Crop specific guidance – Apple Orchards

The IPM Tool allows you to prioritise pests that are important on your farm. This helps guide decisions on which IPM measures are appropriate. Implementing IPM can result in 'trade-offs' where methods to control one pest may increase another. Some of these trade-offs are included in the notes below and in the Tool. Prioritising pests will help decide which pests are most important where there are trade-offs. This guidance document provides advice on IPM measures for apple orchards insect pests and diseases. For information on IPM interventions for weeds, refer to the separate IPM Weeds guidance document.

Insect Pests

Invertebrate pests in apple orchards include aphids, fruit tree spider mite, and lepidopterous caterpillars, which cause damage by reducing crop growth or quality by feeding, or transmitting viruses or toxins. Crop quality standards are high for top fruit crops and the presence of a blemish or pest can result in rejection by the customer. Damage caused by pests can also allow secondary pathogens to gain entry through a plant wound. IPM for pest control in apple orchards involves interrupting the pests' life cycle and encouragement or augmentation of natural enemies.

Few of the non-chemical methods are likely to be 100% effective, however, they do reduce the requirement for chemical control. Combinations of one or more techniques are likely to be most effective.

Hygiene and prevention

Removing dropped fruit from the orchards floor can prevent codling moth caterpillars moving from dropped fruit into the soil to complete their development. This reduces the local population in the orchard the following spring. Grazing with sheep or pigs can be used instead of physically removing fruit, but livestock can cause damage to trees.

Nutrient management

High soil organic matter content has been linked to lower pest pressure. Avoiding excessive nutrient inputs can help to prevent excessive new tree growth, which can result in high numbers of aphids.

Physical exclusion of pests

Netting individual trees to exclude insects and prevent access from the soil can reduce codling moth fruit damage. However, netting can act as a barrier for beneficial insects and natural enemies and has been known to allow populations of aphids to increase. Exclusion bands can be used to prevent ants from gaining access to defend aphid colonies. Supplementary sugar feeders can be used to distract ants from the aphids, enabling predators and parasitoids to access undefended aphids and decrease their population.

Pruning / canopy management

Training the architecture of fruit trees as they grow, for example centrifugal pruning, can enable predators to access pests more easily and reduce the numbers of aphids. Removal of curled leaves in young orchards can reduce colonies of rosy apple aphid. In older orchards removing excess growth

from the central tree zone will encourage aphids to establish on new peripheral growth, where they are more easily accessible to flying predators such as birds and parasitoids.

Birds predate several pests in apple orchards and can reduce numbers of codling moth and other lepidopterous caterpillars during the nesting season. Pruning helps to open the canopy and allow birds access to the pests, however netting or bird scarers may be required to prevent any damage from birds when the fruit is near to ripening. Thinning the orchard canopies can also improve the spray coverage of biopesticides and insecticides.

Undersowing and companion cropping

Providing alternative vegetation such as wildflower mixes in an orchard will provide many predators and parasitoids with shelter and alternative food sources, enabling them to decrease numbers of aphids and fruit tree spider mites. Providing access to flowering plants such as *Alyssum* can help increase the hoverfly population and improve aphid control by predation. Common nettle can be used as a banker plant to establish a nettle aphid population, which will not infest trees but provides a food source to beneficial insects such as ladybirds, lacewings, hoverflies, and aphid parasitoids.

Spatial separation

When establishing a new commercial apple orchard, it is beneficial for it to be situated far from unsprayed orchards or gardens as these can be a source of infestation of flighted pests such lepidoptera.

Variety choice / root stock choice

Apple scion varieties are available, such as Florina and Prima, which are less susceptible to the rosy apple aphid. Rosy apple aphid resistance is linked to the presence of hydroxycinnamic acids, which protect fruit skin from UV light and are common in cider apple varieties. Some apple varieties are susceptible to rosy apple aphid however their buds burst later in the season after egg hatch and tend to have fewer rosy apple aphids as the neonates cannot feed. Information on apple varieties is available direct from breeders.

Bioprotectants macrobiological / Natural enemies

There are many native predator species, which can be found in the orchard habitat especially when insecticide sprays are withheld or reduced. For example, *Anthocorid* species and the common earwig can help to control soft bodied insects, the predatory mite *Typhlodromus pyri* can provide good control of fruit tree red spider mite, and the parasitoid wasp *Platygaster demades* is the natural enemy of apple leaf midge. Earwigs are generalist predators of pests in apple orchards such as aphids and moth caterpillars. Earwigs can be considered a pest in soft fruit crops, but where fruit quality and skin finish are good, they are not considered a pest in top fruit as minimal damage is caused. Earwig nests can be used to encourage earwig populations, which can made from rolled up cardboard in milk bottles with dried cat food as a food source or commercial refuges are available. In organic orchards releases of five to six earwigs per tree reduced aphid numbers to 50 per tree compared with 2000 - 3000 aphids per tree in the untreated controls.

Bioprotectants microbial

Granuloviruses are available which specifically target the codling moth and can be used to provide control without affecting other species. Madex Top (*Cydia pomonella Granulovirus* isolate V15) is currently approved for use on apples in the UK and it is best to apply the virus just before egg hatch to ensure that the vulnerable neonates will ingest the virus when feeding on the fruit surface. The infected larvae will continue feeding for two to four days before death, leaving shallow feeding holes known as 'sting injury', which may lead to downgrading of the fruit and is not recommended close to harvest.

The bacterium *Bacillus thuringiensis* subspecies *kurstaki* ABTS-351 (DiPel DF, EAMU 3028/19) can be used to control lepidopterous larvae. Caterpillars ingest the bacteria which releases a fatal toxin as it breaks down and the caterpillar activity and feeding stops immediately, followed by death after four to five days. This biopesticide is most effective when applied to actively feeding, young larvae, however codling moth larvae only feed for a limited time before boring into the fruit and may not ingest a lethal dose.

Bioprotectants semiochemicals

Sex pheromones are a type of semiochemical that can be used for monitoring and mating disruption for codling moth and other lepidoptera. Mating disruption can be achieved with passive pheromone dispensers, regular aerial sprays or timed-release aerosols to coincide with the female's natural pheromone release to confuse males. Pheromone systems such as RAK 3+4 are available for codling mothand summer fruit tortrix moth mating disruption and are best used in orchards greater than 1 ha in size with a low pest population (where no more than 1% of fruit was damaged in the previous year), and if no other controls have been used and spatially isolated from other tall trees. Pheromones are available to monitor populations of other species such as fruit tree tortrix moth, summer fruit tortrix moth, and light brown apple moth.

Diseases

Apple diseases can cause significant yield and quality losses in orchards, both to the growing plant and the harvested produce during storage or transport. Some of the most economically important pathogens include apple scab, canker, powdery mildew and replant disease.

Field history, Rotation & break crops

Crop rotations of five years or more are likely to be effective at reducing apple diseases such as apple scab and apple replant disease (ARD), with longer rotations showing an increased benefit from avoiding planting the same crop in the same soil continuously. Grass with clover swards can acts as a break crop prior to where trees are to be planted.

Low risk locations

Selecting as low a risk location as possible for apple orchards is effective at reducing apple replant disease (ARD). ARD occurs when new trees are planted in the same soil as previous trees of the same pome or stone fruit crop, for example apples following apples, and they may develop various symptoms including stunted growth, shorter internodes, reduced biomass and reduced yields.

Variety choice / root stock choice

Rootstock selection for resistant varieties will help reduce the risk and incidence of canker and powdery mildew. However, in general the effects of climate, soil factors, and management factors such as mowing and tree spacing will have a greater effect on apple diseases than the rootstock selection. No varieties have complete resistance to powdery mildew, however Discovery and Grenadier have a very low susceptibility to mildew, whereas varieties including Cox, Golden Delicious and Gala are very susceptible.

Pruning / canopy management

Canopy management is important for reducing infection by fungal pathogens, which often spread and infect more rapidly in humid environments, such as apple scab. Pruning to allow good circulation encourages faster drying of leaves and fruit following rain fall or dew, which will decrease infections of apple scab fungus and powdery mildew. Cutting out overwintering wood infected with apple scab or canker is an effective eradication method but can be labour intensive. Care must be taken when cutting or pruning to use wound protectant treatments to reduce the risk of further infections. Pruning and discarding infected shoots showing symptoms of powdery mildew in early spring will reduce the inoculum load.

Hygiene and prevention

Removal of cankered and fungal disease infected prunings and apples from orchards is essential because infected material can continue to produce ascospores for at least 1 - 2 years. For trees heavily infected with canker, complete removal maybe required. Prunings and infected material should be burned on site, or if this is not possible, macerated to ensure rapid decay and breakdown.

Nutrient management and organic amendments

Growth cracks are sites for pathogen entry for fungal diseases and can be exacerbated by high nitrogen and irrigation inputs and subsequent rapid host growth. This risk can be reduced by optimising the amount and timing of nitrogen rich fertilisers and irrigation. Generally, strategies to maintain a healthy soil, with a good population of microbes and organisms, such as the use of organic amendments are likely to reduce the severity of apple replant disease (ARD).

Biostimulants and elicitors

Biostimulants can provide significant yield increases which may offset the effects of diseases which have not been fully controlled in apples, such as canker, in the absence of chemical fungicides. Alternation of conventional fungicides with biostimulants and physical acting products can reduce reliance on fungicides whilst maintaining acceptable powdery mildew control.

A range of biostimulant products are available for use on apple orchards in the UK and further information can be found direct from distributors.

Decision support, including monitoring and forecasting

Maintaining records of infection levels from the previous year (such as for scab), knowledge of varietal susceptibility and disease lifecycles in relation to crop growth stages, along with regular orchard walking and observations of weather conditions conducive to disease development and monitoring disease levels, can help predict and prevent disease outbreaks. Various thresholds for management options for apple scab and powdery mildew are available. Forecasting systems can be helpful for targeting fungicide timings only to high-risk infection dates, and reduce the number of routine applications.

Apple scab monitoring and forecasting systems such as RIM pro or other models based on Mills periods can help target fungicide use to high-risk weather phases, particularly in early season, and are likely to result in reduced spray applications. It is important to monitor trees frequently to make best use of DSS, and this includes the whole season for scab for incidence in the orchard pre-bloom and during apple development, and then post bloom on rosette leaves and shoots and into harvest to estimate the likely scab inoculum carryover for the following year.

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