Canterbury Organic - Pest Management

Workshop' October 2007
Location: Biological Husbandry Unit, Lincoln.
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Farmers often find insects, slugs, birds and disease competing for their harvest. Usually after a year or two of organic production pest and disease pressure drops as the system comes into balance. This often happens by accident in the home garden in the suburbs due to a heterogeneous spatial and biological environment. On a larger scale and away from other people's gardens, organic pest control is a function of conscious design, action and inaction at appropriate times with an awareness of consequences. We will look at organic pest control from a whole or design perspective down to a specific crop/pest complex perspective with some pest examples.

System design
For growing annual or perennial crops in the Canterbury shelter is of paramount importance. Just as in real-estate location, location, location rule, in Canterbury the call is for shelter, shelter, shelter. Shelterbelts also provide an opportunity for building in other ecosystem functions such as the provision of habitat and food sources for predatory and parasitic insects (and other organisms, for example centipedes and birds) to assist in the control of a wide variety of crop pests. In particular flowers year round in the hedgerow are a desirable attribute.

Rotation
The separation of crops in time and space from others that host the same pests enable the breaking of life cycles and reduce pest buildup. Crop hygiene is important, as is separation between years. For example in a 7 year rotation the top design below allows pests to migrate continuously along the growing area while the lower, same rotation but with differing spatial arrangement, disrupts the pattern.

		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7
"Linear Rotation"	yr1	crop 1	crop 2	crop 3	crop 4	crop 5	crop 6	crop 7
	yr2	crop 7	crop 1	crop 2	crop 3	crop 4	crop 5	crop 6
	yr3	crop 6	crop 7	crop 1	crop 2	crop 3	crop 4	crop 5
"Non-Linear"	yr1	crop 1	crop 5	crop 7	crop 3	crop 6	crop 2	crop 4
	yr2	crop 2	crop 6	crop 1	crop 4	crop 7	crop 3	crop 5
	yr3	crop 3	crop 7	crop 2	crop 5	crop 1	crop 4	crop 6

Nutrition and Watering
A vigorous plant with pests attacking it might suffer a 2% loss in production while a poorly performing plant with lower vigour might suffer a 20% reduction while hosting the same pest population.

Weeds and Alternate hosts
Watch that weeds are not harbouring pests that may later infect crops grown in the area. Insect attacks may be reduced if they do not have alternate hosts.

Resistant Varieties
Lettuce aphid is effectively controlled through resistant varieties of hearting lettuce or through growing non-hearting lettuce allowing control through biocontrol agents. Choose varieties that are pest resistant to the specific pests in you area. Talk to to your seed merchant and conduct on farm trials for your self.

Pest avoidance
Timing of the crop is important and can be used to avoid know pest problem times. Unfortunately this usually coincides with a time of market premium so this is a method less used.

Physical barriers
Floating row covers, fences and in the extreme, tunnelhouses can all be used to exclude pests. These options all come with attendant advantage and disadvantages.

Companion planting
Much has been written on this subject and research results have been variable. Often books on the subject repeat old spouses' lore. This is not to say that it doesn't work and some skilled commercial horticulturalists swear by it. This overlaps with rotation, augmentative (conversation) biocontrol and (in the case of perennials) understorey and shelter diversity.

Biological Control

Classical Biological Control
Classical Biological Control is where an organism (biological control agent) that controls a problem pest, disease or weed is introduced into an area to spread itself and perpetuate to control the problem e.g. importation of ladybird species into New Zealand to control aphids.

Inoculation Biological Control
Where the biological control agent is actively spread and requires reintroduction e.g. introduction into a greenhouse of *Encarcia formosa* to control whitefly.

Inundation Biological Control
Where a large amount of the biological control agent is applied like a pesticide (biopesticide) e.g. use of BT (*Bacillus thuringiensis*) sprays to control caterpillar pests.

Augmentative or Conservation Biological Control
Where the success of the biological control agent is aided by the provision of habitat, food source etc and provides an increased level of control of the target (e.g. hoverfly control of aphids enhanced by presence of *Phacelia* flowers for pollen/nectar source).

Intervention
Certain sprays are allowable in organic production although some require prior permission from the certifying agency. As well as justifying the use of restricted sprays, it is usually encouraged by Bio-Gro that there be some plan for reducing and eliminating the need for the product in the future.

Biofertilisers
One approach is to enhance the health of the plant rather than attack the pest or pathogen directly. The broad class of biofertilisers often have claims of reducing pest and disease incidence. The literature shows variable success with such products but some have been shown to lower pest and disease incidence possibly by stimulating the plant to utilise free nitrogen (nitrate, amino acids etc) and soluble sugars thus reducing the availability of those substances to a pest or pathogen.
Some products are also capable of producing induced resistance where substances in the biofertiliser stimulate the production of phytoalexins etc and aid natural defense against pathogens and particularly sucking pests.

Allowable Chemical Sprays
Some simple chemical sprays are allowed on a restricted basis by certifying bodies. These include baking soda, calcium hydroxide (slaked lime), various copper sprays and various sulphur sprays (including lime sulphur). The copper sprays and sulphur sprays (both used as fungicides) are likely to be eventually phased out from organic use as copper sprays can lead to elevated soil copper levels (harmful to earthworms and other soil organisms) and the sulphur sprays are harmful to predators and parasitoids of pest species. Slaked lime is particularly effective on pathogenic leaf fungi through oxidising the fungi and lifting leaf surface pH, but generally disrupts leaf microflora and insect fauna.

Plant Extracts
Some plant extracts are chosen for direct toxic or smothering effect on pests and pathogens. Some of these are well established and reliably effective natural pesticides e.g. pyrethrum, rotenone (derris dust) and neem. The toxic ones are often restricted use due to the effect on non-target organisms e.g. rotenone on bees and fish, and pyrethrum on biological control agents and fish. Neem does not cause the same non-target issues (as it must be ingested to have an effect and therefore does not greatly affect biological control agents – an unfortunate consequence is that it therefore does not control sucking insects. Some plant extracts may act as repellants on plant surfaces (e.g. wormwood).
There is much scope for plant extract research and practical application of some quite impressive results. Of special interest to low input agriculture is the possibility of growing plants and making extracts on the property. Disadvantages of the farm-made approach may be variability in active ingredients and processing, as well as time involved in making the product.

Purchased Biocontrol Agents
This is covered under the previous biocontrol heading. Check with your local agrichemical merchant what is available and check for acceptability with your certification authority.

Conclusions

- Include a diversity of flowering plants and predator habitats in the farm design
- Avoid peak pest times for the susceptible period of crop growth
- Practice good crop hygiene
- Time interventions for the most susceptible phase of the pest lifecycle or when the risk of economic loss is highest
- Choose interventions that reduce the risk of 'collateral damage' (ie allies falling to 'friendly fire')

Examples

Carrot Rust Fly
If a pest is causing significant issues on an organic property, it becomes important to understand the biology of the pest and the pest/host relationship. Appropriate methods of prevention and control can then be formulated and put into practice. In this section, the carrot rust fly is used as an example of "knowing the enemy". The carrot rust fly causes problems with the carrot harvest ranging from cosmetic through to decimation.

Life Cycle
The adult is a small 4-8 mm shiny black fly with yellowish legs and iridescent wings. Eggs are minute, white and elongated with grooves along the length. Flying adults lay eggs in the soil near host plants with larvae hatching 7 to 11 days later and entering carrot roots forming holes and surface scarring. The larvae feed for 4-6 weeks before pupating in the soil for 3-4 weeks or overwintering.
The carrot rust fly season is marked by distinct flights, starting in September/October going through to May. The number of generations can be three or four depending on the region. The third and fourth flights are usually the most severe. These insects are not great flyers, travelling not far off the ground and preferring sheltered areas. The flies prefer to overnight in the shelter of vegetation notably shelterbelts.

Control
Utilising knowledge of the pest biology, the following control methods have been deduced:

- Rotate areas of susceptible crops (carrots, celery, parsley, parsnip and other members of the carrot family)
- Avoid planting in areas where there are wild populations of members of the carrot family and nettles (alternative hosts)
- Avoid planting early and late crops near to each other
- Crop hygiene is important – remove infested plants rather than leaving material around or regrowth of host plants that enable further generations of fly
- Plant carrots after the first flight, grow them fast and harvest before the third flight (thus avoiding peak problem flights)
- Plant carrots in exposed fields and with a gap from the shelterbelt
- Plant a sacrifice crop of carrots between the shelterbelt and crop, harvesting them before larvae emergence
- May be some value in interplanting with garlic or onions to disrupt olfactory (smell-wise) senses of the fly
- In intensive growing, some growers are extremely successful with the use protective covering (floating row covers/frost cloth which also improves the microclimate for crop growth) and there has been some success with short (70cm high) windbreak fencing (the flies not flying high). Make sure barriers are in place before the adults fly into the area otherwise significant damage to the crop can occur.
- Mulching around the carrot crop to prevent successful laying – though this is labour and material intensive
- Encourage predatory ground beetles and other predators of carrot rust fly eggs with grassy areas (e.g. beetlebanks) etc.
- Flight times can be monitored using yellow sticky traps

Codlin Moth

Codlin moth is one of the few (including leaf roller and occasionally scale insects) insect pest that are of economic importance in organic apple orchards in Canterbury.

Life Cycle

Egg - Adult mating then female lays egg during Nov-Feb. (single egg, 1mm size, on leaf near fruit)
Larvae - main damage done to fruit during Nov-April (20mm size, feeding on apple with tunnel damage)
Pupae - overwintering (cocoons under bark, wood pile etc)
Adult - Nov-Jan

Control

- Utilising knowledge of the pest biology, the following control methods have been deduced:
- Floriferous shelterbelts and understory plants to supplementary feed predators and parasitoids of a range of pests
- Pheromone traps and pheromone saturation to minimise mating. Use synthetic female codlin moth hormone lure to attract and trap male on a sticky board or saturation twists to confuse males. Hang the trap or twist tie on the side branch close to main trunk
- Tea of wormwood and tansy to avoid mating. The smell of tea can cause the adults to avoid mating. Cook tea of wormwood and tansy, spray tea all over the tree - trunks, branches, leaves, fruits, etc. Pick some fresh leaves before plant has reached flowering stage. Add enough water to cover and bring to boil. Strain when cool. Dilute one part mixture to four parts water to use. Do not use too frequently, nor too strong a solution on tender vegetables as it may retard natural growth.
- Corrugated cardboard to remove pupae. The larvae will hide into cardboard then over-winter in pupae form. Wrap corrugated cardboard on all the branches close to main trunk. At end of winter, remove it and destroy.
- Monogastric grazing of orchard floor. Pigs and chickens eat early maturing codlin infected fruit as well as the caterpillars. His also applies to reject fruit during harvest. Effectively this is a biological crop hygiene option that allows another ‘bite’ from the lost yield.
- Cleaning bark, hygiene (remove litters, etc)

References and Resources

http://www.bhu.co.nz/Info/CropProtocols/Carrots%20Submitted.doc

www.organics.org.nz/pdf/ccog1.pdf

http://www.organics.org.nz/pdf/ccog7.pdf

http://www.gardenews.co.nz/know.htm

http://www.hortnet.co.nz/publications/science/clwater.htm

http://www.organicpathways.co.nz/answerfile/question/129.html