Canterbury Organic 'Disease Management Workshop' September 2007.

Location: Biological Husbandry Unit, Lincoln.
Presenters: Don Pearson

Glossary

Inoculum:	source of a pathogen that starts the disease cycle
Pathogen:	disease causing organism
Rotation:	the variation in time of crops on an area of land

Rotation

For weed, pest, disease and plant nutrition reasons, good organic management requires rotations with crops not being grown in the same area in successive years. A good rotation length for intensive vegetable production is traditionally 7 years. Ensure that there is sufficient time and/or space between crops that can host specific diseases.

Crop Hygiene

Where possible do not leave crop residues where they can be a source of inoculum that can infect existing or following crops. This can greatly increase the level of disease.

Alternate Hosts

Watch for alternate hosts in the weed and crop spectrum

Clean Propagules

Ensure that seeds, seedlings, tubers or plants are free of disease. As you sow, so shall you reap.

Weed Control

The presence of weeds in the field can have several effects on plant disease

Humidity

Around taller weeds airflow is reduced and higher humidity around the plants encourages fungal infections.

Alternate Hosts

Some weeds can be alternate hosts for diseases eg *Amaranthus* hosting *Sclerotinia.*

Primary Cultivation

Where inoculum levels are high in crop residues it may be appropriate to plough crop residues under as a primary cultivation.

Soil Biological Activity

Biological Control

Where crop residues have been effectively broken down by good soil biological activity there is less inoculum available to start infection the following season. Suppressive soils have been described that inhibit disease causing organisms.

Earthworms

Earthworms have been shown to greatly benefit soil biological activity and hence disease suppression. Their work through the soil needs to be appreciated and encouraged by farmers. In an orchard situation the deep tunnel earthworm *Lumbricus terrestris* has been shown to be effective in removing 99% of leaf litter from an apple orchard floor.

Effective Nutrition

Good pH (generally 6.0-6.5, but varying between crops) ensures that plants suffer less stress, and are hence more resistant to disease, than where they are growing in strongly acid or alkaline soils.

Biologically Mitigated Plant Nutrients

Making soil biology the controller of the release of plant nutrients ensures that there is seldom an excess of any nutrients. In cases where soluble fertilisers are used excesses of nitrogen or phosphorus can trigger disease attack from some pathogens.

Supplemental Feeding

Where there is a clear case of inadequate nutrient availability there may be yield and disease suppressive benefits from a liquid fertiliser

Intervention

Sometimes Mother Nature doesn't quite cooperate quite the way we may hope or anticipate. Intervention is a last resort that must be planned for. I believe that where there is a systemic dependency on intervention then the system needs adjusting over time to reduce or eliminate this and this concurs with the intent and letter of IFOAM organic standards.

Sprays

A number of prophylactic mineral sprays are available to organic growers for the prevention of serious disease outbreaks. The following is a general guide only and more specific information is available in the appropriate standards and from advisors on what is appropriate for particular crop/pathogen complexes.

Copper - effective as a preventative for a range of bacteria and fungal infections
Sulphur - effective as a preventative for a range of fungal infections
Calcium - effective as a preventative for a range of fungal infections

NB both copper and sulphur formulations are likely to be phased out over time as acceptable organic biocides.

A number of plant extract and microbial sprays are available or can be home generated. Two standouts are compost tea and EM (Effective Micro organisms). Both of thee products have been shown to reduce the incidence and severity of disease in plants.

Examples of disease and control measures:

Onion Neck Rot *Botrytis allii*

This can become a catastrophic problem post harvest potentially decimating a crop and incurring sorting and dumping charges. There are usually no field symptoms of the disease. Softness is first noted around the neck of bulbs several weeks after harvest and this may be followed by the production of copious white mycelium scattered with darkened sclerotia (resting bodies). It fortunately does not spread amongst bulbs in the crates but there can be a variation in the length of time between going into storage and symptoms showing so an initial roguing is often insufficient.

One form of management actively employed is to take care to ensure proper drying of the stem before the stem is damaged or cut off at harvest. But as for all other issues there are more systemic management techniques also including avoiding disease inoculum.

The disease is commonly carried on seed and where using untreated seed, care should be taken to ensure low pathogen presence (can be tested). During the growth of the crop, the fungus appears to survive and not be aggressive on crop leaves. Dumped onion material and overwintering bulbs are also sources of the disease.

Control in the order of systems based to interventionist includes:

- Rotation: Diseased onion crop residues can provide a disease source for a persistence of two years so rotations should allow for a three year or more gap in the rotation.
- Crop Hygiene: Dumps of onion plants and unincorporated residues in nearby areas should be avoided.
- Seed: Onion seed treatment with fungicide is common for the most effective means of reducing onion neck rot levels. With untreated seed it becomes important to assess the level of disease present and choose low contamination seed. Growing onion seed under cover has produced anecdotal evidence of reduced *B. allii* contamination and there may also be an effect from the high temperature curing and storing of the seed and of mother bulbs to be planted for seed production.
- Crop Condition: The crop should have a low stress level including planting at optimum soil temperatures in good condition soil, adequate irrigation (though care should be taken to not water on overcast days or in the late afternoon/evenings), and good nutrition.
- Harvesting: Damage to onion bulbs and necks should be avoided during the growing and harvesting of the crop. Particular attention should be paid to not damaging, bending, breaking or cutting the neck of the onion prior to harvest.
- If the crop is harvested with wounded necks e.g. some mechanical harvesting techniques then curing becomes increasingly important.
- Curing: Bulbs cured at 34 to 35^{o}C for 10 to 14 days with forced air can show reduced levels of disease.
- Storing: It is important for onions to be stored in dry conditions with sufficient airflow to reduce chances of post harvest crop loss.

Blackspot in Apples

Blackspot is an economically serious fungal disease of most apple varieties, infecting the surface of fruit and leaves. It's main effect is cosmetic but affects saleability and price achieved. It can also affect storage ability and on some occasions causes cracking that allows in other fruit rotting pathogens in. Serious infections can result in young fruit dropping (stem infections), misshapen growth and loss of effective leaf surface area for photosynthesis.

The fungus overwinters mostly in the fallen leaves. It is there that the sexual phase occurs and in the spring ascospores are forcibly discharged into the air with some landing on suitable plant surfaces (mostly leaves, petals and buds). Ascospores require a certain length of time (dependent on temperature but usually at least 12 hours and often as long as 20 hours) of moisture to germinate and infect the plant tissue so infection events occur during and straight after rainfall events and are aided by warmer temperatures. Most of the ascospores are released in early November though there is some variation.

The ascopores are the cause of primary infections. Once the fungus penetrates the plant surface and forms mycellium under the cuticle of leaves, fruit or petals it can within one or

two weeks produce conidia (asexual spores) and rupture the cuticle. Conidia remain firmly attached until wetted by rain after which they can spread along the surface or onto other surfaces by wind, splashing, dripping or brushing. Conidia cause additional infections in the same manner as ascospores cause primary infection.

Control

Effective control can be achieved through the use of lime sulphur and combinations of spraying with slaked lime etc. These are most efficiently employed when used in conjunction with monitoring of rainfall and temperature conditions (monitoring available commercially). It is of special importance to begin a spray programme early enough in spring to catch the primary infection.

There is concern, however, over sprays such as lime sulphur negatively affecting biological control agents including those controlling mites and caterpillars.

There has been limited success so far with resistant cultivars. Some cultivars are highly resistant to blackspot but many have poor storage characteristics (may not be a problem for e.g. direct sales) or other issues that prevent commercial viability. Breeding programmes are still in progress.

An important feature of organic control of blackspot is to reduce the overwintering success of the fungus and therefore the level of primary infection. Methods used include using orchard understorey species to provide a conducive environment for leaf litter decay and as a foliage trap to prevent ascopores reaching the apple trees.

Some orchardists use sheep grazing to reduce leaf litter levels (if this is done earlier rather than in mid to late winter, there may be a chance for an understorey to recover in time to provide an effective canopy for trapping spores. Various means of speeding up decomposition may be effective in reducing the infection potential also e.g. biofertilisers or the introduction of anecic earthworm species eg *Lumbriccus terrestris* or *Arporectodea longa*. .

There has also been some use of biofertilisers in the reduction of apple susceptibility to blackspot perhaps through stimulation of natural immune systems of the apple or through lowering the tissue levels of free nitrogen and soluble sugars – but this needs further research, confirmation and optimisation.

References

www.bhu.co.nz