Section Six

Weeds, Pests and Disease

Contents

Managing Weeds, Pests and Disease

Weeds

Four Classifications of Weeds

There are four classifications of weeds that you will encounter. Two are based on the life cycle.

Annual weeds grow, flower, release seed and die in less than a year. They are usually soft plants that increase very rapidly by seed each year.

Perennial weeds grow for two or more years. Some perennial weeds die back to an underground root or bulb and re-grow each year, while others stay green all year round.

The other classifications are based on whether there is a woody tissue.
Woody weeds are usually perennial shrubs and trees. Non-woody weeds are soft stemmed weeds that can be either annual or perennial.

Resource Information for Weeds

In Great Britain there is a very good website for weed information: see organicweeds.org.uk

Causes of Weeds

Weeds can be caused through the following:

- incorrect soil cultivation
- soil compaction
- inadequate drainage
- unbalanced nutrition
- incorrect soil pH
- salinity problems
- incorrect crop rotations
- inappropriate choice of species
- lack of diversity
- imbalances in the environment
- imbalances in weather and seasonal conditions
- lunar influences.

Benefits Associated with Weed Growth

- indicators of soil health and conditions
- contribute to soil fertility
- improving soil structure
- hosts for beneficial predators and organisms
- deep rooting weeds can mine minerals and make these available to crops
- weeds are specialists at producing substances lacking in the soil in which they grow
- preventing soil erosion
- source of food for animals and humans
- can be used medicinally
- used as a green manure
- used as a mulch.

Benefits of Weeds

By using herbicides farmers often manage to eliminate a troublesome plant only to discover that the vacated niche is occupied by another even worse weed. Very frequently the new weed will have been present in the system in small numbers. It only attains the status of weed when the dynamic equilibrium of the system is disturbed by removing other plant species.

In his "Soil Fertility" (Lanthorne Press, 1983 pp 124-125) Ehrenfried Pfeiffer talks about the positive aspects of weeds in an agricultural system: "The so-called weeds become enormously significant...They are only weeds from the human utilitarian point of view. At most we might call them misplaced good plants." He points out that weeds are often indicators of mineral imbalances in soils and are even nature's way of correcting those imbalances:" ...many of these plants (weeds) live in or near his (a farmer's) own cultivated areas and at certain times they fertilise the soil by drying off, by dropping their leaves, etc. More important, however, is the fact that they furnish, in organic, finely diluted form just that finely diluted substance which nature needs for healing or stimulating its life processes. The remarkable thing is that many of these plants are just "specialists" in producing the substance which the soil lacks, thus contributing to soil improvement. They accumulate...these substances from states of high dilution and then, by condensing them into more concentrated form, carry them into the soil.

David Williams makes the point that weeds bring diversity into the system. Firstly they diversify the organic matter being returned to the soil as pointed out by Pfeiffer above. Secondly they diversify the diet of the stock. Many of the weeds, for example, are medicinal herbs. Variegated thistle, a common deep rooted weed, is used to treat sufferers of liver cancer and helps to alleviate the side effects of chemotherapy. Shepherd's Purse, another common weed is used by herbalists to combat bleeding. Sheep and cattle browse it after lambing and calving. These are but two examples, there are many others.

Newsleaf, Journal of BDAA Australia, No. 17, p13

Problems Associated with Weed Growth

- competition for space, nutrients, water and sunlight
- can harbour pests and disease
- hinder harvesting of the crop
- lower crop quality
- fast growth which takes over an area and looks unsightly
- infestation of bushland areas, affecting wildlife
- fire hazards
- homes for pests and disease
- spines, thorns, hooks and burrs which can injure animals and people
- poisonous fruit, leaves or stems
- economic problems by contaminating farm products or preventing use of land.

Weeds and the Minerals they Provide

The following weeds can provide vital minerals to stock, your compost heap or liquid tea:

Blackberry	Chlorine
Bracken	Potassium
Broom	Magnesium, sulphur
Chicory	Iron, Calcium, Copper
Cleavers	Iodine, Calcium, Copper, Silica, Sodium
Comfrey	Iron, Chlorine, Potassium, Sodium
Dandelion	Calcium, Copper, Iron, Magnesium, Potassium, Silica
Dock	Iron
Duckweed	Copper, Boron, Zinc, Phosphorus
Fennel	Copper, Potassium, Sodium, Sulphur
Gorse	Phosphorus
Inkweed	Potassium
Nettles	Iron, Potassium, Sodium, Sulphur
Plantain	Calcium, Sulphur, Potassium
Ragwort	Copper
Shepherd's Purse	Calcium, Sodium, Sulphur
Sorrel	Calcium, Phosphorus
Thistles	Nitrogen, Copper, Silica
Willow	Calcium

Newsleaf, Journal of Biodynamic Agriculture Australia, No. 60, p.6.

Looking at the Wide Aspects of Nature

Weeds are indicator plants which help us to identify imbalances in the soil. They are plants growing in the wrong place. The presence of weeds also gives us an indication of the acid and alkaline state of the soil. They are the 'stop lights' or 'warning signals' of soil life.

These plants are specialists at producing the substances that the soil lacks; thus contributing to soil improvement. They accumulate these substances in high dilutions, condense them into a more concentrated form and carry them into the soil.

Some examples of this are;

- The bark of oak trees is especially rich in calcium (up to 60% or more of the oak is calcium). These trees can grow in sandy soil that is poor in calcium and despite this are able to accumulate calcium.
- Tobacco is rich in potassium when it grows in soil poor in potassium.
- Buckwheat is a typical sand/silica plant and accumulates calcium.
- Daises collect calcium in acid soils.
- Horsetail collect silica even in silicon-poor soils
- Orache collects salt and other substances.

The biodynamic practitioner can remedy deficiencies in his soil by composting or using these weeds as an ingredient in liquid manures and then spreading this compost or liquid onto the soil from which these 'weeds' were growing. The soil deficiencies are then remedied in an organic form which is in harmony with biological processes.

Upon their death, these plants will enrich the soil with these elements and change it correspondingly.

Soil Conditions and Weed Species

Weed Species	**Problem**
Common horsetail (*Equisetum arvense*) Corn mint (*Mentha arvensis*) Coltsfoot (*Tussilago farfara*) Marsh woundwort (*Stachys palustris*) Common reed (*Phragmites australis*)	Poor drainage of top and subsoil
Pennycress (*Thlaspi arvense*) Common sorrel (*Rumex acetosa*) Curled dock (*Rumex crispus*) Board-leafed dock (*Rumex obtusifolius*) Heartsease, wild pansy (*Voila tricolour*) Hare's foot clover (*Trifolium arvense*) Corn spurrey (*Spergula arvensis*) Smooth finger grass (*Digitaria ischaemum*) Meadow buttercup (*Ranunculus acris*) Wild chamomile or scented mayweed (*Chamomilla recutita*)	Poor structure and low concentration of lime

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Creeping thistle (*Cirsium arvense*) Knot grass species (*Polygonum sp.*) Scentless mayweed (*Matricaria perforata*) Comfrey (*Symphytum officinale*) Wild bent grass (*Apera spica-venti*)	Lack of stable crumb structure
Black nightshade (*Solanum nigrum*) Annual mercury (*Mercurialis annua*) Petty spurge (*Euphorbia peplus*) Annual nettle (*Urtica urens*) Chickweed (*Stellaria media*)	Good crumb structure for row crops with good supply of nitrates
Lesser bindweed (*Convolvulus arvensis*) Scarlet pimpernel (*Anagallis arvensis*) Annual mercury (*Mercurialis annua*) Forking larkspur (*Consolida regalis*) Common toadflax (*Linaria vulgaris*) White campion (*Silene latifolia*) Dandelion (*Taraxacum officinalis*) Yellow vetchling (*Lathyrus aphaca*) Meadow clary (*Salvia pratensis*) Summer pheasant's eye (*Adonis aestivalis*) Chicory (*Cichorium intybus)*	Stable crumb structure and neutral reaction
Thistles Wild turnip Wild carrot Bindweed	Soil compaction and surface crusting
Buttercups Sorrel Dock	Damp, acidic conditions
Patterson's curse (*Echium lycopsis*) Fireweed Sour grasses Saint John's Wort (*Hypericum*) Salvation Jane and Heliotrope	Usually a calcium and copper deficiency
Broad leafed weeds	Excess potassium (K)
Plantain Hawkbit	Phosphorus deficiency
Bell's daisy Sorrell Speedwell	Indicate a need for lime

Managing Weeds

Removing Weeds

Annual and young perennial weeds are often removed with hand tools in small planted areas (such as garden beds, domestic and commercial situations) or in larger areas where weed infestation if minor.

Machinery such as brush cutters, mowers and slashers are often used where the number and area of weeds are large.

Sometimes with large woody weeds it is necessary to use pruning equipment and chainsaws for weed removal.

Management Practices to Minimise Weed, Pests and Disease

- regular applications of all biodynamic preparations
- yearly applications of biodynamic tree paste
- good soil management which includes:
    - proper composting
    - maintaining good soil structure, drainage and aeration
    - balanced soil pH
- balancing nutrition through:
    - regular use of green manure crops
    - increasing soil humus levels.
- implementing beneficial crop rotations to avoid pest and disease build-up
- addressing nutrient imbalances in the soil through;
    - composting or using weeds in liquid manures and then spreading this compost or liquid onto the soil where weeds were growing
    - remineralising soils.
- undertaking all farm and garden activities in tune with natural rhythms
- well-timed and appropriate soil cultivation
- not allowing the seeding of weeds
- correct timing and density of sowing
- using optimum planting times and conditions
- use of companion plants
- use of allelopathic plants* to inhibit the growth of one species of plant
- selection of pasture species whose blooms provide nectar, pollen, and habitat for beneficial predators
- slashing of weeds prior to seeding
- fallow periods for pastures
- increasing species diversity in plantings
- selection of the most appropriate species for site conditions
- increasing competition
- using decoy crops*, tree lines and natural areas within the site
- planting, conserving and maintaining habitats required by beneficial predators
- providing an alternative food source for pests
- allowing some pests in the field to serve as food or host for natural enemies
- buffering wind through use of shelterbelts whilst allowing adequate wind flow

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- maintaining proper sanitation which requires:
    - removal of all dead and diseased plant material including all fallen fruit in a safe and hygienic method
    - use of separate tools in glass houses
    - sterilisation of all tools and equipment
    - thorough cleaning and control of off farm vehicles
    - maintaining clean and hygienic housing
    - quarantine to isolate infected plant material or to separate sick animals.
- minimising stress in plants through:
    - selection of the most appropriate species
    - adequate supply of fresh, clean water
    - adequate nutrition
    - proper shelter.
- diversity in plantings
- use of companion plants
- adequate supply of fresh, clean water
- adequate nutrition
- proper shelter
- managing plants in accordance to natural rhythms
- using good selection criteria for breeding plants and animals which includes:
    - selection of the most appropriate species for the ecology of the site
    - selection of pest and disease resistance species.
- use of clean seed and plant materials with climatised genetics
- good selection criteria for breeding to optimize resistance.

Definition of Terms:

*Allelopathic plants: Plants which produce chemicals to inhibit the growth of other plants.

*Decoy crops: Crops attractive to specific pest species planted to lure pests away from the main crop.

Weed Control: Alternative Options

By Tim Marshall

Alternative weed control options should always be considered as part of weed control program, before resorting to herbicides. These include:

Hygiene
Avoid transfer of weed propagules (clean equipment etc), quarantine, avoid seed set, prevent establishment, decreases the weed seed reservoir.

Ecosystem Manipulation
Uses changes in soil fertility (nutrition, pH), drainage, irrigation (eg, use drippers to restrict water), planting density and depth, planting date and so on to control weeds.

Physical Barriers
Mulching.

Hand Pulling
Slow, but very selective and can prevent damage to vulnerable plants nearby.
Slashing or mowing – May not be suitable for some weeds, like creeping oxalis (Oxalis corniculata).

Brush Cutting
Expensive, but can give good control. Especially suited to linear features such as fences.

Cultivation
May cause soil erosion or create a seed bed for new weeds to establish.

Thermal Weeding
Burning will break dormancy of many weeds which can then be destroyed (eg, Apple of Sodom solanum hermanni or gorse Ulex europaeus). A minimum temperature of 55° (80°- 100° for persistent weeds or thick seed coat) is required. However it can stimulate germination of some weeds leading to new problems, may be dangerous and need to be restricted to certain time of the year to avoid wildfire hazard.

Solarisation
Cover soil with clear polyethylene sheet (40 – 100mm thick) and seal. Secure the edges of plastic sheet. Soil must be moist. Can kill weed seeds and disease. Allow a minimum four weeks' treatment, depending on daytime temperatures.

Acres Australia, The National Newspaper of Sustainable Agriculture, Australia, Sept, 1999, p47

Using Vegetative Cover for Weed Control

By Tim Marshall

Use of vegetative cover is the most desirable form of weed control, from an ecological perspective. This strategy includes the use of "living mulches" grown to out-compete weeds. Once established, these "living mulches" should require little maintenance.

Closely planted trees may achieve this effect once the canopy closes over, but the technique is more often used with groundcovers.

Vegetative cover has the following advantages:

- It prevents new weeds from germinating or smothers weed seedlings.
- It keeps the soil covered and protected from wind and water erosion.
- It protects the soil ecology, by insulation, temperature control and continuous addition of small quantities of organic matter.
- It keeps the soil active — plant roots are continually exploring the soil profile and stimulating soil biology as they grow.
- It provides food sources or habitat for small animals, birds, insects and other soil organisms.
- If appropriate species are selected and well grown they will require little maintenance and will compete little with crop plants.

Among other factors which influence the economics of this choice are:

- Location and seasonal variation which will influence the number of times per year that grass swards need to be mown or groundcovers replaced.
- Aesthetic requirements of the site.
- Slopes, such as steep batters, where machinery access is difficult.
- The ratio of edge to planting area (i.e. the length of boundary that needs to be maintained against weed infestation).
- Weed resistance of the species chosen for living mulch or groundcover.
- The weed species present (e.g. rhizomatous or stoloniferous perennial weeds such as couch or kikuyu may be difficult to remove from groundcover or massed shrubs).
- The growth rate of species used.
- The requirement of species used for additional inputs (fertiliser, irrigation etc.)
- The quality of planting stock.
- Longevity of living mulches or groundcovers.

Generally, for the technique to be competitive, the groundcover species should be selected to be self-replacing or to have a long life expectancy, but should not themselves become weedy.

Acres Australia, The National Newspaper of Sustainable Agriculture, Australia, Sept, 1999, p47

Organic Weed Management

by Matt Gurnsey

Unfortunately, weeds are a problem that farmers from all backgrounds face. Being Certified Organic or Biodynamic doesn't make you totally immune to weeds...you must still be a responsible landholder and prevent their spread. E.g.,

- Prevention is the best control; this involves soil remineralization, hygiene, quarantine, farm management, good grazing practices and preventing seeding
- Containment involves keeping the weeds in a small area where they can be managed
- Reduction reduces the weed numbers
- Eradication is a last resort

We will be taking a look at how to control these weeds and how we can use them to our advantage. Of course, in nature there will always be some exceptions to the rules.

Blackberry

Blackberry tends to grow best in higher rainfall areas (700mm+). It prefers well drained, acidic soils, but can grow in a wide range of conditions. Blackberries can be shaded out, but in areas with hot summers, it can even do well in partial shade.

The Bad: This weed is usually found on cleared land. They are invasive and can be hard to eradicate, chemically or organically. Blackberries can harbour vermin such as foxes, rabbits and hares. They can become a fire hazard; and can block access on tracks and waterways. Stock may become entangled in thickets. Blackberries compete for moisture, nutrients and light...displacing any native trees, shrubs and grasses that try to germinate.

The Good: Blackberries provide shelter and food for native birds (especially wrens), mammals and even stock. They also provide habitats for predatory insects which kill pests. Blackberry flowers are a good source of nectar for bees. The berries are edible as long as they haven't been sprayed in the past.

They can be excellent fodder for goats (but watch long-haired breeds like Angoras or Cashmeres, as they usually get tangled up). Blackberries help to recycle nutrients (as their leaf drop is quite significant); and even help to aerate the soil with their vigorous root system. They aid in preventing erosion of topsoil by covering otherwise bare patches.

Blackberries can be indicator plants for your soil...they prefer fertile soils but will often grow in Calcium deficient spots. They can accumulate excess Iron (so add leaves to your compost if Iron is low in some areas).

Prevention and control:
In gullies and pastures, Blackberries are best eradicated by shading them out with native trees and shrubs (although this may not be feasible in a cropping situation).

Preventing the fruit forming will help reduce the seed bank; this can be done by slashing at critical times like flowering. Avoid creating bare patches due to overgrazing.

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Burn off old canes, spread lime and slash regularly (monthly is best). In areas that are not accessible to machinery, brush cut and hand weed. Plant other species of plants to compete (perennial native grasses are good in a pasture).

Electric fence off the area and put goats in or use a pen to keep goats in a small area and move it regularly. Biodynamic 'peppering' of Blackberries has also been used to inhibit their spread.

Thistles
Grow in a wide variety of soils but prefer good soil fertility and areas that get boggy in winter. Thistles quickly infest bare patches in pastures and roadsides. They grow readily in stock camps where there is often an excess of potassium and nitrogen.

The Bad: This weed will compete for water, light and nutrients. The spikes can get into animal's eyes and coats. The seeds are variable for a long time. Thistles can cause nitrate poisoning.

The Good: A sufficient stand of this plant can support a good honey flow from the nectar produced. This is useful because it occurs in mid to late summer when other sources have dried up (especially in yellow box areas). The tap root reaches deep into the soil and brings nutrients to the soil surface. Thistles can help stabilise embankments. Excellent to incorporate into compost heaps – adding nitrogen, copper and silica.

Prevention and control:
Avoid stock feed that is contaminated with Thistle seeds. Hand weed small patches or single plants as you came across them. Avoid creating bare patches on the soil especially in Autumn when the seeds germinate. (Do not overgraze, keep at least 3-5mm of grass cover to inhibit germination – deep-rooted perennial pastures provide the best competition). Aerate and balance the soil nutrients. Goats find the flowers palatable and can prevent the seed from forming. Slash or brush cut to prevent flowering. Sow perennial pastures to provide competition. Biodynamic 'peppers' can inhibit their spread.

Paterson's Curse
Seeds germinate in autumn; grow through winter and flower in the spring. It can keep growing for another year. Paterson's Curse is a copper accumulator.

The Bad: Cattle avoid this weed. It can cause liver damage – pigs and horses are most susceptible. It competes for water, nutrients and light.

The Good: Provides a good source of nectar for bees (although new evidence suggests honey made from Paterson's Curse may cause liver damage if consuming over two tablespoons a day for an extended period).

Prevention and control:
Remineralise your soil. Graze sheep or goats, especially during flowering time. This will reduce seed formation and there is some nutritional value for them, their rumens are able to break down the toxins. (Be sure to provide plenty of nutritional supplements like Pat Coleby's dry lick formulation). Avoid buying or cutting contaminated hay. Cultivation kills seedlings, although more will probably germinate. Use rotational grazing practices. Avoid creating bare patches of soil especially in autumn. Provide competition by sowing phalaris, tall fescue, cocksfoot and white clover. Biodynamic peppers can inhibit the spread.

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Bracken

Bracken is a native fern that spreads through a very large and complex underground rhizome. It is a pioneer species and occurs anywhere there is a reduction in the forest canopy. It is very common on recently cleared land. It will grow quite tall in favourable conditions and on sand dunes it will grow very short. Bracken grows best in soil that is well drained, acidic and deficient in Phosphorus, Potassium and Calcium.

The Bad: Stock eating Bracken can cause internal haemorrhaging. This can be a problem for stock when it is baled in hay. Bracken competes for light, moisture and nutrients. It can also suppress other plant growth.

The Good: Bracken can suppress other weeds. An extract from Bracken can be used as an insecticide/fungicide. Bracken can provide shelter for beneficial insects and helps with erosion control; it quickly covers bare earth after fires. Dry Bracken fronds make excellent mulch and add potassium to compost heaps. When used in chicken's nest boxes it helps repel lice and scale. It helps reduce erosion and stabilises embankments.

Prevention and control:
Balance the soil pH and remineralise. Slashing needs to be carried out once a month for several years in order to effectively exhaust the plants. Where ploughing is feasible, completely invert the soil between late June and early August.

This should be worked down immediately for sowing. Cultivations should be repeated in the following Summer. Balance the pH with lime or dolomite and remineralise to increase levels of Phosphorus and Potassium. Plant trees to shade out the Bracken. Use a biodynamic pepper to help prevent Bracken spreading.

Capeweed

This South African native is a common weed of pastures, gardens, cultivated areas, wastelands and roadsides. It germinates in autumn and flowers in spring and summer. Capeweed tends to grow in areas where there is an excess of Nitrogen. It readily establishes itself on overgrazed, compacted pastures, often where chemical fertilisers have been used or stock have regularly congregated.

The Bad: Capeweed can cause nitrate poisoning in stock and taint milk. In the plant, nitrates rise to high levels during cool, cloudy weather. The nitrates then suppress magnesium and iodine levels and bring on tetany. The seeds can form hair balls on sheep. It competes for water, light and nutrients. It can harbour red-legged earth mites.

The Good: Capeweed can provide good nutritional value when growing in sunshine, providing there is enough other feed for stock to eat. If Capeweed is dominant, supplementing stock with dolomite and seaweed is a good idea. It reduces soil moisture loss and helps reduce erosion. Provides food for birds and yields reasonable nectar for bees. Some organic farmers that have remineralised and now have good Calcium levels in their soil find Capeweed a palatable and beneficial addition to their pastures!

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Prevention and control:
Graze heavily with sheep or goats but not in cloudy weather or just after (make sure to supplement with dolomite and seaweed). Cultivate the area and sow a quick-growing annual to compete with the Capeweed. Mow or slash just before the majority of flowers open and repeat when the next flush of flowers appears; this will reduce the amount of seed produced. Clean down slashing and cultivating equipment before working in uninfected paddocks. Do not overgraze or create bare patches of earth, especially in autumn. Avoid contaminated feeds. Improve soil by aerating and remineralise.

African Lovegrass
This grass is an aggressive tussock-forming perennial. The seeds spread by wind, water, stock, machinery, vehicles, fodder and infested soil or gravel. It establishes readily on unimproved, over-grazed land. Lovegrass grows best in sandy soils that are acidic and does well in drought conditions. It proliferates after periods of drought in paddocks that are bare.

The Bad: African Lovegrass reduces the productivity of the land. It is difficult and costly to control. Stock production is reduced as it has a low palatability, low digestibility; low nutritional value, low protein and high fibre content. Large amounts of this plant can become a fire hazard. It also competes for moisture, nutrients and light.

The Good: The Australian Government introduced this grass to trial as an erosion control. Stock can eat this seed but the nutritional value is very low.

Control and prevention:
Prevent bare areas of soil. Take care not to accidentally introduce this weed to your property. Wash down machinery/ vehicles that have been in an infested area at seeding stage. Ensure you get clean weed-free fodder and seeds. It is best to quarantine animals that have been in an infested area – do not overgraze and keep soil fertility up. This weed must be brought under control quickly. If there is a small amount, remove the flowers/seed heads and burn them. Mattock out clumps and burn them. For heavy infestations, cultivate deeply in autumn and sow a fast growing annual like oats or rye grass.

Next season, sow a vigorous pasture species to compete with future infestations of Lovegrass. Remineralise and balance the pH. Spray a biodynamic pepper to prevent farther spread.

Serrated Tussock
Serrated Tussock is a fine leafed perennial grass. Annually, they can produce 100,000 seeds on a single plant. The seeds are dispersed by wind, animals, fodder, machinery, vehicles and in soil. It can look similar to Silver Tussock and spear grass.

The Bad: Serrated Tussock is unpalatable to stock, is high in fibre and low in protein. It competes for moisture, light and nutrients. It can become a fire hazard.

The Good: Reduces soil erosion and provides shelter for birds and insects.

Control and prevention: Control methods are the same as for African Lovegrass.

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St. John's Wort

St John's Wort is a prohibited weed that grows in bushland, roadsides and neglected pastures. It has yellow flowers up to 2cm in diameter and can produce up to 3,000 seeds per plant.

The Bad: St John's Wort can be poisonous to stock, causing loss of condition, abortion and photo-sensitization. White skinned animals have less tolerance than dark skinned animals. It competes well with native plants. It also competes for moisture, nutrients and light.

The Good: St John's Wort can be wild crafted and sold to herbal manufacturers or pharmaceutical companies.

Control and prevention: Remove isolated plants. Aerate soil and improve fertility. In spring and autumn, graze goats or sheep as they are less affected by this weed, although make sure supplements are provided. Sow clover to smother seedlings. Introduce a biological control. Spray a biodynamic pepper.

In General

Weeds are growing in the soil for a reason and tell us at a quick glance what state the soil is in. Before adding anything to the soil, it is best to get a comprehensive soil test done by an independent laboratory (like SWEP or APAL – not by a fertiliser company), so you know what you need to apply. Mixed grazing can help resolve weed problems. Run sheep and cattle together or run a few goats through a paddock after the cattle have moved on, to clean up what's left over. But most of all, remember there are always some alternatives to consider instead of using a toxic chemical spray.

Pests and Disease

Healthy Plants are Not Bothered by Pests

"I define this thinking in agriculture as plant-positive in contrast to the present approach which is pest-negative. It makes sense. Since there are two factors involved, pests and plants, there are two courses of action: to focus on killing the pest, or to focus on strengthening the plant; to treat the symptom or to correct the cause. Since the former appears to be a flawed strategy, we might be wise to try the latter...

"The general tone of these investigations lens support to what has always been a casually stated but inadequately understood tenet of the organic farming movement: "Healthy plants are not bothered by pests." Or, to put it more scientifically, within a balanced ecosystem plants are inherently insusceptible when properly grown and only become subject to insect and disease problems when they are stressed by unfavourable growing conditions. In other words, the pest-free plant is not the normal plant with something added, but the normal plant with nothing taken away."

Coleman, E., *The New Organic Grower,* Chelsea Green Publishing, White River Junction, VT 05001, 1995, pgs 173-174

Preventative Operations

"The preventative operations are those of the best culture…including…choice of seed of plant, soil, situation, and climate. If these are carefully attended to, it will seldom happen that any species of insect will effect serious and permanent injury. Vegetables which are vigorous and thrifty are not apt to be injured by worms, flies bugs, etc."

Thomas Green Fessenden, *The New American Gardener*, 13th Edition, Boston: Otis, Broaders, and Co., 1839, p.169

Conditions Which Lead to Pest and Disease Problems in Plants and Animals

- imbalance in the etheric forces
- imbalance in the wider environment
- stress in plants and animals
- not working with the natural instincts and behaviour of animals
- incorrect soil cultivation
- unbalanced nutrition and incorrect feeding
- inappropriate water management
- incorrect aspect
- incorrect crop rotation
- too high or low soil pH
- incorrect plant spacing and depth
- lack of light
- lack of adequate air flow
- inappropriate choice of species
- diseased seeds and/or plant materials
- using seeds harvested during unfavourable constellations
- genetic weaknesses
- lack of diversity
- bad hygiene practices
- moist conditions
- humid conditions
- use of raw or semi-composted animal manures
- lunar influences especially at times of;
    - excess moisture conditions at times of the full moon
    - moon at perigee
    - lunar sidereal rhythms
    - lunar and planetary nodes
    - lunar eclipses
    - when lunar rhythms coincide.

Management Practices for Pest and Disease Problems in Plants and Animals

- implementation of beneficial crop rotations
- use of cell or rotational grazing to interrupt cycles
- use of quarantine areas
- grazing and mowing of plants
- companion planting
- plant spacing
- timing of planting/cultivating
- use of green manure crops to disrupt pest and disease cycle
- selection for plant species/varieties
- use of plants as biofumigants
- allelopathic plants
- biodynamic controls which include peppering, BD508 and biodynamic tree paste
- lunar rhythms to minimise and control parasites e.g. worming treatments administered on the day of the full moon
- making and applying insect sprays when necessary
- decoy traps
- pheromone traps to disrupt mating cycles
- collection and removal of affected plants, fruit, produce etc
- physical removal of insects
- mechanical and biological controls for interrupting pest or disease cycles
- physical barriers and controls such as trapping, shooting and fencing and netting
- light and sound
- naturally occurring substances (refer to certification standards for a list of allowable substances)
- providing the habitats and food sources required by beneficial organisms such as:
    - pollinators such as insects, bees, butterflies and birds
    - predators such as spiders, lady beetles, ground beetles etc. which eat pest organisms
    - parasitoids such as wasps and flies which parasitoid pest organism
    - pathogens such as fungi, bacteria and viruses which cause disease problems in pest organism
    - nematode worms which attack roots, plants and insects.

Pests

Natural Enemies and their Use

There are many different kinds of organisms in a field and not all of them are 'pests', in fact, many insects can have a beneficial function in the crop ecosystem. Others may be crop visitors, passing by and resting on the plants or soil, or they may be neutrals which live in the crop but do not feed on the plants nor influence pest populations as natural enemies. Even insects that feed on the crop are not necessarily 'pests'. Their population may not be large enough to cause damage to the crop because plants are unable to compensate for some damage without an effect on yields. In addition, the insects can serve as food or as a host for natural enemies.

Natural enemies are the 'friends of the farmer' because they help farmers to control pests or disease in crops. Natural enemies of pests and disease do not damage plants and they are harmless to people. They can be divided into four groups: predators (eating pest organisms), parasitoids (parasiting pest organisms), pathogens (causing a disease in pest organisms) and nematodes.

Chacteristics of Natural Enemies

Predators

- Common predators are spiders, lady beetles, ground beetles and syrphid flies.
- Predators usually hunt or set traps to catch a prey to feed on.
- Predators can feed on many different species of insects.

Parasitoids

- Parasitoids of pests are usually wasps or flies.
- Only the larvae are parasitic and they develop on or inside a single insect host.
- Parasitoids are usually smaller than their host.

Pathogens

- Insect-pathogens are fungi, bacteria or viruses that can infect and kill insects.
- Pathogens require special conditions (e.g. high humidity, low sunlight) to infect insects and to multiply.
- Commonly used insect-pathogens are Bacillus thuringiensis (Bt), and NPV virus

Nematodes

- Nematodes are a kind of tiny worm.
- Some nematodes attack plants (e.g. rootknot). Others, called entomopathogenic nematodes, attack and kill insects.
- Entomopathogenic nematodes are usually only effective against pests in the soil, or in humid conditions.

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Beneficial Insects are Available Through:

- The Beneficial Bug Company, www.thebeneficialinsectco.com
- Goodbugs (www.goodbugs.org.au/)
- Bugs for Bugs

Outside Australia; Please research other companies in your country which supply beneficial bugs.

Promoting and Managing Natural Enemies

Active populations of natural enemies can effectively control pest and disease organisms and thus prevent their mass multiplication. Therefore, the organic farmer should try to conserve natural enemies already present in the crop environment and enhance their impact.

Population Dynamics of Pests and Predators

As previously stated, insects, mites, fungi, bacteria and others develop according to the environmental conditions. Whenever these are favourable, their population density will grow, and when they are unfavourable, it will decrease again. This interaction becomes very important for the population dynamics of pests and their predators. Whenever the pest finds suitable conditions to grow, it increases its population. As a consequence, the predators which feed on the pest finds more food and therefore increase in number as well. As a consequence of an increased predator population, however, the pest population will be reduced, as they serve as food for the predator. A reduced pest population will then limit the food sources for the predator and its own population will shrink again. That's when the pest population can increase anew and the whole cycle restarts. This is a general principle of population dynamics, which applies whenever the food resources are the limiting factor for the predator population density

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Using Beneficial Organisms

- identifying the life cycles and habitats of beneficial predator insects
- identifying the role of predator insects in the ecosystem
- access to suitable biological controls
- providing the conditions required for the use of any biological control measures
- planting and maintenance of hedges to provide habitats for predator birds and insects
- planting and maintenance of understory plants that help support bird and beneficial insect populations
- providing permanent food source.

Pasture Management for Beneficial Insects

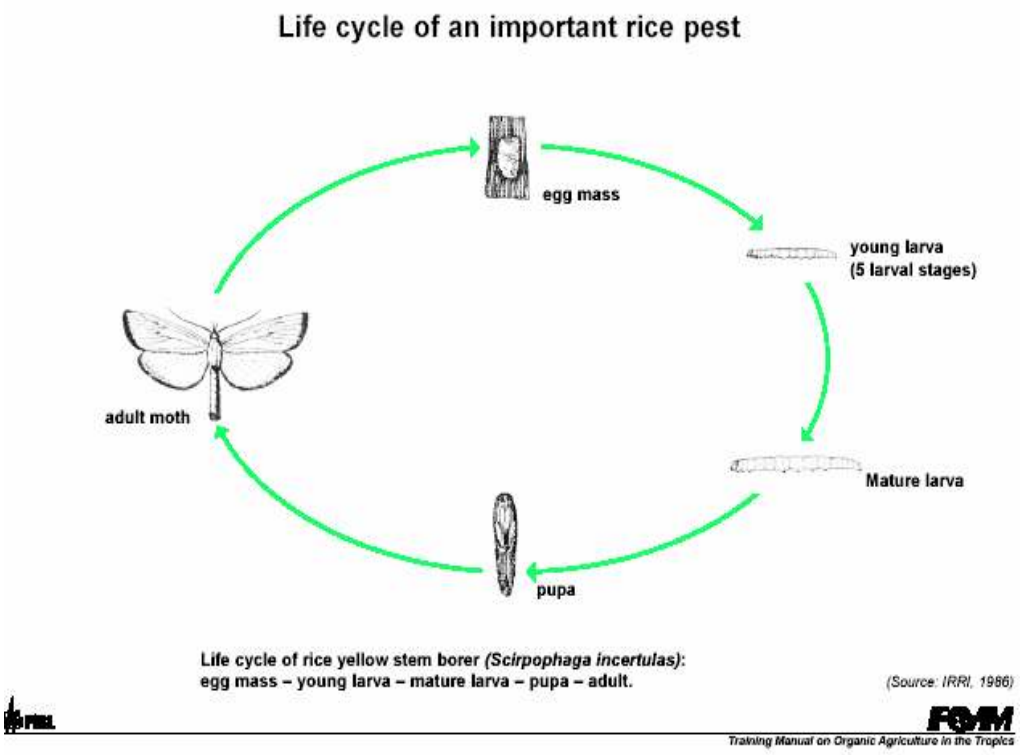
Select meadow seed blends whose blooms provide nectar, pollen, and habitat for predatory wasps, lacewings, ladybugs, and other beneficial insects are sold under brand names such as Good Bud Blend and Border Patrol. Of course, the same plantings can also provide habitat for pest insects. Researchers have investigated a number of management strategies for enhancing the effect of the beneficials. There are scientific references in Mary Louise Flint's Pests of the Garden and Small Farm (Davis, CA:, University of California, 1990) that provide more information to growers interested in exploring that option.

Coleman, E., *The New Organic Grower*, Chelsea Green Publishing, White River Junction, VT 05001.

Life Cycles of Pests

As not all the life stages of a pest are able to attack a plant, it is important to understand their life cycle. Knowing which life stages of insects or pathogens are damaging the plant and when and where they occur, is crucial for implementing effective preventative measures.

Furthermore, most insects or pathogens preferably infest the plant in a specific growth stage. Therefore, the interaction of pest and disease life cycle with the growing periods of the crop is equally important.



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Biological Controls

Of all the methods and approaches presently used for the management of pests, diseases and weeds, biological control is by far the most complex and, as a consequence, probably the least understood.

Biological control is the use of natural enemies to manage populations of pests and diseases. This implies that we are dealing with living systems, which are complex and vary from place to place and from time to time. The basis principles of biological control systems are explained below in brief. More extensive information on the use of natural enemies is available from work on Integrated Pest Management (IPM).

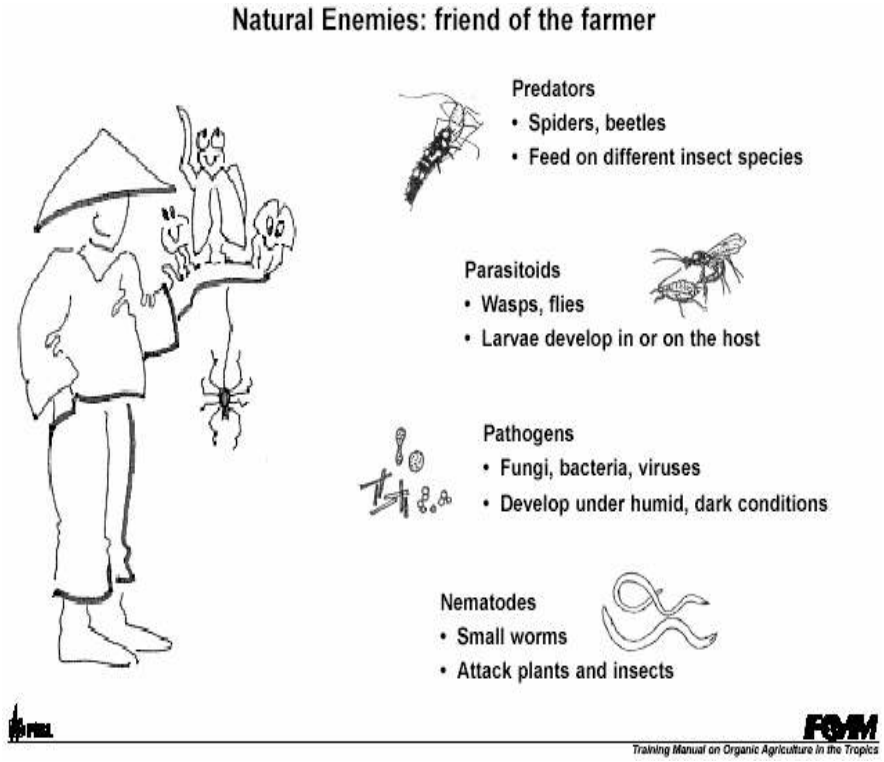
Releasing Natural Enemies

If populations of natural enemies present in the field are too small to sufficiently control pests, they can be reared in a laboratory or rearing unit. The reared natural enemies are released in the crop to boost field populations and keep pest populations down. There are two approaches to biological control through the release of natural enemies.

- Preventative release of the natural enemies at the beginning of each season. This is used when the natural enemies could not persist from one cropping season to another due to unfavourable climate or the absence of the pest. Populations of the natural enemy then establish and grown during the season.
- Releasing natural enemies when pest populations start to cause damage to crops. Pathogens are usually used in that way, because they can not persist and spread in the crop environment without the presence of a host ('pest'). They are also often inexpensive to produce.

Example: Trichogramma to control tomato fruitborer

The tiny black wasps of Trichogramma brasiliensis search the eggs of the tomato fruitborer (Helcoverpa armigera) to lay their own eggs into them instead of a fruitborer larva; a tiny wasp emerges out of the egg. Trichogramma is harmless to the tomato plant. Trichogramma is mass-reared and can be released into the field on 'trichocards', cards containing several thousand parasitoid eggs.



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Flowering Plants for Beneficial Insects

Agent	Targets	Feeding Plants
Hover flies	Larvae eat aphids and small caterpillars	Phacelia, buckwheat, parsley, mustard, alyssum
Lacewings	Larvae eat aphids, spider mites	Angelica, buckwheat, canola*, Coreopsis, mustard, pak choi, sunflower, alyssum, Phacelia
Ladybirds	Adults and larvae eat aphids, spider mites	Angelica, buckwheat, buddleia, coreopsis, coriander, dill fennel, yarrow, alyssum, Phacelia
Parasitic wasps	Pests parasitised (eggs laid in pests) different species of wasps for different pest species	Canola*, cow parsley, dill, fennel, Queen Anne's lace, mustard, pak choi*, buckwheat, alyssum
Tachinid flies	Adult flies lay eggs on cutworms, leaf roller caterpillars, grass grub etc.	Broad bean, buckwheat, canola*, cow parsley, mustard, pak choi*, Queen Anne's lace, Phacelia, buckwheat

*take care with all species that neighbours aren't growing a seed crop that could be contaminated from your beneficial flowers of similar crops.

Article Biodiversity on Farmland, Good Management Practices, p25

Using Antagonistic Microbes

Natural enemies that kill or suppress pests or disease are often fungi or bacteria. They are called antagonists or referred to as microbial insecticides or bio-pesticides.
Some commonly used antagonistic microbes are:

- Bacteria such as Bacillus thuringiensis (Bt). Bt has been available as a commercial microbial insecticide since the 1960s. Different types of Bt are available for the control of caterpillars and beetles in vegetables and other agricultural crops, and for mosquito and black fly control.
- Viruses such as NPV (nuclearpolyhedrosis virus), effective for control of several caterpillar pest species. Every insect species, however, requires a specific NPV-species. An example: The armyworm Spodoptera exigua is a major problem in shallot production in Indonesia. Since experiments showed that SeNPV (NPV specific for S. exigua) provided better control than insecticides, farmers have adopted this control method. Many farmers in West Sumatra are now producing NPV on -farm.
- Fungi that kill insects, such as Beauveria bassiana. Different strains of this fungus are commercially available. For example: strain Bb 147 is used for control of corm borers (Ostrinia nubilalis and O. furnacais) in maize, strain GHA is used against whitefly, thrips, aphids and mealybugs in vegetables and ornamentals. Several species of fungi can occur naturally in ecosystems. For example, aphids can be killed by a green or white coloured fungus during humid weather.
- Fungi that work against plant-pathogens. For example Trichoderma sp., widely used in Asia for prevention of soil- borne diseases such a damping-off and root rots in vegetables.
- Nematodes such as Steinernema carpocapsae control soil insects like cutworms (Agrotis spp.) in vegetables.

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Integrated Pest Management

Human-power used in shaking, plucking, pulling, hoeing, swatting fits in well with organic farming

Alley crop between legume rows for nitrogen supply to non-legume crops.

Poultry, particularly turkeys, guinea fowl and chooks control grasshoppers.

Strips of forest hinder grasshopper movement.

Enhance Soil microbiological activity to help nutrient availability for plant uptake, with VAM (mycorrhizal fungi), legume nodulation or algae for nitrogen fixing.

Mycoherbicides, herbicides derived from fungal cultures, control weeds.

Polycrop or intercrop. Use more than one species to provide benefits that include;

- shading out weeds and making less light available for some weeds that need it to stimulate germination.
  Polycultures of corn with combinations of squash, beans and sweet potato outcompete many weeds. These mixes have large areas of leaf that intercept most available sunlight. The traditional corn, beans, squash polyculture of South America was very successful at reducing weed and other problems and giving high total yields.
  Some organic farmers plant soybeans between their corn rows about four weeks after the corn. The corn harvest does little damage to the soybeans. When the soybeans are harvested, the remains of the two crops are turned in ready for the next crop in the rotation.

- allelopathic effects

- very long rows (such as 1km of broccoli then a parallel row of peas or beans, then a parallel row of tomatoes and so on) reduces the density of the crop to pests and diseases. It is a polyculture in one direction and a monoculture at right angles to the polyculture. This allows the farmer to get many of the advantages of both systems with few of the disadvantages

- inter-cropping an early-flowering crop similar to the main crop may encourage parasites to colonise early. For example an early broccoli crop where some of the crop plants are allowed to flower keeps the adult nectar-feeding parasites of pests available for the next brassica crop

- planting dill near cabbage allows hoverfly larvae to prey on cabbage aphids

- celery and dill repel cabbage moth females entering broccoli crops to lay eggs. Plant one repellent plant row to 14 crop plant rows

The nectar and pollen of many flowers, such as buckwheat, brassicas, legumes and sunflowers, can provide food for beneficial insects that reduce pest problems of other crops. A study in the USSR showed that when small plots of umbellifers (such as carrots and dill) were planted near cabbages in a ration of one umbellifer to 400 crop plants almost all the cabbage cutworms parasitised

Continued over page

Select a range of plants with different flowering times to extend the benefits of beneficial organisms.

Harvest your crop over a longer period by using successive sowings and so help predators to move from old to young plants, following the pests.

Buy predators and parasites to release if you have the right conditions for them to survive and be effective.

Short-season varieties. Shorten the exposure of the crop to a pest or disease by using short-season varieties. These are varieties that grow in a different season, or varieties that you can push along with fertile soil and water management.

Altitude. Some insect pests that spread diseases are not found at high altitudes. Farmers who grow potatoes as seed for others do not want disease in their seed so they are usually at high altitudes.

Lucerne as a long fallow over 18 months. Plant it with your wheat crop and then slash it or turn it in when you are ready to plant the next one. Lucerne grows better with a cover crop such as wheat, preferably sown lighter than usual.

Use natural fertilisers, such as reactive phosphate rock instead of superphosphate.

Resistant varieties.

Change crop planting date and method.

Pheromone attractants and traps. Pheromones are chemical signals used to communicate between insects. Many insects use sex pheromones to attract a mate. By using these pheromones we can lure one gender to a trap or so confuse them that few mate successfully.

Semiochemicals have some similarities to pheromones because they are chemicals that send signals. Some of them are signals to warn the insect to stay away (alarm pheromones), some deter them from eating certain foods (antifeedants) and others attract them to other foods. Some others attract them and stimulate them to certain activities. Canola has odour cues that help bees find the flowers and then stimulate them to forage, thus increasing the pollination.

Repellent crops also send out chemical signals to pests. Insects choose what they eat partly through attraction to the smell of something rather than to the food value of it. Aromatic plants interplanted with a crop can interfere with pest feeding by masking the smell of the crop. Repellent crops include various strong-smelling vegetables from the Solanaceae (capsicum, tamarillo, tomato, eggplant) and Allium (onion and garlic) families and aromatic herbs.

Use biocides only when a threshold is reached, that is only when more of the pest would lead to financial disaster.

Use microbial and botanical insecticides so the effects last only a matter of days. This minimises disruption of beneficial species. You may need to use them earlier than you would artificial chemicals because they are often less effective.

Continued over page

Vacuuming. Huge machines are used to vacuum strawberry crops in California to remove lygus bugs. The beneficial insects get out of the way.

Mimic nature by using cropping systems similar to local native systems or by choosing species that parallel local succession patterns to reduce the energy required to keep succession at bay.

Sanitation or hygiene is the removal and destruction of any infested or diseased fruit or other parts of the plant. Many of our worst fruit pests crawl from fallen fruit into the soil to pupate. They emerge as adults in spring and re-infest the tree. Fruit fly is one example. Poultry or pigs under the trees during the fruit season can help break this cycle by cleaning up the fruit and the larvae in them. Or you can collect the fruit and destroy the insects by drowning or solarising in a sealed plastic bag. Burying is useless because the pupae still get into the soil.

Sow crucifers with beets. The nematodes that attack the beets may develop partially in the crucifers. If these are ploughed in, the cyst nematodes will not develop fully.

Plants as lures. Some plants can lure pests away from the crop. These crops can also breed enemies of pests. In California lucerne strips are grown in paddocks of cotton and the lygus bug (a serious pest of cotton) migrates from the cotton to the lucerne. Because of the concentration of lygus bugs, the lucerne provides food for predatory insects.

Members of the cabbage family attract large numbers of aphids and keep parasitic wasps active over winter. When aphids attack crops in spring, the wasp population is large enough to control the aphids quickly.

Plants that are hosts for aphids provide a niche for the possible development of ladybirds and lacewings. When the crop is established, the weeds can be slashed, forcing the enemies onto the crops. However, don't use weeds that compete too strongly, or encourage any plant that supports aphids that carry diseases.

Decoy crops on crop margins lure pests into the decoys rather than the main crop.

Pest enemies (beneficial) can be encouraged in two ways: they can be reared in large numbers under controlled conditions (insectaries, often commercial ones that sell to farmers) and released at strategic times into crops, or the farm can be managed to favour the beneficials already present.

Time the management of companion and other crops. For example, if you cut nettles in summer in some cropping systems you force predators of insect pests to move into the crops that the pests are damaging.

Companion cropping. Certain weeds or other plants in certain crops may entice pest insects from the crop and the reduced damage to the crop compensates for the competition caused by the other plants. Other plants may deter pests because of odours for example garlic, some eucalypts.

Continued over page

Concentrate weed control methods to protect crops in the early stages, particularly during germination and emergence. Weed competition during the first third or so of the crop's life usually has the greatest effect on yields. Yield generally increases little when crops are weeded after this period. This generalisation is useful, but effects will differ depending on the specific interaction between the crop and the weed.

Fertility management. The effect of weeds varies with fertility. At high fertility, there may be little difference in yield between weedy and weed-free crops. At low fertility, there is more competition for nutrients, so weedy crops yield less.

Soil moisture. If soil moisture is low, the extent to which weeds affect crop yield varies with the crop and weed species.

Pest-killing crops. Some marigolds kill certain root-infecting nematodes.

Solarisation. Cover the soil on vegetable farms with dark or clear plastic so it heats up on sunny days for long enough periods to kill weed seeds and soil pathogens (disease-causing organisms). This also destroys beneficial soil organisms, but these are likely to re-colonise faster than pathogens. The weeds are killed outright, except for those that are buried too deep for the heat to have an effect.

Germinate weeds to suit yourself. Use a chaff spreader to put weed seeds in contact with the soil so they are encouraged to germinate. Provide a good seedbed some time before you plan to sow to encourage weeds to germinate and then you can kill them in the sowing operations.

Undersow with pasture legumes to encourage stock to eat more weeds after the oversown crop is harvested.

Sow after most weeds have germinated, which usually means planting the crop later. This means you kill the weeds in the sowing operations.

NSW Agriculture, *Ecology for Organic Farmers*

Pest Management in Tropical Queensland

By Andre Leu

There are a range of pest and disease strategies adopted by Andre Leu, skilled organic tropical fruit grower who runs a certified organic property, Daintree Tropical Fruit Orchards that occupies 12 hectares of a 64 hectare property and produces a range of exotic tropical fruits, particularly lychees. There is a wide range of other exotic fruits on the property, including Brazil nut, rambutans, star apples, mangosteen and durian being produced in commercial quantities.

Andre states: "A poor soil results in poor plants, more pests and diseases and poor yield...Soil organic carbon also encourages soil microorganisms that make minerals bio-available, and beneficial fungi such as Trichoderma, which control pathogens like Rhizoctonia, Phytophthora, Amilleria and Pythium, which can be a problem in the wet."

Andrea says: "Most pests are controlled by a range of bio control strategies. Where possible, it is best to use the free ones that were always here, such as green ants and insect eating birds.

A fascinating aspect of Andre's farm is the odd mowing pattern. At first sight it seems as though it has been made by an inexperienced tractor operator, who couldn't decide what slasher height to use. In fact it is a planned and considered approach to encouraging biological control.

Andrea says: "I never clear all the weeds in the orchard at the same time. It is important to leave packets of un-moved vegetation as refuges for beneficial insects and other organisms. The refuge cycle areas are simply cut down in another slashing cycle, to stop the weeds from getting out of control. In that mowing cycle, new areas are left as refuge for beneficials. Managed this way, I can balance the weeds to provide habitat, mulch and soil stabilization."

Andre also encourages small flowering plants to grow throughout the orchard, as they are essential for the adult stage of many beneficial predators such as lacewings and Trichogramma wasps. Collections of different varieties of poultry range the orchard hunting for insects. The rainforest has been allowed to regenerate in marginal areas of the farm, especially on the steeper slopes and along watercourses. Native species are planted to provide habitat for rainforest birds, which Andre says spend many hours each day removing pest species from fruit trees. These areas also host beneficial insects and mites.

Andre says "An example of this are predatory mite species that control Erinose Mite, the major leaf damaging pest in the lychees. Most growers spray continuously for this pest. However, it has reached a balance on my trees where it no longer affects their vigour. I spray wettable sulphur on the emerging flowers, as a precaution, to protect them from mite damage. At this stage I also use BT to protect the lychees flowers from caterpillars and envirospray gold to prevent beetle damage. These particular sprays are acceptable in organic standards and are very specific to the pest, so non-target species are not harmed. Lychee flowers are the only things I have to protect with a spray programme. However this year the ecology is working in my favour and I have not sprayed the flowers at all."

Controlling Pests

Pest Controls

Problem	Control
Aphids	Deter aphids with Nasturtiums, coriander, marigolds, calendula and garlic. Spray with garlic (see recipe below).
Carrot fly	Rosemary and onions.
Cockchafers	Spray with garlic (see recipe below).
Codling Moth	Spray with garlic (see recipe below).
Flying insects	Garlic and tansy deter flying insects.
Insect repellent	Pyrethrum, feverfew, Marigolds.
Nematodes (root)	Nematodes indicate low soil biological life. Good control can be achieved through balancing the carbon/nitrogen ration and increasing soil biota. French marigolds secrete a substance which kills root-eating nematodes.
Tomato disease	Basil.
White cabbage butterfly	Mint and sage when grown close offers some protection. Spray with garlic (see recipe below).
Wireworms	Spray with garlic (see recipe below).
Woolly aphis	Plant a ring of nasturtiums (Tropaeolum majus) around the trees. The flower has a strong scent which aphis do not like and the roots of the nasturtium excrete substances which, when absorbed by the tree, changes the composition of the sap and renders the tree unsuitable for habitation by the aphis.

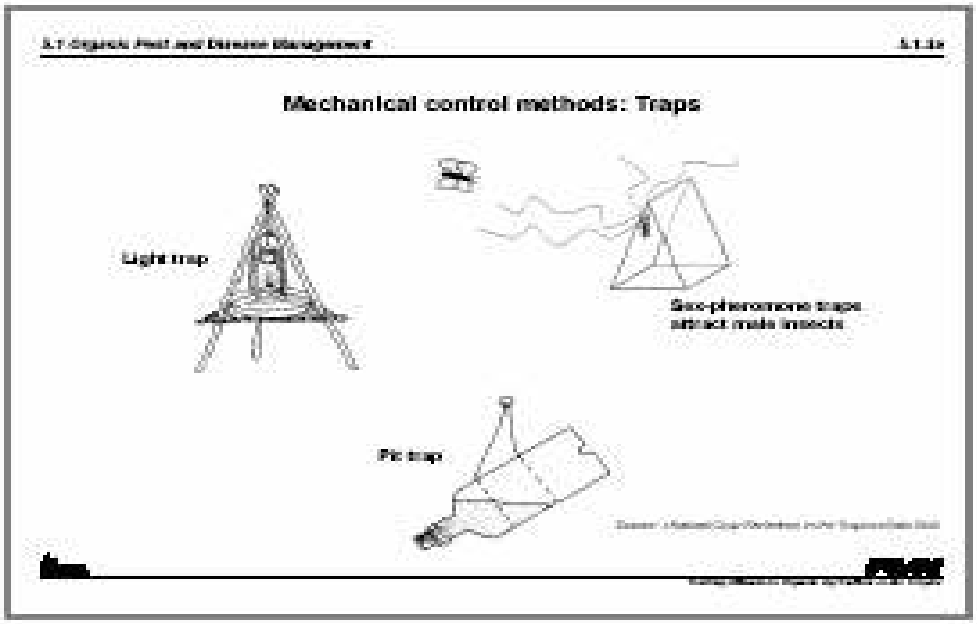
Curative Crop Protection Methods

If all preventative crop protection practices fail to sufficiently prevent economic losses to the farmer, it may be necessary to take curative action. Curative action means controlling the pest or disease once it has already infested the crop. Several options exist in organic agriculture.
1) Biological control with natural predators or antagonistic microbes.
2) Natural pesticides based on herbal preparations or other natural products.
3) Mechanical control with traps or hand picking.

Traps
Traps can help to reduce the population of certain pests. If used at an early stage, their use can prevent mass multiplication. There are several types of traps:

- Light traps attract night flying pest insects.
- Pitfalls catch creeping insects and slugs.
- Sticky traps. e.g. of a colour attracting a certain pest insect.
- Pheromone traps release a sex-hormone of the female insect, thus attracting the males which get stuck in the trap. If a small number of pheromone containers is distributed in an area, the male insects get confused and will not manage to find the females to reproduce.

Practical work: Make an insect trap.
Bait One. - Peel oranges or cucumbers, 100ml cow urine, 0.5 litres water. All ingredients should be mixed together well and allowed to stand overnight. Mixture will be diluted with 15 litres water and poured into traps.
Bait Two. - 1 litre of water, 0.5 cup cow urine, 1.5 teaspoons vanilla essence, 100g sugar, 10g pyrethrum. All ingredients should be well mixed and used in traps.
Bait Three. - 1 teaspoon pyrethrum, 1 cup honey, 1 teaspoon vanilla essence, 1 cup fruit pulp of cucumber, 10 litres water. All ingredients should be well mixed. One cup is poured into trap.



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Garlic Spray

Used for cockchafers, wireworms, aphids, cabbage white butterflies and codling moth. Also useful for lice.

85 grams chopped garlic mixed with 2 teaspoons medicinal paraffin. Leave to soak for 45 hours. Dissolve 7 grams pure soap in a ½ litre of hot water. Mix all together, strain, and bottle. Use a part to 99 parts water. Increase strength if required.

Ref: Bio Dynamic Agricultural Assoc. of Aust. Practical Notes

Recipe for Slugs and Snails

Oakleaf tea
Fill copper 2/3 full with fallen oak leaves
Add sixty litres water.
Bring to boil, reduce heat and simmer for one hour.
Allow to cool and pour into 1.25 litre bottles
Store in a cupboard.
Use one bottle to about 10 litres of water.
Spray three consecutive evenings in a row.

Pine cone soup to repel slugs and snails
By Dr. Andrew Lorand
I suggest you make up some pine cone soup. Pine cone soup is made from boiling pine cones in water. Use only a pot that you can afford to through way afterwards as it will be a sticky mess. Fill your pot 2/3 with fertile (seeded) cones, then add water. Boil under low flames and stir. Should produce a black/brown goo, that you can pour (at least a couple of inches wide) around your garden and areas affected by snails. Do not cover! My experience both in Switzerland and in Pennsylvania is that this works quite well for repelling slugs and snails for a period of a month, sometimes a little longer. I used only local species of pine in each case. Snails will attempt to cross this line and retreat. This recipe was given to me by a very old farmer who lived in the Jura mountains of Switzerland near Neuchatel.

Rhubarb Spray

Use for the control of aphids
Boil 1kg of rhubarb leaves in 3 litres of water for 30 minutes
Allow to cool and strain
Dilute with water to a 30% solution
Spray over whole plant including the undersides of leaves as well.

Natural Insecticide

Pour boiling water over 3kg of powered plant material; use wormwood and/or tansy. Leave to stand for 24hrs. Add water to make 100 litres.
The addition of a sticker or wetter (bentonite or soft soap) is always advisable.

Controlling Caterpillars

To control caterpillars – boil up rhubarb leaves and use undiluted.

Nettle Tea used to Combat Aphids

To make liquid tea:

- gather nettles
- place in a suitable container
- press lightly down into the container
- add just enough rain water to cover the nettles
- use after 24 – 48hrs
- dilute 1 part nettle tea to four parts water (1:4)
- spray on affected plants.

John Soper, *Studying the Agriculture Course,*
BD Agricultural Association UK, 1991, p51.

Control Fruit Fly

Equipment: 2 litre plastic bottles and wire to hang in trees
Attractant: for approx. 100 traps: 10 cups sugar, 400mls cloudy ammonia, 40 mls vanilla, 20 litres water.
Mix ingredients
Burn holes ¾ way up plastic bottles
Place ½ a litre of mixture in each bottle.
Hang up from under the top ridge of the bottle.
Use one trap for every 3 trees.

There are other fruit fly lures made up of beer; vegemite (one teaspoon/cup of water); malt, vinegar and honey (equal portions); malt vinegar and brown sugar (one teaspoon of each/cup of water).

Fruit fly deterrents comprise of diesel, or equal quantities of naphthalene flakes and creosote placed in jam tins and hung in trees before the fruit starts to ripen.

A fruit fly bait that works
Ingredients:

- 500ml water
- 1 tablespoon of cloudy ammonia
- 4 dessert spoons of white sugar
- 1 dessert spoon of natural vanilla.

Place in a 2 litre plastic juice container with cap on. Drill 10mm holes above the liquid. Hang two traps per tree (1-2 metres high). Change the liquid every week. The person who gave the recipe to the ABC reports that he trapped 1300 females in one summer using this method. For the first time ever he had clean peaches!

Fruit Fly Management

Six Part Fruit Fly Pest Management Plan:

- Keep fruit fly numbers as low as possible by not feeding them. Fruit flies live on entero bacteria that feed on the excess nitrates that are excreted on the undersides of leaves. Avoid soluble nitrate fertilisers – use only nitrogen in an organic form.
- Use insectary systems and do not destroy beneficial species with toxic chemicals. A lot of predator species in fruit trees such as spiders, green ants, and assassin bugs will eat fruit flies.
- Use protein hydrolysate baits (vegemite and water in old milk bottles) to attract and drown the females before they lay eggs in the fruit and males before they mate.
- Constantly harvest to remove ripe fruit from trees. Fruit flies prefer to sting ripe fruit. Keeping fruit at the hard green stage significantly reduces the breeding cycle.
- Use geese and other fowls to eat all fallen fruit and mature fruit to prevent the breeding cycle. The larvae live in the over ripe fruit and pupate in the ground.
- Adopt a strict post harvest inspection system to remove any potentially infected or damaged fruit. Fruit flies prefer to sting fruit with broken or damaged skin.

Suncoast Organics, September 2002, Excerpt from Article in Hunter Organics Summer/Autumn 2003

Control of Red Legged Earth Mite

The following method has been found effective when Red Legged Earth Mite (Halotydeus destructor) is attacking the very early growth of pasture or lucerne. It has also had some success where vegetable plants were being attacked by sucking pests.

The principle to be applied when considering this treatment is the activity/vitality of the plants, since pests attack plants with low vitality as part of the decomposition/recycling activity of Nature.

Using 500 and 501 together can help to invigorate the vitality of the plant. For example:

- Where plants have germinated (from the two leaf stage), but growth is slow to start due to cold climatic conditions.
- It can also help to invigorate the plant at the end of the growing season (e.g. when tomatoes have neared the end of the fruiting process).

Procedure:
Using 1 gram of 501 and 35 grams of BD500 per acre, stir both substances together for one hour in the same manner as is done for either substance on its own. Spray out in the morning over the plants at a pressure of 30-40 psi.

Biodynamic Gardeners Association, *Biodynamic Practical Notes*, 1993

Codlin Moth

A serious pest of apples and pears. Keep a close eye on your apple trees, and remove and destroy any fruit that has brown detritus exuding from a small hole. In early spring, tie a 10cm wide corrugated cardboard or hessian strip around the tree trunks. Inspect each month through the growing season and destroy if any grubs are found. Keep the bark healthy and don't allow loose, rough bark to remain – this provides ideal conditions for codlin moths to pupate.

Pheromone ties (codlin moth sex attractant) can be attached to the trees to disrupt breeding. Also. Trichogramma wasp eggs can be purchased and place din the trees from the time the moths start hatching (trichogramma wasps are predators of codlin moth).

Combating Pests with Milk and Honey Spray

The basic formula used is one part milk to nine parts water, (i.e. 1:9 ratio). The honey is sometimes added in a ratio of 1:100 to the entire volume. It is stirred in the biodynamic fashion for twenty minutes and then sprayed in a medium to fine mist. For larger volumes, the proportions of both the milk and the honey to the total quantity of water can be substantially reduced.
For instance, if one is spraying a forty acre field using a 300 gallon tank, the total volume of milk could be as little as 6 gallons (one gallon of milk to 49 gallons of water), and the quantity of honey could be as little as a pint-and-a half (one quarter cup per 49 gallons on water).

Observations and experiences
More than 2 years ago we conducted a participatory experiment on the use of milk and honey spray to combat rice stem borer with five farmers from five different locations. The amazing effect of milk and honey became the basis for the replication of the practice among the rest of the more than one thousand rice-based farmers.

The following recounts the five farmers' experiment using milk and honey spray:
1. Three days after the application of the milk and honey spray during the early stage of the infestation with rice stem borers, farmers observed a massive presence of beneficial insects: beetles (ladybirds), crickets, grasshoppers, bugs, spiders, wasps, and even frogs. Farmers obtained from zero (Rodrigo Piamonte's farm) to minimal damage (Eduardo Lapinid's farm) by stem borers, compared to total major damage in chemical-dependant farms just adjacent to these farms.

2. One farm, Billy Pilare's, was 85 percent damaged by whorl maggots (feeding on the whorl of the leaf) one month after transplanting. Three days after the milk and honey spray was applied, the massive presence of many species of beneficial insects was observed and the rice crop fully recovered.

3. Rizalito Bermudez' farm was 98 percent damaged by brown plant hopper (feeding on the leaves, causing them to dry out and turn brown) during the vegetative stage. BD500 followed by the milk and honey spray was applied. Five days later new tillers started shooting from the damaged plants. As maintenance, milk and honey spray was applied every fifteen days and Equisetum tea (BD508) two days before or after the full moon and perigee. The crop fully recovered.

4. Arthur Jimena's farm was 75 percent infested by tungro virus. BD508 was sprayed on five successive days and after three days, the milk and honey spray was applied in the late afternoon. Fifteen days after the application the crop fully recovered.

Developed by Hugh Courtney, *N.Z Harvests*, Vol 58, No. 2, pgs 2 & 3.

Disease

Disease Control

Crop rotation has tremendous potential for reducing and often preventing the transmission of disease. Disease pressures change with changing environmental conditions. Table 3 lists examples of disease that can be controlled with rotation. Crop rotation, in combination with cultural practices, is the most desirable method of disease control.

Table 3. Common disease controlled entirely or in part by rotation.

Disease	Major Crops Attacked[1]	Best Control Methods
Common root rot	wheat, barley, grasses	Rotation, seed trt.
Ergot	rye, wheat, grasses	Rotation, tillage
Bacterial blights	wheat, barley, grasses, rye	Rotation
Scab	wheat, barley, corn, rye	Rotation
Tan spot	wheat, durum	Rotation, fungicide
Net blotch	barley	Rotation, fungicide
Septoria (different species)	wheat, barley	Rotation, fungicide
Septoria (different species)	wheat	Rotation, fungicide
Septoria (different species)	barley	Rotation, fungicide
Pasmo	flax	Rotation, variety
Wilt (flax)	flax	Rotation, variety
Rust (flax)	flax	Resistant Variety, rotation
Seedling blight	wheat, barley, corn, oats, rye	Seed treatment
Smut (corn)	corn	Rotation
Bacterial wilt	alfalfa	Variety resistance
Crown rot	alfalfa	Variety resistance
Verticillium wilt	potato, sunflower, safflower	Rotation, variety
Rust (sunflower)	sunflower	Variety, rotation
Sclerotinia (white mold)	sunflower, dry beans safflower, soybean, potato, canola	Rotation 4 to 5 years
Phoma	sunflower	Rotation

[1]Wheat includes durum.

Phytophera

Phytophthora or Pythium
Use alternative sprays of BD500 and BD508 every second day. Saturate the whole plant including roots with the solution. Ensure long grass is removed from the base of the trunk, and that adequate space and light are provided. Tress must have good drainage.

After 3 to 4 applications, finish the procedure.

Biodynamic Gardeners Association, *Biodynamic Practical Notes*, 1993

Black Spot (Marssonina sp.) or Brown Rot (Sclerotinia sp.):

Use either Casuarina or Equisetum Tea: Dilute the solution to an average tea colour. Stir as for 500 for 20 minutes, before applying. Saturate the whole plant including the roots with the solution.

Treating Curly Leaf (Taphrina deformans) and Shot Hole (Stigmina carpophila):

Spray peaches and nectarines for leaf curl and apricots for shot hole with ¾ % sodium silicate, as soon as these diseases appear. Use ½ % solution only if the leaves are young.

Black Scale (Saissetia oleae) on Citrus Trees:

Instead of using petroleum based white oil, a spray made of Kaolin clay and sodium silicate can be used. The purpose of this spray is to close off the oxygen supply to the scale. In the past, an application of cold starch liquefied in water was for the same purpose.

In either case do not saturate the whole tree as it still needs to breathe. Cover the patches infested with scale.

Another effective old remedy is to blow lime over the entire tree.

Biodynamic Gardeners Association, *Biodynamic Practical Notes*, 1993

White Oil (Use for sooty mould)

Mix 1 cup cooking oil and 1 cup water. Add small amount detergent.
Mix well.
Dilute 1part oil to 14 parts water.
Spray onto affected plants as required.

Fungal Disease

Apply BD508 regularly
Apply BD501
These spray help to harden the plant and counter the conditions which lead to fungal disease.

Animal Management

Fertility Problems in Cattle and Sheep

Selenium is important for fertility. If problems arise add crushed leached garlic bulbs, as a source of selenium, into the animals' water troughs. This improves fertility and birth rate. Place one cupful of the leached garlic mixture into the drinking trough and let the animal drink it dry, then refill. Apply for 21 days (in keeping with their ovulation cycle).

Apple Cider Vinegar can be used as a supplement either sprinkled on feed or put into the animals' water trough to help during the birthing process, and to help minimise mastitis.

Newsleaf, Journal of BDAA Australia, No. 71, p28

Preventing Pests and Disease in Animals

- maintaining conditions to meet the basic requirements of all animals
- using cell grazing and/or rotational grazing
- providing access to a variety of suitable plants for grazing including herbs
- minimising stress in animals through:
    - adequate supply of fresh, clean water
    - proper shelter
    - clean bedding
    - fresh air
    - correct species selection
    - managing animals in accordance with natural instincts and behaviour
    - adequate variety of high quality food
    - maintaining access to fresh pasture
    - suitable stocking rates and herd size
    - maintaining appropriate age and sex distribution within the herd
    - ensuring frequent exercise and free movement
- maintaining good sanitation
- handling and restraining animals without causing stress or injury

Treating Livestock Problems

Once a farm has undergone the transformation of soil structure and plant health, Bio-Dynamic livestock are less prone to suffering health problems. Any problems that do arise are then usually the result of a climatic upset to the finely turned farm ecosystem. It is a constant challenge to determine the weakness as a result of the upset and to support the system until it can again regain harmony.

Worm Burden

Ensure the provision of high quality feed and access to mineral licks. When climatic conditions result in an increased worm build-up stock may need to be rotated more frequently, or in the case of Barber's Pole, sheep may even be rotated before cattle. Also refer to Herbal Recipes – Rhubarb Drench.

Fly Strike
Under correct Bio-Dynamic management stock odour becomes sweeter and fly problems reduce. Where humid and wet conditions occur weaker stock may succumb to strike. In such cases garlic or pyrethrum sprays or citronella oil has proven effective and healing. Inclusion of dolomite and sulphur licks may also reduce stock susceptibility. A good mix for fly strike is natural pyrethrum, eucalyptus oil, a few drops of citronella and a small amount of liquid soap (enables the mixture to penetrate the wool of sheep).

Lice
Provision of sulphur licks is often enough to overcome this problem. Also a good buffer zone/fence between you and your neighbour reduces possible infestation.

Ticks
Interesting to note that Biodynamic members often find that introduced non-Bio-Dynamic stock take about a year to gain in health and naturally overcome the problem of ticks. During this time you may try a mixture of Pyrethrum and vegetable or sump oil (from petrol engines only) poured along the cow's back.

Biodynamic Gardeners Association, *Biodynamic Practical Notes*, 1993

Pest Control for Animals

Excerpt from Report by Dawn Russell

Bess, the 12 month old bucket-reared heifer calf, was sprinkled from head to tail with sulphur powder for lice control and then given a treat in a paper cup for animals lacking copper (spectacles around their eyes - means they are wormy):

1 tablespoon dolomite
1 flat teaspoon copper sulphate
enough honey to make a ball.

Never give copper without dolomite, i.e. double the dolomite to copper – to avoid copper poisoning.

Worming Cattle
Introduce Apple Cider Vinegar gradually into the cattle's drinking water for them to acquire the taste).

1. Bath tub containing 200 litres water, 2 litres Apple Cider Vinegar, 1 heaped tablespoon garlic powder, give 24 hours before a full moon (worms detach themselves from the stomach wall only on a full moon). It is best to have this as the only drinking supply to ensure cattle are taking the mix.

2. If giving worm treatment as a drench:
1/2 cup Apple Cider Vinegar
1 heaped teaspoon garlic powder
1 cup water (gives you 2 adult doses)

3. Ground up pumpkin seeds are given 24 hours before the full moon in their feed. Large pumpkin seeds should be ground up. 1 cup small seeds can be given whole.

4. Drench of
1/2 cup A/C Vinegar and
1/2 cup wormwood (Artemisia absinthium)
in water to fill a wine bottle.

Continued over page

Have fresh pick for cattle to go into the paddock after or during their worming. After sunlight exposure of the expelled manure, the worms perish after 6 weeks. Sheep can follow cattle within a few days and cattle can follow sheep after they are cleaned out. The gut bacteria are still alive in the animal and the following day they are still gaining weight. Do not overstock.

Wormwood for Dogs
1 large capsule per day for 3 days before full moon. Small dogs – 2 capsules.

Wormwood Infusion – Put 500g Wormwood leaves into 4 litres Apple Cider Vinegar and leave for a few months.

Injections used – VAM (for 3-day sickness, calving paralysis - a general pick me up), Vitamin C and Vitamin B12

Liver Fluke
Make a 750ml drench of strong tea (Liver Fluke cannot stand tannins. Helps to clean liver out and get functioning again). Give an injection of VAM.

Rock Salt
Given to cattle in winter in block form, for warmth and energy.

Itchy Mix for Horses
Pour a mix onto backs of horses:

- 1/2 cup cooking oil
- 1/2 cup cod liver oil
- 1 cup kerosene
- 1 tablespoon sulphur.

Diatomaceous Earth – used in dust bath for chickens.

Seaweed Meal
Used in the mineral mix.

Injury on the horse – helped with 1 cup Apple Cider Vinegar and 1 teaspoon copper sulphate mixed with water made up to 500ml to disinfect. Use on foot rot and ringworm. One cup A/C vinegar in 1 cup water for any swelling on animals or for a dog's infected paw.

Lice
3 drops Neem Oil, 6 drops Tea Tree Oil in water in a 500ml spray bottle. Neem Oil available from health food stores.

Wormwood is put into capsules after grinding in a coffee grinder. A capsule filler is a very handy tool to have!

Hydatids Disease
Keep dogs wormed to stop hydatids getting into cattle or sheep.

Ticks
For dogs give 5ml injected Vitamin C after tick bite. Neem oil and Sulphur are used for ticks on cattle.

The Feverfew flower has a dot in the centre of the flower and the Chamomile has lay back petals with a bulky centre. Feverfew is used particularly for migraines. Chamomile for a relaxant.

Hunter Valley Biodynamic Group Newsletter, No. 11, June 2002

Cattle Ticks

Use Neem Oil, 4 drops in 500ml water and apply in a fine spray.
Also give cattle sulphur.

Sourced from Hunter Valley Biodynamic Group

Lice

"John suggests dolomite dusting of cattle for lice. The lice are an indication of malnutrition to some degree. This may be caused by lack of nutrition for the stock or overstocking of the available pasture. Once again if the health and management of the property are correct the animal's won't have problems. John suggests dolomite dusting of cattle for lice, and diatomaceous earth for lice on chooks."

Newsleaf, Journal of BDAA Australia, No. 71, p27

Rhubarb Drench

One medium sized leaf of Rhubarb (Dinner Plate size) for every 400 to 500kg live weight beast. Chop or vitamise leaf finely, then dilute the substance with water and administer as a drench. It is very important to follow up this process twice more at three weekly intervals.

Biodynamic Gardeners Association, *Biodynamic Practical Notes*, 1993

Pyrethrum Spray

Requirements:
Well growing pyrethrum plant from the garden;
Garlic oil;
Eucalyptus oil;
Pure soap flakes;
Water

Cut up into small pieces 1kg of pyrethrum plant when in full flower. Place in a sealed container with 8 litres of water. Allow to brew for 3 weeks or so, shaking occasionally when you walk past to encourage extraction process. (The smell is not pleasant, but worth the effort!)

Strain and add the following to 1 litre of the pyrethrum mix:
1 cup garlic oil
2 tablespoons eucalyptus oil
½ cup pure soap flakes

Bottle and keep in cool, dark place until required.
Ref: Bio Dynamic Agricultural Assoc. of Aust. Practical Notes

Johne's Diseases (mycobacterium paratuberculosis)

This disease is related to copper deficiency in our soils and food. The use of superphosphates (even with added copper) suppresses copper in the soil.

Bloat Control

Spray BD501 on pastures using appropriate times on the planting calendar

Worm Drench for Cattle

Drenches for parasite control can be easily made using a range of ingredients such as apple cider vinegar, garlic and herbs such as tansy, wormwood, yarrow and comfrey. The effectiveness of all drenches can be improved by administering these 24 hours before the full moon.

Per horse or cattle per day
Brew 1 large handful dried American wormseed herb in 11/2 litres water (bring to boil, simmer three minutes, leave to steep eight hours or overnight best). Mix 2 tablespoons powered garlic with half a litre organic apple cider vinegar, and two tablespoons molasses. Combine with strained liquid from the American wormseed. Add water if necessary.

You can also add whole handfuls of apple cider vinegar or organic garlic to drinking troughs.

Mary Richardson, *N.Z Harvests*, BD Assoc. N.Z., Volume 57, No. 1, 2004

Recipe for Worm Drench

5 litres cider vinegar
1 kg soaked garlic
Soak together for a few months if required.

Chop finely and add herbs that are beneficial for worm treatments (wormwood and Allocasuarina; high silica content)

For lambs: a solution of copper sulphate and water mixed with powered charcoal.

For two adult doses
½ cup apple cider vinegar
1 heaped teaspoon of garlic powder
1 cup of water

If introducing to animals drinking water
To one bathtub full of water add
2 litres of apple cider vinegar per 200 litres of water
1 heaped tablespoon garlic
The most effective time to use any worm drench is two to three days before the full moon.

Liver Fluke
Make a 750 ml drench of strong tea as liver fluke cannot stand tannins.

Lice
3 drops of neem oil
6 drops tea tree oil
Put oils in water in a 500 ml spray bottle.
or
Dust animals with either sulphur or dolomite (lice are an indication of a lack of sulphur)

Pink eye
2 to 5 ml of cod liver squirted into the eye and the 20ml given orally.

Warts
Warts re an indication of a lack of magnesium, make dolomite available.

Mastitis in Cows
Strip out some milk twice a day if you can. Mix 20 drops Phytolacca decandra 1:5 tincture (pokeroot) (toxic if used in large doses) available from a herbalist into ½ cups of warm vegetable oil and apply all over udder or affected section twice a day. Internally give Echinacea 5-10 mls and 20 drops Phytolacca tincture with feed twice a day.

Susan Schmiedte, Pelicans Nest, Hunter Valley, NSW

Reducing Milk Fever by Feed Management

Good nutrition is useful method of reducing the incidence of milk fever at calving time. It seems that cattle are better able to cope with the calcium demands of high milk production if their "efficiency" of calcium metabolism prior to calving can be promoted. This implies a diet restricted in calcium rich feeds up to the point of calving, followed by feeds adequate on calcium afterwards.

One such regime is the one used at Milmore Downs for the beef cattle. In-calf cows are break fed on winter feed crops – regrowth wheat and tick beans, with initially unlimited oat straw, and later oat hay at 5 cows to the bale. A high diet of carbohydrate, with restricted green material, and hence restricted calcium, promotes the cow's ability to use the available calcium efficiently. This ability is still active at calving time when the demand for calcium rises dramatically.

Cows are moved onto herbal ley pastures on the day of calving, which means that the amount of dietary calcium also rises. If this increased supply is used efficiently, the calcium demand can be met, and milk fever problems are avoided.

Ian Henderson, *N.Z Harvests*, Vol 50, No. 1

Coccidiosis in Chickens

Powered comfrey leaves added to drinking water cures coccidiosis.

Queensland Itch

A few drops of lavender as necessary to stop the itch mite becoming established is proving effective with Queensland itch. The lavender is placed along the back and the wither.

Newsleaf, Journal of BDAA Australia, No. 71, p27

Buffalo Fly

Neem oil is effective for Buffalo Fly and Tick. If there is a real problem the neem oil can be diluted and sprayed on. Another preventative measure is to establish neem trees that the animals can browse on and camp under to help alleviate the problem.

Newsleaf, Journal of BDAA Australia, No. 71, p27