



Agriculture & Horticulture
DEVELOPMENT BOARD



Grower Summary

TF 184

Apple – Evaluation of
treatments to control mouldy
core

Final 2012

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Before using all pesticides check the approval status and conditions of use.

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Further information

If you would like a copy of the full report, please email the HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

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HDC is a division of the Agriculture and Horticulture Development Board.

Project Number: TF 184

Project Title: Apple – Evaluation of treatments to control muddy core

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Contractor: EMR

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Headline

Bellis and Switch both had some effect in reducing mouldy core or core rot in Cameo in trials in 2009

Background and expected deliverables

Mouldy core or core rot is an internal rot of certain apple cultivars that have an open eye which allows saprophytic fungi colonising senescing flower parts to be washed into the core. Fungal growth then develops within the apple core, initially without invading the apple flesh (mouldy core). The fungi may then invade the flesh leading to the development of a slow, dry rot confined to the apple centre (core rot). Mouldy core may also continue to develop in store and may then appear at the cheek, eye or stalk end of the fruit as a more distinctive core rot.

The main problem with mouldy core is that it develops inside the apple and can remain undetected until the fruit is eaten or processed. Discovery of mouldy core in this way can obviously affect consumer acceptability of the variety and rejection of consignments by supermarkets. In shelf-life tests conducted by a local pack house after grading, levels of 10-20% mouldy core were commonly found in samples of Cameo and recently in a bag of ten Cameo fruits purchased from a supermarket three were found to have mouldy core. External symptoms in the orchard are rare but fruit may colour and fall prematurely. Many cultivars of apples are affected worldwide, especially Red Delicious and Red Delicious types. In the UK the problem is mainly associated with the cultivars Cameo and Bramley's Seedling, but may also occur in Ida Red, Braeburn, Gloster and certain cider apple cultivars.

Mouldy core can be caused by a range of different fungi including *Alternaria*, *Stemphylium*, *Cladosporium*, *Epicoccum* and *Fusarium*. In other countries *Alternaria* is generally the most important cause of core rots (Kennel, 1983; Archer, 2002).

Wet weather during blossom encourages colonisation of flower parts by fungi and can increase the risk of mouldy core.

In some apple varieties, especially Bramley, core rots can also result from fungi that enter the core when the fruit is drenched post-harvest in fungicide or anti-scald agents. The core rots then develop during cold storage. These core rots are caused by a range of fungi including *Fusarium*, *Mucor* and *Penicillium*. In most cases the problem can be solved by only drenching post-harvest if necessary and adopting strict hygiene measures in the drenching operation to prevent the build up of mud, fungal spores and other debris in the drenching solution.

There have been many studies conducted in other countries on control of mouldy core or core rot, particularly on the cultivar Red Delicious where *Alternaria* is generally the main cause of the problem. Application of fungicides between first flower and petal fall reduced the incidence of mouldy core in most experiments. Not all fungicide trials were successful and this may be related to differences in the complex of fungi responsible for mouldy core. Treatments found to reduce the incidence of mouldy core in trials included carbendazim, mancozeb (Karamate), various DMI fungicides (e.g. myclobutanil), vinclozolin (Ronilan), strobilurin fungicides (e.g. azoxystrobin) and potassium phosphite. In the UK, vinclozolin, carbendazim or tolylfluanid (Elvaron Multi) were previously used for control of mouldy core. However, these fungicides are no longer approved for use on apples.

The purpose of this project is to identify the main fungi responsible for mouldy core or core rot in Cameo and Bramley, and to identify alternative fungicides or chemicals that are effective in controlling the problem.

Summary of the project and main conclusions

In August 2008-2010, random samples of 100 apples were collected from the orchard floor and from trees in Cameo and Bramley orchards in Kent. Sampled fruit were chopped and checked for the presence of mouldy core or core rot. In Cameo the incidence of mouldy core in fruit on the tree varied from 0-19% in 2008, 0-20% in 2009 and 0-10% in 2010. The incidence in fruit on the orchard floor varied from 0-38% in 2008, 0-50% in 2009 and 3-34% in 2010. In Bramley the incidence of mouldy core or core rot in fruit on the tree varied from 0-14% in 2008, 2-14% in 2009 and 0-4% in 2010. The incidence in fruit on the orchard floor varied from 2-48% in 2008, 27-54% in 2009 and 10-27% in 2010. The main fungi isolated from the rotted cores in both years in both cultivars were *Fusarium* spp. (at least 3 different species), *Alternaria* sp. and *Penicillium* sp. Other fungi recorded included *Cladosporium* sp, *Phomopsis* sp, *Colletotrichum* sp. and *Botrytis cinerea*. In addition, information on core rot incidence in stored Bramley was also obtained. Total losses due to rots ranged from <1-10% in 2008, <1-4% in 2009 and 0.1-5.5% in 2010. In 2008 up to 20% of these losses (mean 8%) could be attributed to core rots. In 2009 the incidence of core rots was higher with up to 32% of rotting due to core rots (mean 14%). In 2010 the incidence of core rots ranged from 0-22.2% (mean of 7.1%). The survey confirmed that mouldy core and core rot were a significant problem in Cameo and also showed that they were a more significant problem in Bramley than previously thought, particularly in long-term stored Bramley.

In 2010, two trials were established to evaluate fungicides and alternative products for control of mouldy core and core rots. One trial was in a commercial Cameo orchard located in west Kent and the second trial was in an established Bramley orchard located at East Malling Research. Treatments evaluated were Bellis (pyraclostrobin + boscalid), Switch (cyprodonil + fludioxonil), an experimental fungicide, Farmfos 44 (potassium phosphite) and Serenade (*Bacillus subtilis*) all applied as a two spray programme at full bloom and 7-10 days later. An additional treatment of three sprays was included with Switch alternating with Bellis, starting at 50% open bloom. An untreated control was included for comparison. Unfortunately the weather conditions in 2010 were unfavourable for mouldy core and core rot, so the incidence of core rots in the two trials was too low for any meaningful conclusions on control to be made. The results from trials in 2009 indicated that both Bellis and Switch had some effect on reducing mouldy core in Cameo.

Financial benefits

Cameo is a niche variety grown by around 30 growers in the UK. In 2007, about 700 tonnes of apples were produced but this quantity is likely to increase each season as many orchards have only recently been planted. It is well liked by consumers. This variety appears to be very susceptible to mouldy core or core rot, with average incidence in 2007/8 of around 10%.

Bramley is one of the main varieties grown in the UK and is important as a culinary apple and for processing.

The main problem with mouldy core is that it develops inside the apple, often in store or as the fruit ripens during marketing and can remain undetected until the fruit is eaten or processed. Discovery of core rots in this way can obviously affect consumer acceptability of the variety and rejection of consignments by supermarkets and processors. It is therefore important that an effective solution is found for this problem. The problem does occur in other varieties but at a much lower incidence.

Action points for growers

- Mouldy core is a significant problem in Cameo and fungicide treatments should be applied during blossom to reduce losses.
- Core rots are a more significant problem in Bramley than previously thought (particularly in long-term stored Bramley) and fungicide treatments should be applied during blossom to reduce losses.
- The fungicide trials in 2009 indicated that Bellis and Switch have some effect on reducing mouldy core. These should be applied at full bloom and repeated 7-10 days later.