2012: Final report on findings

Partial replacement of chemical treatments with Aston Horticulture's *Tree Wash* and its affect on apple pests and diseases in cider orchards

A report prepared by Emily Durrant in 2012 for HONE and sponsored by Heineken UK Ltd

Summary

Tree Wash (TW) was tested on five sites across Herefordshire and the surrounding area. The trial period was two years, commencing in 2010 and ending in 2012. All relevant results from the trial are presented here (first year results are detailed in the *Yr One Findings – Tree Wash* document, available on request). Overall, TW performed positively as a boost for natural defences but struggled to maintain pest levels at the same level as the comparison (CO, conventional treatment).

~ YIELD: In year one, yields from Control (CO) plots were higher than those from TW plots on sites A and B, whereas site C and D saw no statistically significant difference in yields from both plots. Yields from site E were not available owing to technical problems.

Owing to an early scab infection detected by the farm's agronomist, site A was abandoned for trial in year two. For the remaining sites, CO plots were higher yielding than TW plots, bar site E, where yield data was again not available owing to technical problems.

~ DISEASE: Overall, trees treated with Tree Wash experienced higher levels of apple scab infection than trees treated with conventional sprays. Powdery mildew affected two sites in particular, however no significant difference between the TW and CO plots was found. Although canker and blossom wilt were detected in the first year on some orchards, these diseases were not assessed in year two owing to time constraints and greater importance of powdery mildew and apple scab.

~ INSECTS: A wide range of insects were assessed but only a few were affected by the change in treatment to TW. Those affected were Ermin moth, scale insects and fruit tree red spider mites. Ermin moth and scale insects were found in higher numbers on TW plots, whereas red spider mites were found in higher numbers on CO plots.

Background

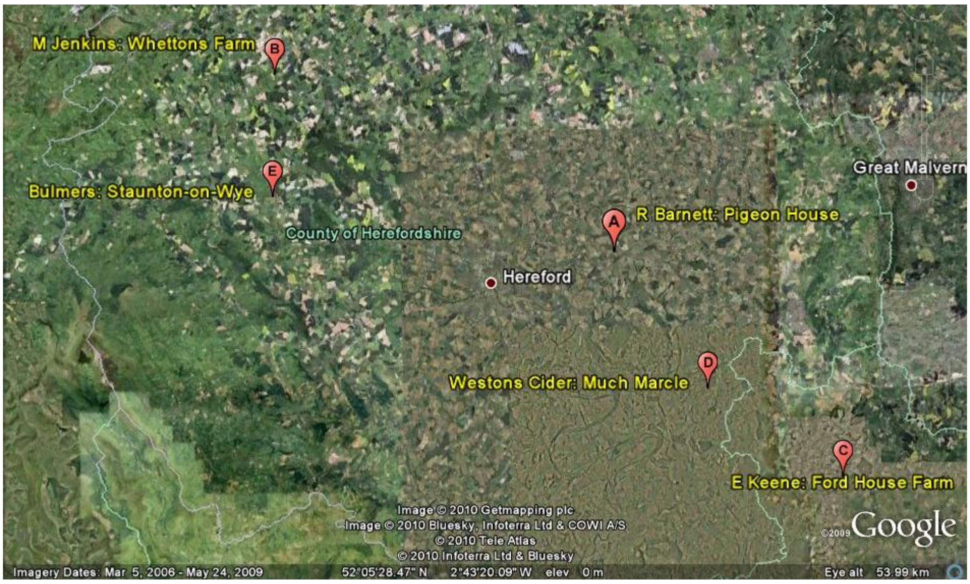
Four field studies selected by cider apple growers in the West Midlands commenced in spring 2010 as part of Heineken UK's More Sustainable Orchards Project. The studies were then transferred to the HONE project (Herefordshire Orchards Network of Excellence) at the start of 2011, which remains the main organising body. The studies give growers the opportunity to test ideas and products likely to have a positive influence on the economic, environmental and social sustainability of their cider orchards, with the support of the network and cider makers. Ideas are either selected, or voted for, by growers on the network and are, in general, ones which may have been found to work on other crops, regions or in research laboratories, but have had limited application on farms in the west of the UK. Aston Horticulture's Tree Wash was selected as one of the studies.

Introduction

Five farms around Herefordshire were selected for trial of Aston Horticulture's *Tree Wash* foliar spray, a tree 'tonic' said to boost the trees natural defence systems. Tree Wash is also said to act as a control agent for most fungal diseases (including two significant diseases found in apple orchards, Apple Scab, *Venturia inaequalis,* and Powdery Mildew, *Podosphaera leucotricha*) and a repellent for insect pests. It contains seaweed and is therefore a partial replacement of foliar feed.

Hypothesis: *Tree Wash will act as a tonic and pest repellent, thus helping the tree to defend against fungal diseases and some insect pests. Owing to the systemic resistance inducing characteristic of Tree Wash, trees treated will resist disease and insect infestation and yield higher in subsequent years than in year 1.*

Figure 1: Distribution of Sites (Hereford in centre)



Sites Key

A: Weston Beggard

B: Broxwood

C: Newent

D: Much Marcle

E: Staunton-on-Wye

Each farm contains one trial site, itself containing two plots;

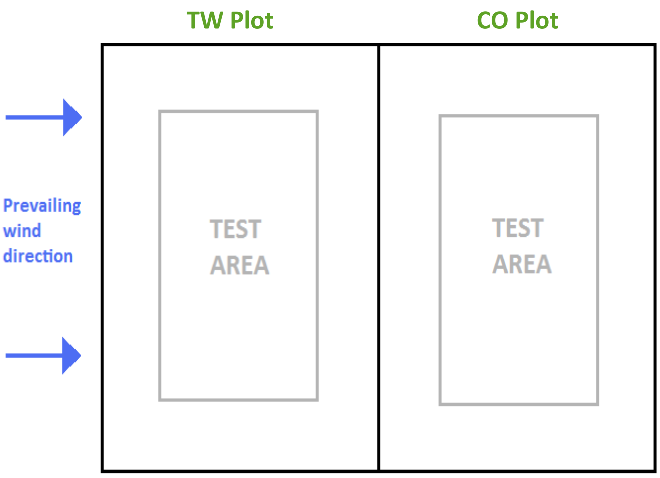
- Tree Wash plot (TW), on which Tree Wash will be applied as a tree tonic, boosting natural defence systems and deterring pests, and conventional fungicide (and in some cases insecticide), will not be used, and;
- a *pseudo* Control plot (CO), on which usual application of conventional fungicides will continue.

Major cider apple pests and diseases will be assessed throughout the growing season. Some will be assessed in terms of acceptable pest thresholds (APT)[1] and others simply in numbers sampled. Results of the pest and disease assessments, as well as plot yield, with be compared across the Tree Wash and control plots (more detail in methodology). The full trial period is two years with the possibility of a third year if required.

[1] Acceptable pest threshold (APT) according to Copas & Umpelby (2008) & HDC (2010)

Experimental design

Plot design: Each site contains two plots of the same variety, age and tree-spacing, as shown in the diagram below. The thick black lines indicate the perimeter of the sample area (not to scale, dimensions are not stipulated). The sample area is surrounded by a buffer to reduce contamination by drift of treatments or spores. The direction of prevailing wind is a preference and not precise in all sites.



To prepare TW, dilute 1:50 in water. Spray the solution directly on to trees as a fine mist to run-off throughout the season

See Appendix 2 for more detail on each site.

Protocol for Growers:

TRIAL SITE:	CONTROL SITE:
a) Growth season (approx. April - June) Apply Tree Wash every 7 days for the first 2 applications and every 10 days thereafter. **b) Throughout growth season and at harvest** Fulfil reporting requirements. **c) Late winter/early spring** Repeat the above preparation guidelines and apply tree wash solution twice throughout the winter season.	**a) Growth season (approx. April - June)** Apply fungicide and insecticide sprays when required (i.e. continue conventional orchard management). Do not apply tree wash. **b) Throughout growth season and at harvest** Fulfil reporting requirements. **c) Late winter/early spring** Do not treat trees

Rain: Tree Wash is rain fast within 1 hour in summer and 2 hours in winter.
Calcium: Mixing tree wash with calcium should be avoided (check manufacturers label for full information).
Insecticide: Insecticide use is not prohibited, but farmers were advised to avoid it where possible (particularly pre-blossom) and record any applications made. Insecticide must be applied *separately*.
Management: All other orchard management practices must be maintained throughout the trial period, including; pruning and training, fertilisation and herbicide use.
Flexibility: Farmers were asked to stick to the application frequency specified as closely as possible but flexibility was given where weather and other factors beyond the control of the farmer prevent this.

Measurement and evaluation: All sites were visited four times throughout the main spray season in order to assess pest and disease occurrence. At harvest, crops from Tree Wash and control sites were weighed separately. The primary diseases monitored throughout the season were apple scab, powdery mildew and blossom wilt. As the effect of Tree Wash on insects is little known, a wide range of insect pests were monitored in the first year;

- Winter Moth
- Tortrix Moth
- Ermin Moth
- Apple Blossom Weevil
- Woolly Aphid
- Rosey Apple Aphid
- Apple Grass Aphid
- Apple Saw Fly
- Nut Scale
- Mussel Scale
- Scarlet Mite
- Rust Mite
- Red Spider Mite

Insects monitored in year two were selected using results from year one. The selected insects were;

- Winter Moth
- Tortrix Moth
- Ermin Moth
- Apple Blossom Weevil
- Rosey Apple Aphid
- Apple Saw Fly
- Nut Scale
- Mussel Scale
- Scarlet Mite
- Red Spider Mite

Grids were drawn for each plot on each site, numbering trees individually. On orchards of one variety, ten trees on each plot were selected for sampling by randomly generating numbers. On orchards of two varieties, twelve trees on each plot were selected for sampling in the same way.

Results & Discussion

Year One results were published in detail in the interim report. Summaries of the results in the context of Year Two results are presented below. In Year One, apple scab infection was severe in Site A. In order to prevent carry-over from Year One, in Year 2 of the trial, all sites received a winter wash in addition to the regular applications as per the methodology.

An early scab infection was detected in Year 2 on Site A by the farm agronomist. The grower subsequently decided to pull-out of the trial and usual practice resumed. Nonetheless, yields from site A were measured individually by plot so results are presented below. Scab infection was deemed too high on Site E in Year Two in May so one application of Captan, a conventional fungicide, was applied to the TW plot. After which, the grower returned to TW treatment.

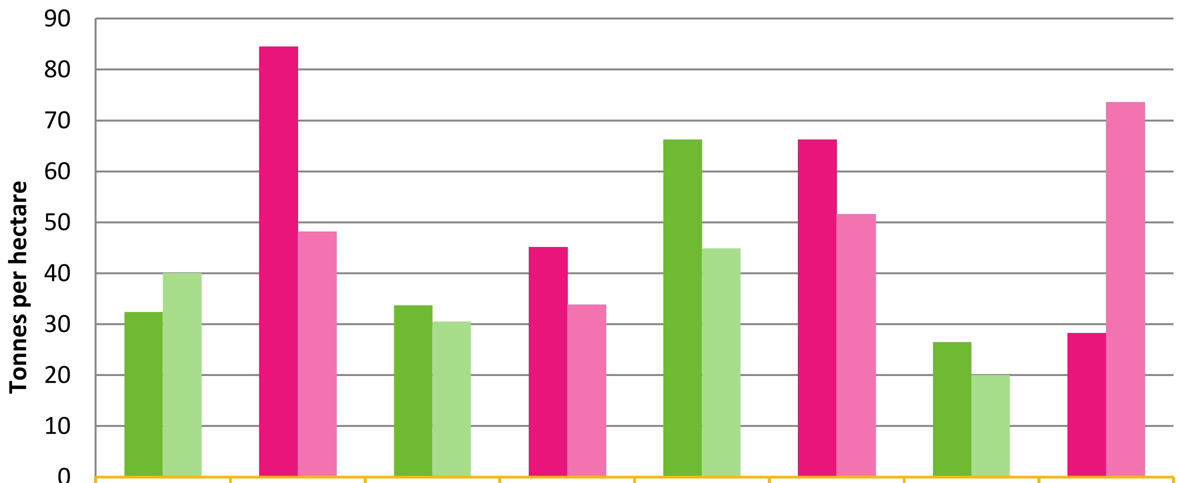
The trial was concluded after two years.

YIELD

In year one, yields from Control plots were higher than those from TW plots in sites A and B, whereas site C and D saw no statistically significant difference in yields from both plots. Yields from site E were not available owing to technical problems.

Owing to an early scab infection detected by the farm's agronomist, site A was abandoned for trial in year two. For the remaining sites, CO plots were higher yielding than TW plots, bar site E, where yield data was again not available owing to technical problems.

Submitted yields for sites A, B, C, and D*



	A* TW	A* CO	B TW	B CO	C TW	C CO	D TW	D CO
Y1 Crop	32.40	84.48	33.74	45.09	66.24	66.24	26.49	28.18
Y2 Crop	40.04	48.20	30.50	33.80	44.88	51.55	20.04	73.55

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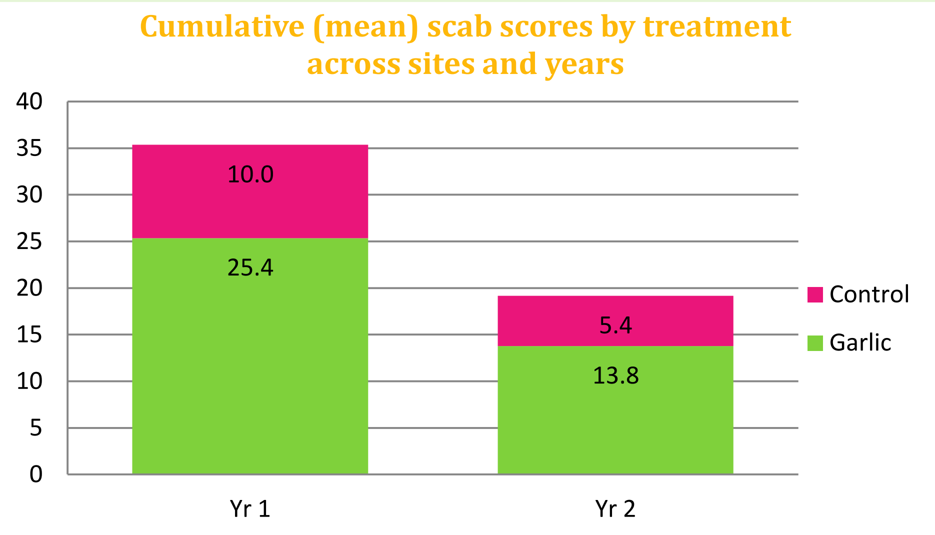
DISEASE

Although canker and blossom wilt were detected in the first year on some orchards, these diseases were not assessed in year two owing to time constraints and greater importance of powdery mildew and apple scab.

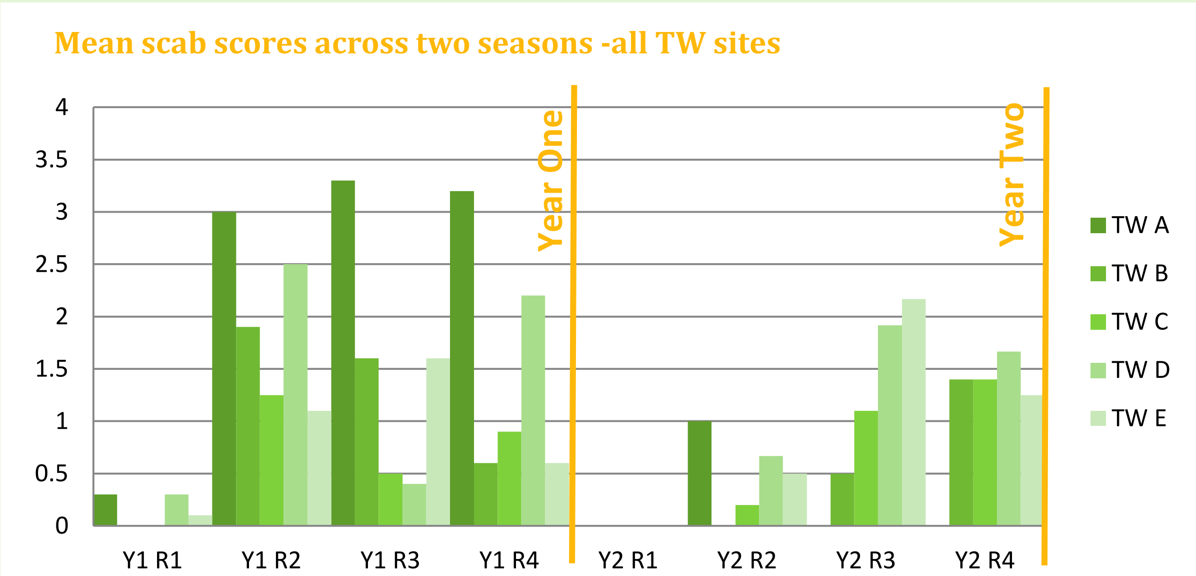
Apple Scab (*Venturia Inaequalis*)

ACCEPTABLE PEST THRESHOLD: SCORE > 2

Overall, trees treated with Tree Wash experienced higher levels of apple scab infection than trees treated with conventional sprays.



Apple Scab was more severe in Year One than in Year Two. It was also greater in TW plots than in CO plots.



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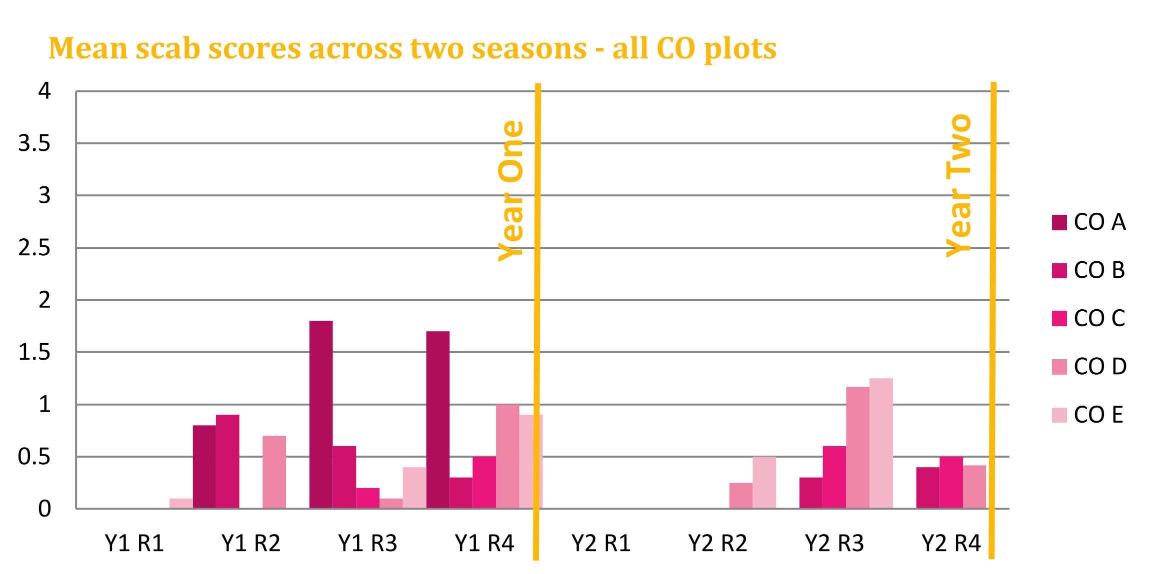
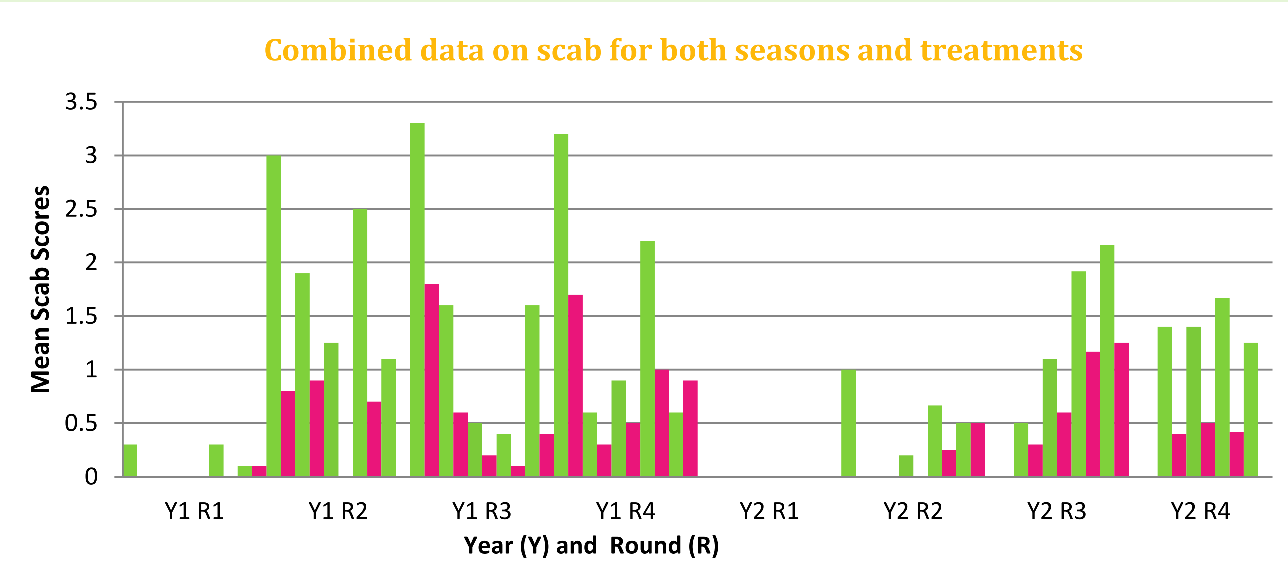


As can be seen from the above two graphs showing average (mean) scab scores for sites across the two years, the acceptable pest threshold (APT) for scab (< 3) was exceeded in TW plots on Site A in rounds 3 and 4 of Year 1 assessment. Data collected for individual trees shows that the APT was in fact exceeded on 7 individual trees in Round 3 of Year One and 8 times in Round 4 of the same year. The APT was not exceeded (in terms of mean scores) on any control sites.

Again, the below graph shows that mean scab scores were generally higher in TW plots than in controls for the same site.



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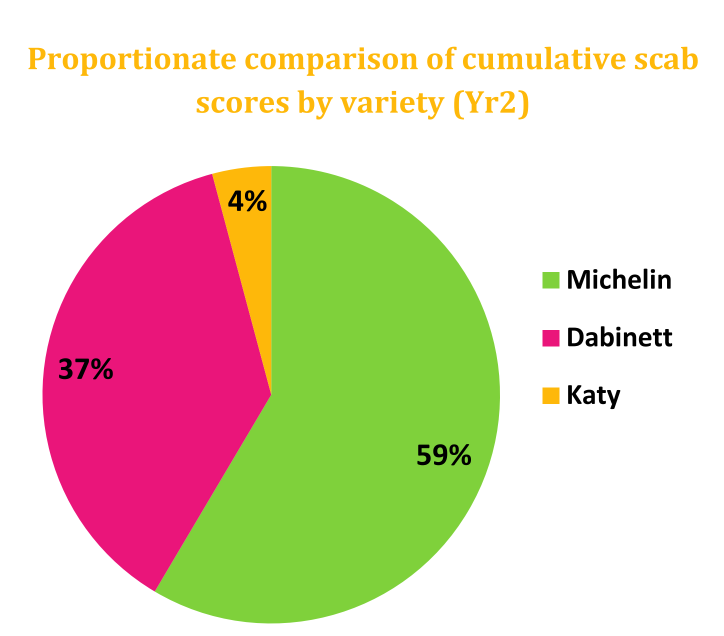
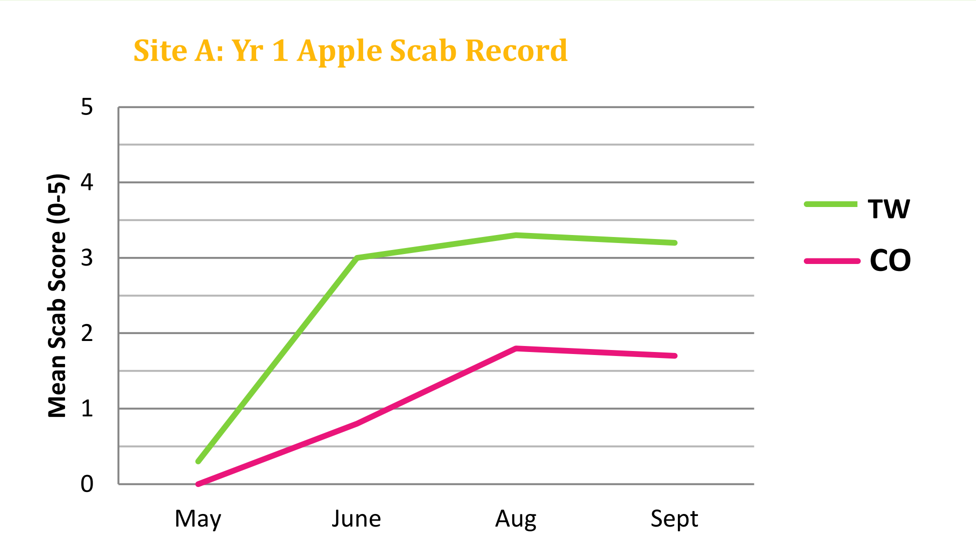
The pie chart (right) shows the relationship between variety and scab in TW plots. Michelin trees treated with TW were most likely to display symptoms of scab infection, whereas Katy trees were least likely. This follows general knowledge regarding these varieties, which places Michelin as a scab susceptible variety and Katy as a fairly resistant variety.

The following figures show the results for apple scab on individual farms. As can be seen from the figures, there is significant variation between sites.



Site A

Site A suffered badly in the Year One and scab scores not available for most of Year Two, owing to abandonment of the trial at this site. There are a number of possible reasons for the severity of scab infection on Site B; firstly, the site sits in a river basin and is therefore moist; secondly, it is surrounded on two sides by tall trees and is therefore sheltered from the wind, and lastly; one of the varieties (Michelin) appears to be the most scab susceptible.



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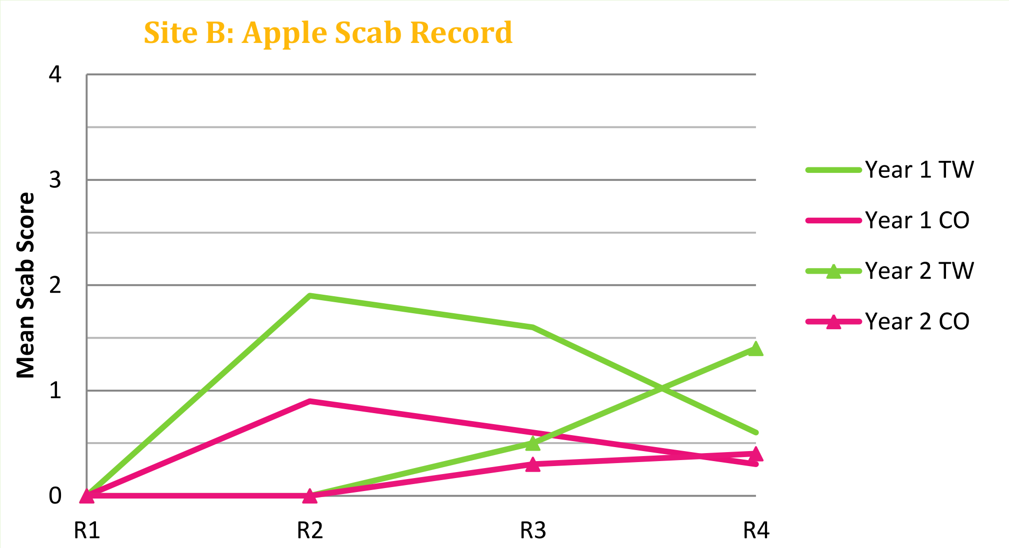
Site B

Site B had limited infection throughout the two years. This may be owing to the variety (Katy) being fairly scab resistant.



Site C

Mean scab scores on Site B did not exceed the APT at any point through both years. Scab scores for individual trees show that the APT was exceeded on TW plots on only 4 trees throughout the entire two years. Scores were generally higher in the second year.

The variety (Michelin) has otherwise been proven to be the most susceptible to scab, making these results particularly interesting. It should be noted that the site is on sloping high ground with good airflow, which may have contributed to the low scores.

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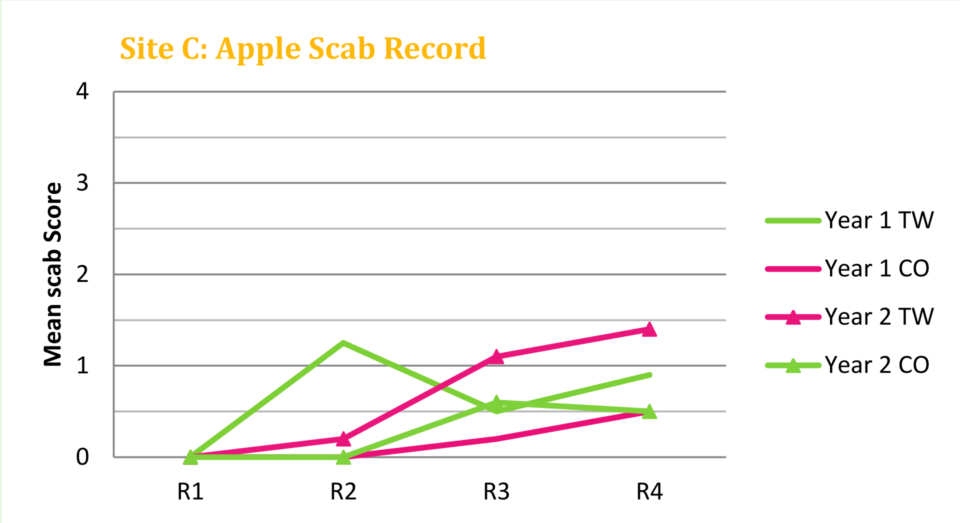
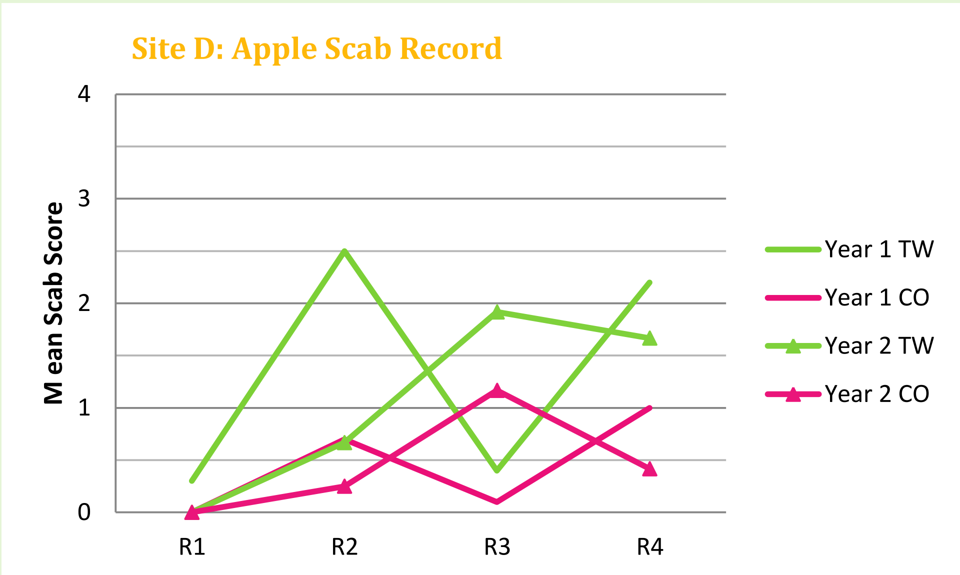


Site D

Mean scab scores for Site D dipped in August in the first year of the trial, whereas they peaked in August in the second year. This demonstrates how seasonality can play a large part in results of such a trial. Overall, scab was high in TW plots than controls. Powdery Mildew was a more significant fungal pest on Site D and the Scab scores rarely exceed the APT.



Site E

Mean scab scores were almost consistently higher for TW plots on Site A, although they rarely exceeded the APT in either year. This is likely to be (at least partially) due to one application of Captan, a conventional fungicide, in Year 2.

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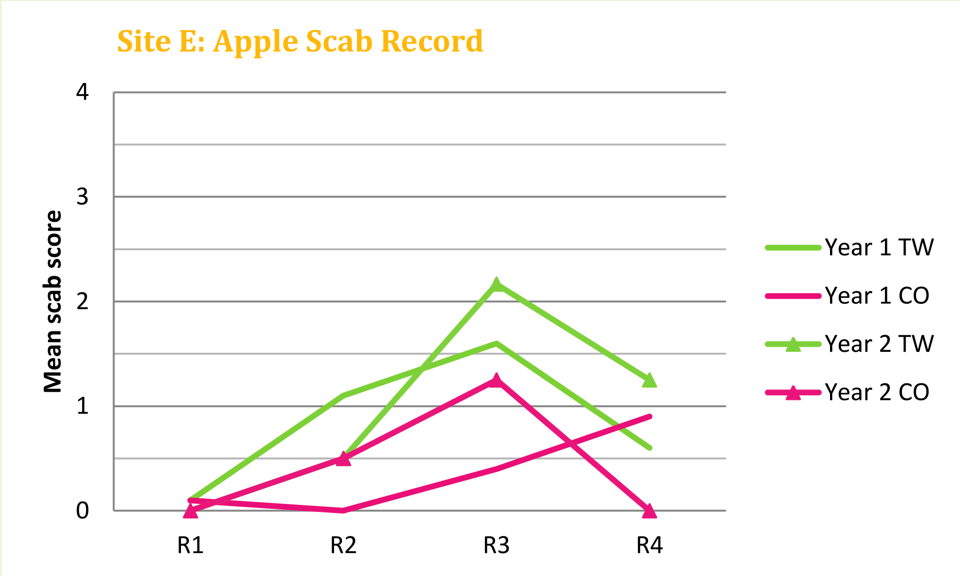
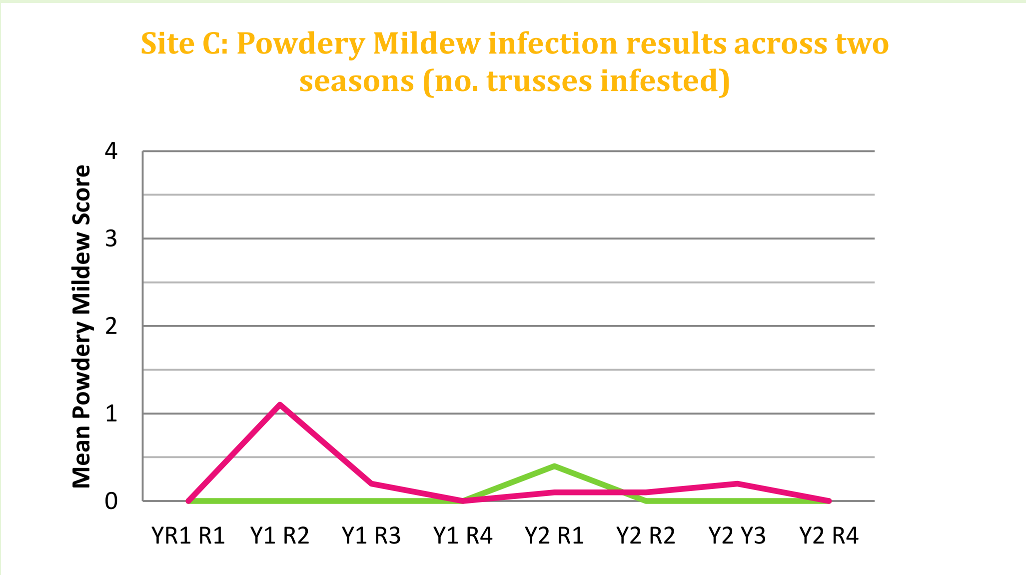


Powdery Mildew (*Podosphaera leucotricha*)

<u>ACCEPTABLE THRESHOLD: PRIMARY APPLE MILDEW, ABOVE = 5% TRUSSES INFESTED, SECONDARY (after petal fall) = 8%</u>

Only sites C and D showed significant presence of powdery mildew. There were no instances of powdery mildew infection in the TW plots at Site C and some mild mildew on the CO plots. Some trees assessed on site D were severely infected with powdery mildew; however, little difference between TW and CO plots was found.



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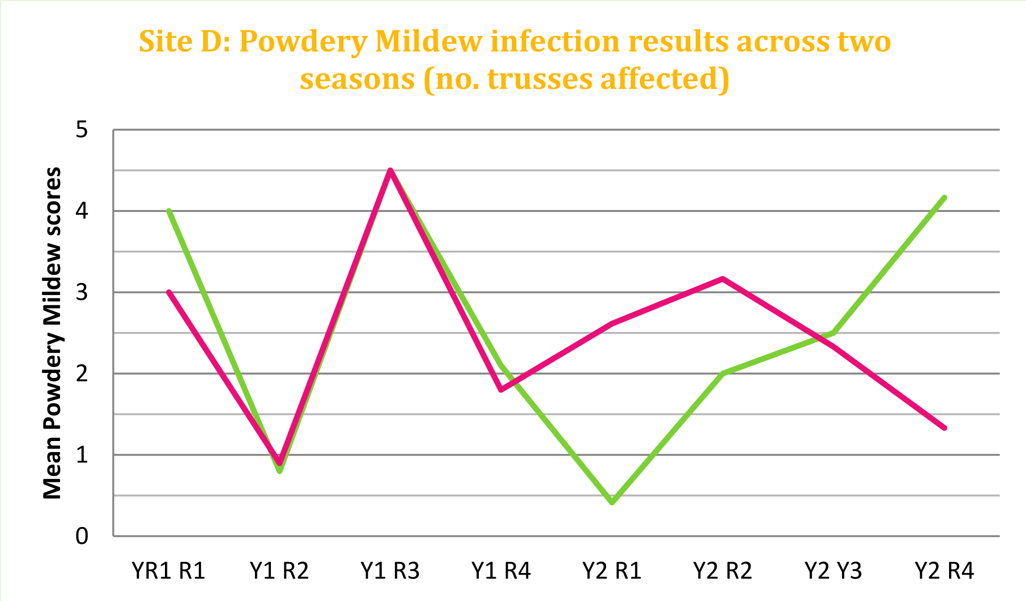
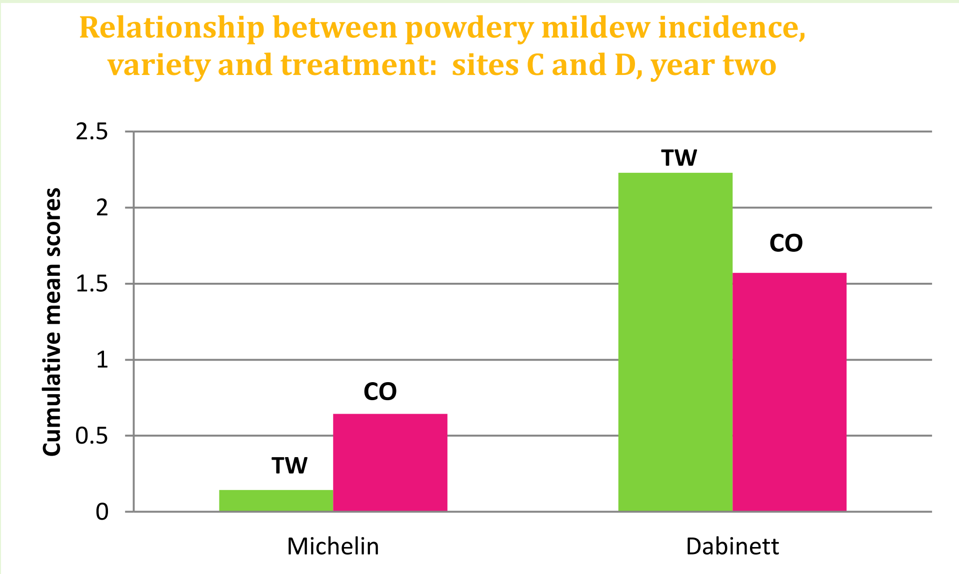


Dabinett trees were more prone to powdery mildew on TW plots and Michelin trees more prone to infection on CO plots.



INSECT PESTS

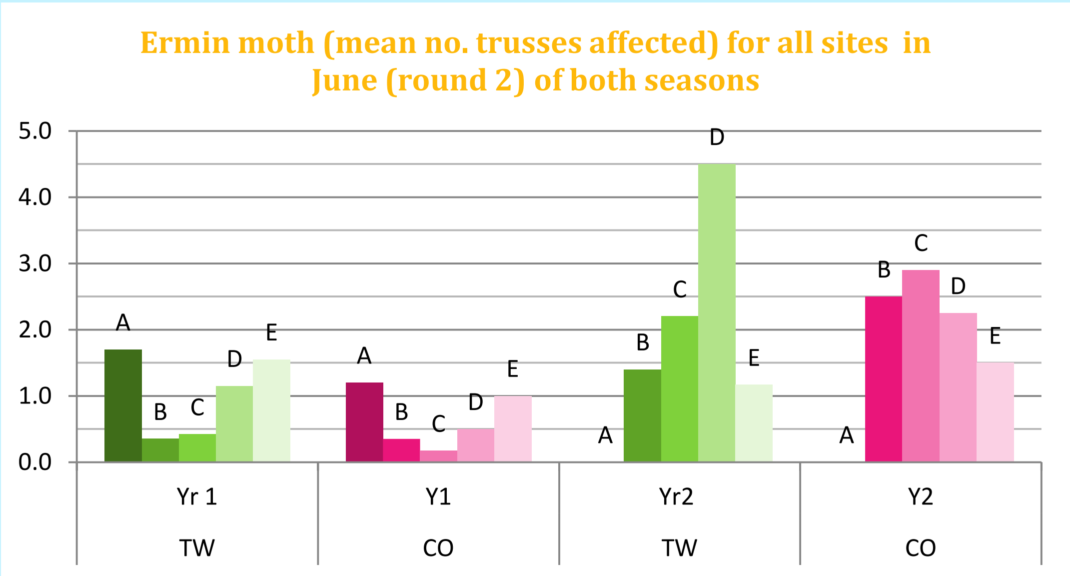
There were no instances of Woolly Aphid or Rosey Apple Aphid in any of the assessments in year one. Rosey Apple Aphids were present on orchards C, D and E in year two but there was no correlation between aphid presence and treatment so this data is not presented. Where assessments did not reveal notable results, or significant differences between TW and CO plots in terms of pest presence, results are not presented.

Details of assessments may be available in Excel file format on request, however all noteworthy results are shown below in graphs and tables.

Moths

Winter moth and Tortrix moth results did not vary much between sites or treatments, except at Site D in May, where the average number of leaves affected was zero for the Tree Wash plot and three for the control. Caterpillar damage later in the season (precise caterpillar unidentifiable by damage) was not insignificant in some instances; however, results from TW and CO plots were not significantly different, hence results are not relevant to this trial and not presented.

Ermin moths were more prevalent across sites and in almost all cases were found in higher numbers on Tree Wash plots than on the controls (as show in Figures 6 and 7 below).



Scale insects

Presence of scale insects was not uncommon on the orchards visited. In some cases, mean scale records on TW plots were more frequently above the APT, and in others, the same was true for CO plots. Overall, the Tree Wash plots had higher mean numbers of scale present.

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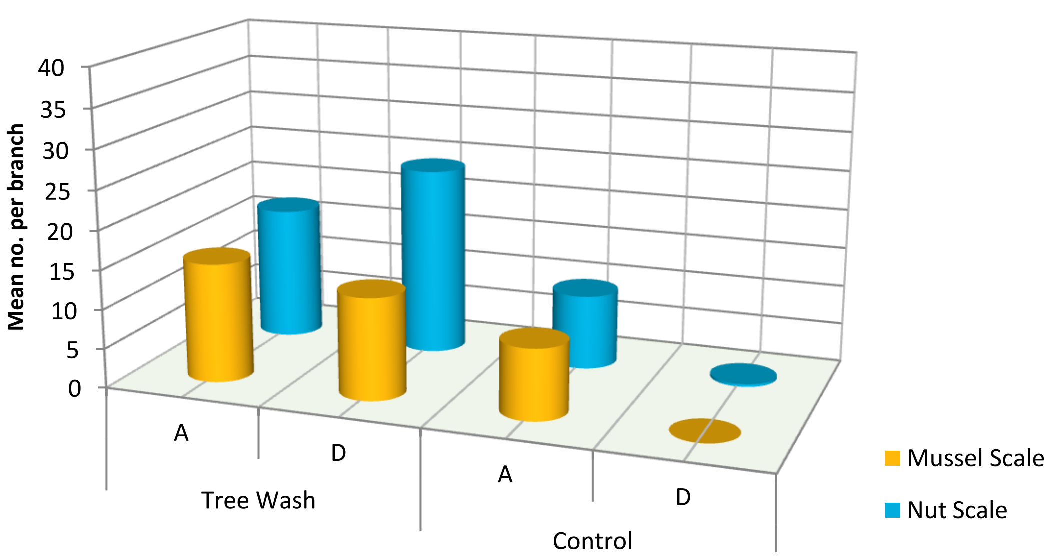
Scale insects record, Y1, R2

May Assessment		Nut Scale		Mussel Scale	
Site		Present	Over APT	Present	Over APT
A	Tree Wash	6	3	5	1
	Control	4	3	4	3
B	Tree Wash	0	0	0	0
	Control	0	0	1	0
C	Tree Wash	0	0	1	1
	Control	0	0	3	1
D	Tree Wash	5	4	4	3
	Control	1	4	2	1
E	Tree Wash	6	2	6	1
	Control	7	3	5	0
Mean across all sites		2.9	1.9	3.1	1.1
Mean for TW sites		3.4	1.8	3.2	1.2
Mean for CO sites		2.4	2	3	1

Sites A and D: Scale insects on Michelin trees, R 1, Y 2



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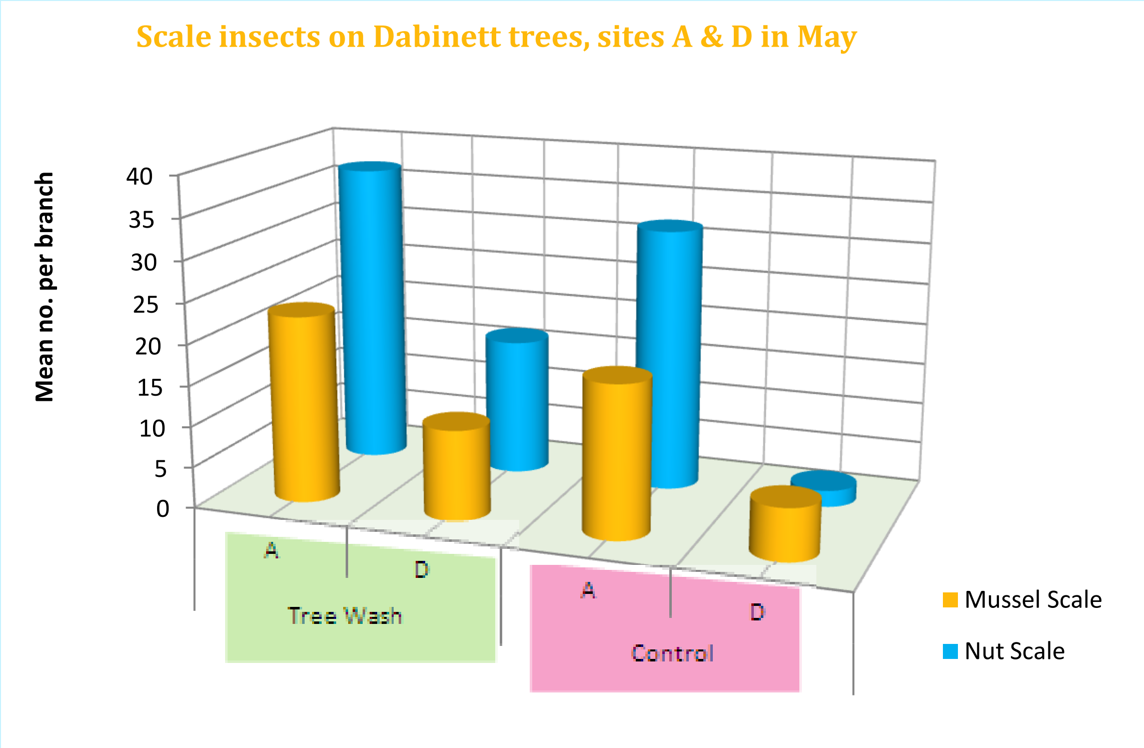

Mites

ACCEPTABLE PEST THRESHOLD: < 3 MITES PER LEAF, OF EVERY 5 SAMPLED

On average, fruit tree red spider mite and flat scarlet mite numbers were higher on CO plots than on TW ones. Occasions where the scores exceeded the APT (highlighted in pink bold typeface below) were also more common on CO plots.

Fruit tree red spider mite and flat scarlet mite scores, Y1

Month:		May				August			
		Mean no. FT red spider mite		Mean no. flat scarlet mite		Mean no. FT red spider mite		Mean no. flat scarlet mite	
Site		Present	> APT	Present	> APT	Present	> APT	Present	> APT
A	Tree Wash	5	**1**	3	0	6	**1**	0	0
	Control	7	**1**	2	0	5	**1**	1	0
B	Tree Wash	3	0	3	0	0	0	0	0
	Control	3	0	1	0	2	0	0	0
C	Tree Wash	5	0	5	0	10	**8**	1	0
	Control	5	0	6	0	8	**6**	1	0
D	Tree Wash	3	0	1	0	0	0	0	0
	Control	8	**3**	3	0	0	0	0	0
E	Tree Wash	8	0	0	0	9	**5**	0	0
	Control	7	**3**	0	0	0	**7**	0	0
Mean		5.4	0.8	2.4	0	4	2.8	0.3	0
Mean for TW sites		4.8	0.2	2.4	0	5	2.8	0.2	0
Mean for Controls		6	1.4	2.4	0	3	2.8	0.4	0

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Fruit tree red spider mite scores, Y2

Site		Y2 R1 Mean no. FT red spider mite Present	Y2 R1 Mean no. FT red spider mite > APT	Y2 R3 Mean no. FT red spider mite Present	Y2 R3 Mean no. FT red spider mite > APT
A	Tree Wash	0	0	-	-
	Control	0	0	-	-
B	Tree Wash	0	0	0	0
	Control	0	**1**	0	0
C	Tree Wash	5.0	**4**	0	0
	Control	3	**3**	0	0
D	Tree Wash	0	0	1	**1**
	Control	5	0	0	**0**
E	Tree Wash	5	**5**	1	0
	Control	9	**12**	1	0
Mean		2.7	2.5	0.375	0.125
Mean for TW sites		**2**	**1.8**	**0.5**	**0.25**
Mean for Controls		**3.4**	**3.2**	**0.25**	**0**

References

Copas, L. & Umpelby, R., 2002. *Growing cider apples: a guide to good practice*, Hereford, NACM/St Owen's Press.

HDC, 2010. *Top fruit best practice, IPM monitoring 2010*, Horticultural Development Council.

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Appendix 1: Tree Wash Plots

A: Pigeon Farm, Weston Beggard, Herefordshire

B: Lower Whettons, Broxwood, Herefordshire

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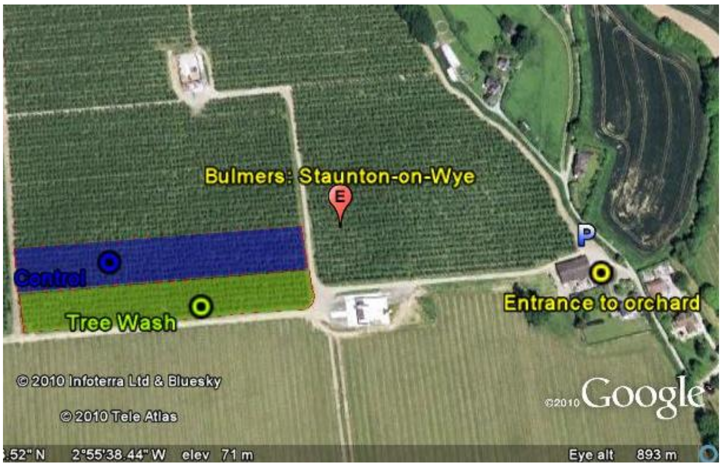
C: Ford House Farm, Newent, Gloucestershire

D: Westons Cider Farm, Much Marcle, Herefordshire



E: Heineken Farm, Staunton-on-Wye, Herefordshire

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Appendix 2: Orchard plot details

Site	Apple Variety	Age	Planting density	TW plot size	Control plot size	Soil type	Position/ topography	Drainage conditions	Est. Rainfall
A	4 Michelin, 1 Dabinett	12 years	18 x 9	2 hectares	2 hectares	Clay loam	Flat, lies in the River Frome valley	Herring-bone drainage system	750 mm
B	Katy	10 years	19 x 9	0.8 hectares	0.8 hectares	Clay loam	Slight north slope	Very good	750 mm
C	Mitchelin	13 years	18 x 9	1.5 hectares	1.5 hectares	Sand/ gravel	South-west slope	Good	750 mm
D	4 Michelin, 4 Dabinett	11 years	16 x 8	2 hectares	2 hectares	Medium loam, poor depth (15")	Slight east-west slope	Good	780 mm
E	4 Michelin, 1 Dabinett	40 years	18 x 9	0.45 hectares	0.45 hectares	?	Flat	Good	750 mm

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