae counts among the treatments. Here is the mean table based on the untransformed data.

```
***** Tables of means *****

Variate: Larvae

Grand mean  35.2

 Treatmen lettuce1 lettuce2 lettuce3     onion
             47.5      36.6      34.6      22.3
```

```
***** Analysis of variance 4 Jan 01 *****

Variate: logLar

Source of variation           d.f.       s.s.       m.s.
v.r.  F pr.
Treatmen                         3     1.4028     0.4676
2.33  0.113
Residual                        16     3.2054     0.2003
Total                           19     4.6082


***** Tables of means *****

Variate: logLar

Grand mean  3.45

 Treatmen lettuce1 lettuce2 lettuce3     onion      l.s.d.
             3.80      3.48      3.47      3.06       0.6
```

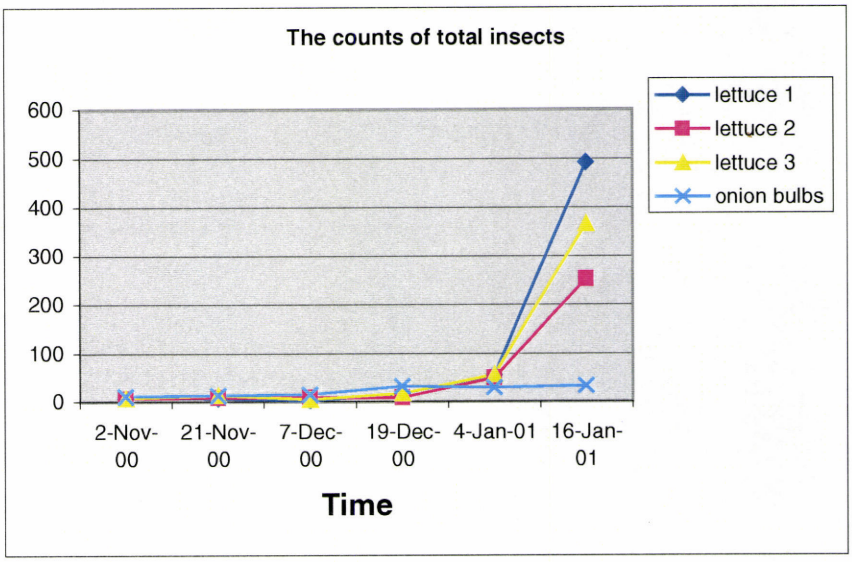
16 Jan 01

On 16 Jan 01 the amount of larvae in 'onion' is significantly less than for the other treatments. There is no significant difference in the number of larvae in 'lettuce1' and 'lettuce3'. Here is the mean table on the untransformed data.

```
***** Tables of means *****

Variate: Larvae

Grand mean  260.

 Treatmen lettuce1 lettuce2 lettuce3     onion
             453.      223.      334.       30.
```

```
***** Analysis of variance on 16 Jan 01 *****

Variate: sqrtLar

Source of variation          d.f.       s.s.       m.s.
v.r.  F pr.
Treatmen                        3    740.934    246.978
33.41  <.001
Residual                       16    118.268      7.392
Total                          19    859.202


***** Tables of means *****

Variate: sqrtLar

Grand mean  14.74

 Treatmen lettuce1 lettuce2 lettuce3    onion   l.s.d.
            21.05    14.86    18.14     4.90    3.645
```

3. Analysis of the TOTAL counts (adults + larvae) from 2 Nov 00 to 16 Jan 01



Since the total number is determined largely by the number of the larvae, the results are the same as for the 'Larvae' counts. We only show the mean tables of the 'Total' counts here.

```
***** Tables of means  on 2 Nov 00 *****

Variate: Total

Grand mean  8.29

 Treatmen lettuce1 lettuce2 lettuce3    onion
             7.60     6.72     7.84    11.00
```

***** Tables of means on 21 Nov 00 *****

Variate: Total

Grand mean 10.54

Treatmen	lettuce1	lettuce2	lettuce3	onion
	6.72	9.16	13.44	12.84

***** Tables of means 7 Dec 00 *****

Variate: Total

Grand mean 7.69

Treatmen	lettuce1	lettuce2	lettuce3	onion
	2.24	9.08	4.64	14.80

***** Tables of means 19 Dec 00 *****

Variate: Total

Grand mean 19.3

Treatmen	lettuce1	lettuce2	lettuce3	onion
	17.6	9.3	17.0	33.2

***** Tables of means 4 Jan 01 *****

Variate: Total

Grand mean 48.2

Treatmen	lettuce1	lettuce2	lettuce3	onion
	56.1	50.8	55.5	30.3

***** Tables of means 16 Jan 01 *****

Variate: Total

Grand mean 287.

Treatmen	lettuce1	lettuce2	lettuce3	onion
	493.	253.	367.	34.