Factsheet 15/11
Apples
Projects TF 164, TF 173 and
Defra HH2502STF, HH3122STF

Horticulture Development Company

Stoneleigh Park
Kenilworth
Warwickshire CV8 2TL
T: 0247 669 2051
E: hdc@hdc.ahdb.org.uk

The zero residue management system for apples

Angela Berrie, East Malling Research

The Zero Residue Management System (ZRMS) has been developed through a series of research projects funded by Defra and more recently HDC to find a new growing regime for producing fruit that is free from detectable pesticide residues. This factsheet outlines the background to the work and offers growers advice on converting and managing ZRMS orchards.

Introduction

The tree fruit industry has come under increasing pressure from both consumers and retailers to produce fruit that is free from detectable pesticide residues (Figures 1 & 2). Such pressure prompted several research projects to be set up to explore and develop ways of producing fruit that is free from such residues. Given that apple acts as a host to a wide range of insect pests and diseases, commercial apple growers are forced to use a significant number of crop protection products to ensure that the fruit harvested is of a high enough standard to meet the demands of consumers and retailers. It is therefore an extremely difficult task to produce fruit of similar quality with reduced reliance on conventional crop protection products.

1 Apple producers are under pressure to produce high quality fruit that is free from detectable pesticide residues

2 Pesticide residue analysis sometimes detects the presence of chemical residues

Defra and HDC funded research

During a period of six years, two Defra funded projects (HH2502STF and HH3122STF) and an HDC project (TF 164) were co-ordinated by East Malling Research both on station and in commercial orchards. The aim was to develop a suitable pest and disease control programme which could gain effective control of the key insect pests and diseases of apples, whilst minimising the risk of detectable pesticide residues occurring in the harvested fruit.

The varieties Cox, Gala, Braeburn and Bramley were used in these projects as they are considered to be highly susceptible to the most commonly occurring pests, diseases and storage rots of apple. The control programme was developed with three objectives in mind:

1. To control diseases and pests after harvest and during the dormant season (Figure 3) to reduce or minimise the quantity of disease inoculum and pests being carried from season to season.
2. To rely upon the use of conventional pesticides only after harvest and up until petal fall in the year of harvest.
3. To rely solely on the use of biological control agents and sulphur (for disease control) from petal fall until harvest.

3 One objective of the system is to control diseases and pests after harvest and during the dormant season

Initial trials were undertaken at East Malling Research to develop a Zero Residue Management System (ZRMS) and later, during a period of three seasons, this was tested on two commercial Cox and two commercial Gala orchards in Kent. The results were very promising and demonstrated that scab, powdery mildew and storage rot control was better or equal to that achieved in conventional orchard plots (Figure 4), whilst insect pest control was satisfactory.

As a result of this initial research, the HDC decided to fund a further trial (TF 173) to more rigorously test the ZRMS in orchards and locations where the pest and disease pressure was rather greater. Project TF 173 ran for three seasons from 2007 until 2010. The varieties Gala, Bramley and Braeburn were assessed on four sites, three of which were in Kent and one in Gloucestershire, where higher average annual rainfall increased the risk of disease infection.

The ZRMS programme of control treatments is listed in Table 1.

4 Conventional control of diseases was compared to control in the ZRMS

Table 1 Summary of treatments in the zero residue management system

Timing	Pest/Disease target	Suggested treatment Typical product (Active ingredient)
Post-harvest (conventional pesticides)		
September/October	scab/mildew	Systhane (myclobutanil) + Alpha Captan (captan)
October	nectria canker	Folicur (tebuconazole)*
October (approx. 7-14 Oct)	aphids	Aphox (pirimicarb) or other aphicide but different chemical group to Calypso (thiacloprid)
Pre-leaf fall	scab	Urea
Leaf fall	nectria canker	Cuprokylt (copper oxychloride) Folicur (tebuconazole)*
Winter	overwintering codling	Nematodes
Winter	canker	Removal in pruning
Winter/spring	scab	Macerate leaf litter
Pre bud burst (conventional pesticides)	scab/nectria canker	Cuprokylt (copper oxychloride)
Bud burst – petal fall (conventional pesticides)		
Bud burst - petal fall	scab	Dithianon (dithianon) Alpha Captan (captan) Systhane (myclobutanil)
Petal fall – June	scab - On very susceptible cultivars such as Gala conventional sprays can be continued for 2 to 3 rounds after petal fall in high risk years	Systhane (myclobutanil) + Alpha Captan (captan)
Bud burst - petal fall	mildew	Systhane (myclobutanil) or Nimrod (bupirimate) or Topas (penconazole)
Mouse ear/green cluster	tortrix/winter moth	Runner (methoxyfenozide)
Pink bud	tortrix	Insegar (fenoxycarb)
	aphids/weevils/sawfly/capsids	Calypso (thiacloprid)
Blossom and petal fall	nectria/storage rots	Bellis (boscalid + pyraclostrobin) or Alpha Captan (captan)
Petal fall	tortrix/codling moth	Insegar (fenoxycarb)
	aphids/weevils/sawfly/capsids	Calypso (thiacloprid)
Petal fall – harvest (sulphur, biocontrol or cultural control only)		
Petal fall – harvest	mildew	Sulphur
Petal fall – harvest	codling moth	Granulosis virus
Petal fall – harvest	tortrix	Dipel* (*Bacillus thuringiensis*)
Petal fall – harvest	storage rots	Rot risk assessment Inoculum removal Selective picking

* Specific Off Label Approval

General findings from all projects

The control of apple scab in most seasons was commercially acceptable.

Similarly, insect pest control was commercially acceptable, although the incidence of damage was generally higher in ZRMS fruit at harvest compared to conventional orchards.

The control of storage rots was as good or better from the ZRMS orchards compared to the conventional.

The control of powdery mildew was satisfactory in the experimental plots at East Malling Research. However, the control of powdery mildew in the commercial trials was poor in many cases, with high levels of primary and secondary mildew in many of the ZRMS orchards and in some of the conventional orchards too, suggesting an inherent problem with mildew control in commercial orchards.

No detectable pesticide residues were found in fruit produced from the ZRMS orchards. In contrast, penconazole, myclobutanil, captan, pyraclostrobin, boscalid, pirimicarb, indoxacarb, chlorpyrifos and methoxyfenozide

were detected in fruit produced in the conventional orchards, but none of these exceeded the maximum residue level (MRL). It should be noted that with analytical methods continuously being improved and able to detect extremely low residues, zero residues may not be an appropriate name for the system in future. The risk of disease infection or insect pest infestation is generally higher in the ZRMS regime so it is essential to practice more careful orchard monitoring in this type of production system.

Some of the growers perceived that the ZRMS cost more to practice than a traditional control programme, but this was only true of one of the sites tested. However, the costs of monitoring are greater compared to monitoring a traditional programme.

Key considerations when employing a zero residue management system

Given that the risks of pest and disease infection and spread are greater with this system, before adopting it, growers will need to consider ways of reducing the risks to provide confidence that satisfactory control can still be achieved.

There are four major issues to consider:

Scab

For apple varieties that are very susceptible to scab such as Gala, a more flexible approach to control may be required than that followed in the trial ZRMS orchards. In orchards in areas of high rainfall or in high risk seasons, the use of conventional control programmes may need to be extended for a couple of spray rounds after petal fall to ensure adequate control is achieved.

Powdery mildew

Powdery mildew control in the trials in commercial orchards was generally poor and there is little doubt that a similar approach to apple scab in high risk situations would need to be followed. Additional spray rounds beyond the end of petal fall would be necessary to provide improved control.

Probably of greatest importance is closely monitoring the mildew incidence in the orchard and managing the risk by adjusting fungicide dose and spray interval to match it.

5 The HDC DVD 'Mastering rot risk assessments' trains staff on how to assess orchards for rot risk

6 Particular attention should be reserved for mussel scale

Storage rots

Based on the findings of the trials, growers can afford to be more relaxed about the incidence of rots in store.

However, rot risk assessments should involve thorough monitoring in orchards. Growers should use the HDC Rot Risk Assessment DVD to help with this (Figure 5).

Insect pests

Although control was generally satisfactory in trials, particular attention should be reserved for woolly aphid and mussel scale (Figure 6). For these pests, there may be a need to extend conventional control programmes beyond petal fall and then to extend the harvest interval to be sure of avoiding residues.

Setting up a ZRMS orchard

Although the ZRMS trials demonstrated a commercially acceptable level of control of apple scab, storage rots and insect pests, growers are advised to exercise caution before converting large numbers of orchards to this control regime.

It is better to convert one or a small number of orchards to a ZRMS regime for a few seasons to assess how well it works for you in commercial practice.

Before converting an orchard, be guided by the following:

The key feature of the zero residue management system is to reduce the populations of pests and diseases during the dormant season to ensure negligible inoculum carryover from one season to the next. Choice of orchard, starting at the right time and meticulous and sustained orchard monitoring and implementation of the management programme are vital to success.

Choice of orchard

It is important that orchards selected for a ZRMS programme have a low incidence of pests and diseases at the outset, especially powdery mildew. Those with a history of disease or pest problems should be avoided. The orchard must be well managed and trees trained and pruned to ensure an open canopy for good air circulation and spray penetration. Trials experience so far has been on Cox, Gala, Fiesta, Bramley and Braeburn and on scab resistant varieties where good success has been achieved. Use orchards of these varieties first.

When to start

It is important to start the ZRMS programme in the autumn, shortly after harvest to implement the important late season and dormant period tasks that are vital to success.

Zero residue management system

Follow the features of the zero residue management system in Table 1.

Management of the herbicide strip

Management of the tree strip is the same as in conventional production. Excessive weed growth is undesirable, but if weeds are managed, they could provide soil cover to prevent soil splash to fruit pre-harvest. A dead-grass mulch is ideal. Applying a straw or compost mulch would also prevent soil splash (Figure 7).

Orchard monitoring

A rigorous, regular programme of orchard monitoring for pests and diseases is vital. This enables timely corrective action to be taken. Orchard inspection for scab during blossom and petal fall is critical. If significant levels of scab are present then proceeding with the zero residue programme is not advisable. Similarly, if a problem gets out of control between petal fall and harvest then it may be necessary to intervene with pesticide applications. This should rarely be necessary and may not result in residues if a sufficiently long harvest interval can be observed.

7 Dead grass or a straw mulch is ideal for preventing soil splash

Action points for growers

- The zero residue management system (ZRMS) for apples is commercially viable, but growers should be aware of the risks involved.
- The risk of disease infection or insect pest infestation is higher in the ZRMS regime, so a rigorous, regular programme of orchard monitoring for pests and diseases is vital. The costs of monitoring a ZRMS are greater than those of a traditionally managed orchard.
- Before setting up a ZRMS, consider ways of reducing risks to provide confidence that satisfactory control can still be achieved.
- For varieties susceptible to scab or powdery mildew, additional spray rounds beyond the end of petal fall may be necessary to provide improved control.
- To avoid rots, orchard rot risk assessments should be made at key stages in the season.
- For woolly aphid and mussel scale, conventional control programmes may need to be extended beyond petal fall.
- It is best to convert one or a small number of orchards to a ZRMS regime for a few seasons to assess how well it works for you in commercial practice.
- Choice of orchard, starting at the right time and meticulous and sustained orchard monitoring and implementation of the management programme are vital to success.

Further information

Project reports

TF 164
Producing apples free from pesticide residues

TF 173
On-farm evaluation of zero residue system for apples

Other useful publications

HDC Apple Best Practice Guide
(Available on tree fruit page of the HDC website www.hdc.org.uk)

Aug 2011