Section Two

Biodynamic Production

Contents

What Makes a Biodynamic System?

- Maintaining the soil as a living organism.
- Feeding the plant naturally according to its requirements.
- Careful care and attention to soil structure.
- Use of the full set of biodynamic preparations.
- Diversified farming systems.
- Working in harmony with natural rhythms.

Success in Biodynamic Practice Depends Upon:

- Maintaining and increasing soil humus levels through:
  - composting
  - green manuring
  - incorporating crop stubble
  - harrowing manures
  - crop rotations
  - rotational grazing.

- Use of the biodynamic preparations:
  - regular use of all nine biodynamic preparations.

- Diversified farming systems which includes:
  - diversity of both plants and animals.

- Working in harmony with daily, seasonal and lunar rhythms when undertaking:
  - cultivating
  - sowing
  - harvesting
  - applying BD preparations.

Timetable of Biodynamic Activities

Please note; these are general guidelines. The exact time and conditions for each of the following activities can only be determined by your observations of site conditions and the timing of production activities.

Activity	Season			
	Spring	Summer	Autumn	Winter
BD500 X2 year	▪ Afternoon ▪ Terrestrial conditions ▪ Descending moon if possible.		▪ Afternoon ▪ Terrestrial conditions ▪ Descending moon if possible.	
BD501 X3 year (most crops)	Four leaf stage: ▪ Sidereal rhythm ▪ Ascending moon ▪ Morning.	First fruits form: ▪ Sidereal rhythm ▪ Ascending moon ▪ Morning.	Two weeks before harvest: ▪ Sidereal rhythm ▪ Afternoon.	
BD508	Preventative to fungal diseases: ▪ Morning ▪ Perigee Moon ▪ Full moon.			
Compost applications; most beneficial seasons.	▪ Afternoon ▪ Terrestrial conditions ▪ Descending moon if possible.		▪ Afternoon ▪ Terrestrial conditions ▪ Descending moon if possible.	
Manure concentrate (barrel preparation)	Whenever organic matter is available; after cropping, grazing, as a general spray. ▪ Afternoon ▪ Terrestrial conditions ▪ Descending moon if possible.			
Liquid manures	Applied at suitable times throughout the growing season. ▪ Afternoon ▪ Terrestrial conditions ▪ Descending moon if possible.			
Tree paste				All trees and vines

Land Capability Classes

Classes	Land use	Management options
1	Mainly cropping	Wide variety of uses – vegetables and fruit production, grain crops, energy crops and fodder, sugar cane. No special soil conservation works or practices necessary.
2		Soil conservation practices such as strip cropping, conservation tillage and adequate crop rotations.
3		Structure soil conservation works such as graded banks and waterways are necessary, together with soil conservation practices as in Class 1.
4	Mainly grazing	Occasional cultivation, better grazing land. Soil conservation practices such as pasture improvement, stock control, minimal cultivation for the establishment and re-establishment of permanent pasture, maintenance of good ground cover.
5		Similar to 4, structural soil conservation works such as diversion banks and contour ripping, together with the practices in Class 4, like the maintenance of good ground cover.
6	Grazing	Not capable of cultivation, less productive grazing, can have saline areas. Soil conservation practices including limitation of stock, broadcasting of seed, promotion of native pasture regeneration, prevention of fire and destruction of vermin. This may require some structural works and maintenance of good ground cover.
7	Tree cover	Land best protected by trees. Very important habitat areas for protecting biodiversity. Timber production and honey is possible.
8	Unsuitable for agriculture	Cliff, lakes or swamps or other lands where it is impractical to grow agricultural produce or timber.

Farming for the Future, Physical Property Planning, Page 52, 1999, ISBN 0 7313 0521 3

Good Farm Practices

Biodynamic applications are most effective when combined with good farm practice. This includes:

- Creating diversity through a broad range of grasses and herbs planted to encourage diversity in soil bacteria and fungi and applying compost, kelp, fish emulsion and weed teas.
- Aerating paddocks with renovating ploughs or weighed spikes followed by a soil spray allows air (oxygen and nitrogen) down into the sub-soil
- Always mulch mow or slash each paddock once a year to provide for earthworms and stimulate root development.
- Strip graze paddocks so that pasture is not eaten to bare ground. Graze down to a fixed height to allow stock to tread down ("put down") 1/3rd of the grass back into the soil.
- Make a deliberate policy of always under-stocking to ensure enough feed is available through drought periods and the pasture is not damaged and debilitated –this practice will ensure you have enough hay for compost making.

Good farming practice applies the ecological mind set when confronted with weed, animal or insect problems – i.e. do not rush into treating the symptoms but look back to find the real cause.

Elementals, Journal of BD Tasmania, December 2006

Plants

Suitable Varieties for a Biodynamic System

Many years of reliance on chemical inputs and supplements to maintain fertility, production outcomes and combat weeds, pests and diseases has significantly weakened the genetic strength of our plants and animals. Plants and animals which have been raised with chemical inputs may not thrive under the natural conditions of a biodynamic system.

Make every effort to source the plants and animals you need from either biodynamic or organic systems as these will have the genetic strength required in a more natural system.

Selection Criteria for Seeds, Plants and Trees

- plants and animals suitable to biodynamic production
- suited to local and regional conditions
- non hybrid, open pollinated seed
- derived from biodynamic and/or organic seed and /or plant material
- eating quality; includes the flavour, tenderness and aroma of the vegetable, both raw and cooked.
- appearance; colour, size and shape
- water requirements
- pest and disease resistance
- frost tender or hardy
- sowing dates (seasons only)
- physical management required; pruning, staking, tying etc.
- days to maturity
- storage; suitable for long and short periods in storage
- vigour; includes quick germination and quick growth
- performance; vigour under a wide range of conditions
- standability; describes non-cracking tomatoes, non splitting cabbages, and so forth
- ease of harvest
- time of harvest
- frost resistance and hardiness
- adaptability
- nutrition; selected for higher levels of nutrition
- marketability; specialty, ethnic, and gourmet varieties.

Coleman, E., *The New Organic Grower,* Chelsea Green Publishing, White River Junction, VT 05001, p44, 1995

Plant Families

Poaceae
- Corn
- Maize
- Wheat
- Rice
- Millet
- Barley
- Sorghum
- Oats

Chenopodiaceae
- Beet
- Chard
- Silverbeet
- Spinach

Cucurbitaceae
- Squash, summer & winter
- Cucumber
- Pumpkin
- Zucchini
- Melons

Liliaceae
- Onion
- Leek
- Garlic
- Shallots
- Asparagus
- Chives

Brassicaceae
- Broccoli
- Cauliflower
- Cabbage
- Brussels sprouts
- Radish
- Turnip
- Swede
- Rocket
- Kohlrabi
- Mizuna
- Bok Choy
- Mustard
- Rutabaga
- Kale

Fabaceae (legumes)
- Pea
- Bean
- Broad beans
- Lucerne
- Clover
- Lentils

Apiaceae
- Carrot
- Parsley
- Celery
- Parsnip
- Fennel
- Dill
- Coriander

Solanaceae
- Potato
- Tomato
- Pepper
- Capsicum
- Chilli
- Eggplant

Asteraceae
- Lettuce
- Endive
- Chicory
- Jerusalem artichoke

Plants to Attract Beneficial Insects and Predators

- Yarrow
- Rosemary
- Buckwheat
- Rue
- White clover
- Cosmos
- Sweet Alice
- Dill tansy
- Queen Anne's Lace
- Chinese mustard
- Parsley daises
- Daisy family; feverfew and Chrysanthemum

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Umbelliferae family plants include:

- Carrots (*Daucus carota*)
- Parsnips
- Parsley (*Caruim petroselunium*)
- Corinader
- Dill
- Fennel.

Compositae family plants include:

- Common or pot marigolds (*Calendula officinalis*)
- Cornflower (*Centaurea cyanus or C. montanta*)
- Common daisy (*Bellis perennis*)
- Felicia (*Felicia amelloides*)
- Sunflower (*Helianthus).*

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)	canola, cow parsley, dill, fennel, Queen Anne's lace, different species of wasps for mustard, pak choi, buckwheat, alyssum, different pest species
Tachinid flies	Adult flies lay eggs on cutworms, leaf roller caterpillars, grass grub	broad bean, buckwheat, canola, cow parsley, mustard, pak choi, Queen Anne's lace, phacelia, buckwheat

Biodiversity on Farmland, Good Management Practices

Companion Planting

Allelopathy is the scientific name given to the compatibility of plants, companion planting. The experiments necessary to turn it into an exact science have not yet been made, but gardening has been going on for a long time and people make observations. E.g. When tomatoes and potatoes planted close together, have for three years in a row, produced tomatoes too languid to hold their fruit and potatoes like marbles, but have come up with bumper crops when they were planted at opposite ends of the garden, something clicks. The reason may be obscure, but the result is obvious and once you have proof of the pudding you stick to the recipe.

For those who pine for scientific reasons as to why plants can make good or bad neighbours, it has much to do with exhalations, scents and root excretions. Halitosis, body odour and whiffy socks are no higher in the plant popularity stakes than our own. But there's no accounting for tastes; plants can prefer strange bedfellows. Like us they have their Dr Fells and seemingly irrational love-objects. Contentment is a matter of who's with whom. That's what allelopathy or companion planting is all about.

Companion Planting in Australia, Brenda Little Reed Books, NSW, 1986, ISBN 0 7301 01223

Other books of interest on companion planting:
Richard Bird Companion Planting ISBN 0 7318 0158 X
Helen Philbrick & Richard Gregg Companion Plants and how to use them Devin-Adair Co. Conneticut 1966 ISBN 0 8159 5210 4
Louis Riotte Secrets of Companion Planting for Successful Gardening Garden Way Publishing Vermont 1978 ISBN 0 88266 064 0
Simon Schuster Companion Planting ISBN 0 7225 0694 5

Companion Herbs and Their Uses

Herb	Companion and their effects
Basil	Companion to tomatoes; dislikes rue intensely. Improves growth and flavour, repels flies and mosquitoes.
Beebalm	Companion to tomatoes. Improves growth and flavour.
Borage	Companion to tomatoes, squash and strawberries. Deters tomato worm, improves growth and flavour.
Caraway	Plant here and there; loosens soil.
Catnip	Plant in borders; deters flea beetle.
Camomile	Companion to cabbages and onions. Improves growth and flavour.
Chervil	Companion to radishes. Improves growth and flavour.
Chives	Companion to carrots. Improves growth and flavour.
Dead nettle	Companion to potatoes. Deters potato bug; improves growth and flavour.
Dill	Companion to cabbage; dislikes to carrots. Improves growth and health of cabbage.
Fennel	Plant away from gardens; most plants dislike it. Plant near roses and raspberries; deters Japanese beetles. Improves growth and flavour.
Horseradish	Plant at corners of potato patch to deter potato bug.
Hyssop	Deters cabbage moth; companion to cabbage and grapes. Keep away from radishes.
Lamb's Quarters	This edible weed should be allowed to grow in moderate amounts in the garden, especially in corn.
Lovage	Improves flavour and health of plants if planted here and there.
Marigold	The workhorse of the pest deterrents; plant throughout the garden it discourages nematodes and other beetles.
Mint	Companion to cabbage and tomatoes; improves health and flavour. Deters white cabbage moth.
Marjoram	Here and there in the garden; improves flavour.
Nasturtium	Companion to radishes, cabbage and curcurbits; plant under fruit trees. Deters aphids, squash bugs, striped pumpkin beetles. Improves growth and flavour.

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Pot marigold	Companion to tomatoes, but plant elsewhere in garden. Deters asparagus beetle, tomato worm and general garden pests.
Purslane	This edible weed makes good ground cover in the corn.
Pigweed	One of the best plants for pumping nutrients from the subsoil. Especially beneficial to potatoes, onion and corn. Keeps weeds thinned.
Peppermint	Planted among cabbages it repels the white cabbage butterfly.
Rosemary	Companion to cabbage, bean, carrots and sage. Deters cabbage moth, bean beetles and carrot fly.
Rue	Keep it away from sweet basil; plant near roses and raspberries. Deters Japanese beetle.
Sage	Plant with Rosemary, cabbage, and carrots; keep away from cucumbers; deters cabbage moth, carrot fly.
Southernwood	Plant here and there in garden; companion to cabbage. Improves growth and flavour; deters cabbage moth.
Sowthistle	This weed in moderate amounts can help tomatoes, onions and corn.
Summer savoury	Plant under fruit trees; companion to roses and raspberries. Improves growth and flavour; deters bean beetles.
Tansy	Plant under fruit trees; companion to roses and raspberries. Deters flying insects, Japanese beetles, striped cucumber beetles, squash bugs and ants.
Thyme	Here and there in the garden; deters cabbage worm.
Wormwood	As a border, it keeps animals from the garden.
Yarrow	Plant along borders, paths, near aromatic herbs. Enhances essential oil production.

This information was collected from many sources, most notably the Biodynamic Association and Herb Society of America.

Mulching

Guidelines for Mulching

"Mulching is not a practice to be followed stubbornly under all circumstances but should be done with common sense and an understanding of its function. The effects of mulching depend on conditions of the soil and weather, wet or dry."

"Under climatic conditions where frost plays a role, there is nothing more natural and better than frost action on a soil to produce crumbly structure, provided the frost can freely penetrate and the soil is well drained. A waterlogged, soaky mulch which freezes and thaws is of no help and only acts as an insulator; does not even keep the soil warm and does not protect against frost damage to sensitive plants. The freezing out of plants during the winter is increased with waterlogged conditions of the soil or mulch. Even snow acts as mulch. Underneath the snow, the soil warms up to about a depth that the snow is thick. A half metre of snow would penetrate with its warming effect to about the same depth. The action of frost on a soil produces a crumbly soil structure."

Pfeiffer, E., *Biodynamic Farming and Gardenin*g, Vol.1, Mercury Press, USA, 1983

Requirements for Use of Mulch in a Biodynamic System

- removal of mulch before applying biodynamic soil preparations
- using mulching in such a way as not to cause the following:
    - retaining water with the possibility of increased water logging
    - increase in acidity and the development of fungal diseases
    - cold soil conditions
    - use of high carbon materials that can cause temporary losses of nitrogen
    - increasing weed seeds
    - robbing the soil of oxygen
    - proliferation of organisms which find shelter under mulch
    - harbouring of pests and diseases.

Benefits of Mulching

- reduces water evaporation
- helps soils retain water
- preserves humus
- reduces soil erosion
- protects soil biology
- suppress weeds
- buffering against wind and water erosion
- increases the organic matter content in soils
- modifying soil pH
- improving soil structure
- prevents surface crusting of soils
- source of plant nutrients as mulch breaks down.
- feeding and protecting soil organisms
- helping to cool soils.

Problems of Mulching

- in wet, cold seasons mulching can do great damage
- collecting and retaining water
- water logging
- increases acidity and the development of fungal diseases
- soils take longer to warm up in spring
- some mulch materials with high C:N ratios cause a temporary loss of nitrogen for use by plants
- can be a source of weed seeds
- if applied too thickly can rob the soil of oxygen.

Materials that Can be Used for Mulching

1. Compost – however has a much higher value when mixed into the soil
2. Lucerne hay – being a legume it is very high in nitrogen
3. Straw – generally oaten or wheaten
4. Leaf litter – very useful as a garden mulch
5. Seaweed – high in trace elements – excellent mulch for asparagus
6. Animal manures – should always be composted
7. Lawn clippings – preferable to compost rather than use as a mulch. Dried clippings can be used if only a thin layer
8. Weeds, cover crops or crop residues
9. Wood chips – excellent cover for retaining moisture and protecting the soil
10. Sugarcane residue (bagasse) – use organic sugarcane and conventionally grown may contain high levels of chemical residues.
11. Mushroom compost – alkaline
12. Bracken – high in potassium, good mulch for potatoes
13. Pine bark
14. Pine needles – acidic, very useful for acid loving plants such as strawberries, blueberries, azaleas and camellias
15. Sawdust – because of its high C:N (carbon to nitrogen) ratio (approx 400 – 500:1), use sparingly and ensure it is not from untreated timber
16. Newspaper – don't apply in a thick layer, if allowed to completely dry out, it is very difficult for water (under normal weather conditions) to permeate.
17. Gravel and pebbles – used not only for aesthetic purposes but also for mulching plants such as cacti ad succulents
18. Weed mat – often covered with other material
19. Black plastic – can be used to warm the soil before planting in spring
20. Clear plastic – also warms the soil and can be used to kill weed seeds in hot weather. In cool weather, clear plastic can be used as a temporary cover to speed up the germination of seeds.
21. Rocks – good mulch around trees if chickens are free ranging as it protects the roots.

Water Evaporation With and Without Mulch

Tons of Water Evaporated from an Acre of Soil With and Without Mulch
(Data for a period of 100 days)

Depth of Mulch	Clay Loam	Black Marsh	Sandy Loam
None	2,414	588	741
2.5 cms	1,260	355	373
5 cms	979	270	339
8 cms	889	256	287
10 cms	883	252	315

'Under the conditions of the above test, the losses of water by surface evaporation were practically cut in half by use of mulch.'

Pfeiffer, E., *Biodynamic Farming and Gardening*, Vol.1, Mercury Press, USA, 1983

Pastures

Pasture Species

AgResearch Grasslands manager Gavin Milne says choosing the right seed to sow for a new pasture is often confusing. He says the easiest way to decide is to choose which species, then the type within a species and finally which cultivar.

Perennial Ryegrass

This is the most commonly used grass. This persistent species suits areas with reasonable summer rainfall, moderate summer temperatures and good soil fertility. It is quick to establish and easy to manage. However it grows poorly in either dry or hot summers. Stock does not perform on perennial ryegrass as well as on some species. It needs endophyte to survive which causes staggers. Italian ryegrass grows high quality feed, and lasts for one to two years. It is quick to establish and grows more than perennial over winter. Hybrid ryegrasses last three to five years and have similar features. Both the Italian and hybrid lack persistence, but suit a ryegrass mix.

Tall Fescue

Fescue is the 'prima donna' of the drought and insect resist grasses. It is often an alternative to ryegrass, and is best suited to fertile soils. It has better summer and autumn growth than ryegrass, but poorer in mid spring. Fescue has good tolerance of both dry and wet soils, hot summers and grass grub. Feed quality and animal performance is usually higher in summer and autumn, if managed correctly. However, tall fescue can have slow establishment, and different grazing management requirements. Grasslands suggests cropping or fallowing before sowing in early autumn or spring.

Chicory

Chicory is a tap-rooted leafy herb producing high-quality summer forage. It is a must for any farmer wanting to improve lamb production who can cultivate free draining paddocks. Chicory has higher mineral content than ryegrass. On the down side it has a short life span (three to five years), winter dormancy, and different grazing management.

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Cocksfoot
Grasslands says in the 1920s cocksfoot was the most common grass, and has made a comeback in the past 10 years with new varieties having improved quality and performance. It is a hardy grass with good drought and pest tolerance. The new varieties have very good autumn and winter growth. It will survive better in lower soil fertility than ryegrass, though lambs do not usually grow as well as they do on tall fescue or ryegrass.

Phalaris
Phalaris is a new species with excellent winter growth, grass grub and porina resistance, and drought survival. It's often mixed with tall fescue or ryegrass, as it can be toxic in pure stands.

Prairie
The Prairie grass is the most winter active perennial grass. It is suitable for free draining and fertile soils and rotational grazing. Grasslands says it doesn't persist as long as other species, one to three years in northern regions and three to six years in central and southern regions.

Grazing Brome
Grazing brome is closely related to prairie grass. It persists better on light soils and under close grazing. Timothy is good in pasture mixes because of its palatability. However Grasslands says it doesn't persist well in hot regions or under close grazing.

Lucerne
Lucerne is often a solo legume that is valuable for making high quality hay and finishing lambs. New varieties are more disease and pest resistant. It suits free draining soils and lasts from five to 10 years.

White Clover
Grasslands says white clover shows one of the biggest improvements in plant breeding. New varieties are about 60% more productive than the old. If sown with a new grass or herb pasture it supplies up to 250kg of nitrogen annually. New varieties are suited to specific grazing systems and can increase feed value up to 100% more than ryegrass.

Red Clover
Red clover is quite an emotional legume. Grasslands say, "Farmers either love it or hate it". It has better summer and drought growth than white clover, so improves the overall pasture quality. However it is not as persistent as white, and lasts about three to five years.

Sourced from: The Wool Report, March 1994

Maintaining Pastures

The following practices should be adopted to maintain health and diversity in pastures:

- encourage a wide range of species of pasture plants
- increasing diversity of species
- use of native grass species indigenous to the area
- use of intercrops and cover crops
- use of beneficial crop rotations, rotational grazing and green manures
- slashing excess pasture
- using legumes to increase soil nitrogen levels
- sod sowing of pasture plants to avoid cultivation of poor soils
- use of native grass species indigenous to the area
- careful grazing of pasture to maintain plant health and vitality
- allowing adequate regrowth of pasture
- limiting grazing to ensure animals do not graze pasture until there is at least the level of regrowth that there was before previous grazing
- occasionally letting the paddocks go through a full cycle without being grazed or cropped
- manage to maximise benefits and minimise damage to the soil, reduce tillage and other soil-damaging activities
- avoid pasture compaction through over-use of heavy machinery which will destroy soil structure
- harrowing of manures after grazing
- planting of fodder or cash crops for pasture management
- fallow periods in the rotation
- activities undertaken in accordance with daily, lunar and seasonal rhythms.

Managing Fertility of Pastures in a Biodynamic System

- applying preparation 500 regularly, in spring and autumn to improve and maintain soil quality and structure
- applying preparation 501 to pasture - particularly to the hay and silage paddocks to enhance fodder quality
- harrowing of manures after grazing
- using preparations 502 - 507 regularly by means of compost, various liquid manures or cow pat pit so as to bring their influence over the whole farm. These preparations allow the energies of the planets to balance the trace elements and major nutrients, and thus give the soil the ability to grow health giving plants. The beneficial effect on animal health of the regular and adequate use of these preparations is probably the one single factor on which all biodynamic farmers agree.

Selection of Pasture Species for a Biodynamic System

Select of pasture species for a biodynamic system needs to consider the following:

- suitability to biodynamic production
- adaptability to the local environment
- good nutritional values
- will grow in harmony with other species
- free from pests and diseases.

Rejuvenating Pastures

The following practices should be adopted to rejuvenate pastures:

- grazing paddock down
- spreading compost
- deep ripping
- spraying BD500
- over sowing the pasture with more diverse species of grasses
- sowing seeds on a root day so young plants can compete
- allowing pasture to develop their full cycle, flowering to seeding without grazing.

Value of Lucerne Based Pasture

In the Williams rotation scheme the soil fertility and structure gradually declines during the cropping phase under the twin pressures of cultivation (leading to oxidation of humus) and nutrient removal (in exported crops). Between crops there is some recovery during the off year under medics.

The real fertility recovery comes during the pasture phase when the soil is left undisturbed for between four to six years allowing humus levels to recover. The central role which lucerne plays in this fertility recovery hinges on the fact that it is a deep rooted legume. The roots can go down as far as 40 feet so they use the whole soil profile. From here they draw soil moisture and recycle nutrients from deep in the sub soil to the surface. Being a legume, lucerne also fixes nitrogen. The fact that it is a tall growing plant means that it can be used to shade out weed competition if left to grow out and go to flower. David....lets the lucerne come to flower at least once a year as he believes that flowering is an essential process for perennial plants.

At those times when the lucerne-based pasture becomes overly lucerne dominant, David always ensures that stock have access to an adjoining hill paddock for roughage and variety of diet. He uses a long grazing rotation and never leaves stock in a paddock for more than 15 days as part of the strategy to break worm cycles. The alternating of sheep and cattle, which are susceptible to different parasites, assist this process.

Williams, Helen (1993), '"Demeter" A Closed System Farm Organism', *New Leaf,* No. 17, p.12.

Cropping Systems

Cropping systems should be designed in such a way that the soil is almost permanently covered with plant canopy. In arable crops, careful timing of sowing and planting can help to avoid uncovered soil being washed away during the rainy season. After the main crops are harvested, a green manure crop may be sown. On slopes crops should be sown in lines across the slopes (along contour lines) rather than vertically. This can contribute enormously to reduce the speed of surface water.

In crops which take some time to develop a protecting canopy, intercropping of fast growing species such as beans or clover can help to protect the soil in the initial stage of the main crop.

Possible measures to ensure a permanent plant cover may have a focus on:

- timing of soil cultivation
- timing of planting or sowing
- producing seedlings and planting them
- mixed cultivation
- associating crops
- cover crops
- mulching
- timing of weeding
- sowing of a green manure crop in the off-season.

The following aspects must also be taken into account:

- expected effect on yields
- availability of suitable species
- costs of seeds
- availability of water
- availability of labour
- additional use of side-crops
- reduction of the risk
- food security.

IFOAM Training Manual for Organic Agriculture in the Tropics, 2003,
Complied by FiBL, ISBN 3-934055-25-7

Fodder Crops

Name *botanical*	Life	Site Requirements Climate	Soil	Uses
Sheep's fescue *Festuca ovina*	perennial	all sites	light also dry	pasture green manuring
Meadow foxtail *Alopecurus pratensis*	perennial	damp, fresh	not too light	meadow
Creeping or red fescue *Festuca rubra*	perennial	all sites, incl. harsh climates	all, incl. wet	pasture
Smooth meadow grass *Poa pratensis*	perennial	all sites	all, except wet, heavy	meadow and pasture
Swamp meadow grass *Poa palustrus*	perennial not long-lived	damp	damp, wet	meadow and pasture
Cocksfoot *Dactylis glomerate*	perennial	damp	all, incl. light	grazing none too frequent
Perennial ryegrass *Lolium perenne*	perennial dense tufts	high rainfall	all damp soils	pasture, frequent grazing
Meadow fescue *Festuca pratensis*	perennial	high humidity high rainfall	medium to better quality	pasture, sensitive to overgrazing
Italian ryegrass *Lolium multiflorum*	annual or longer	high humidity high rainfall	almost all	winter catch crop
False oatgrass *Arrhenatherum elatius*	perennial	warm, not too wet	well structured rich in lime	not for grazing, not to be cut too often
Yellow oatgrass *Trisetum flavescens*	perennial	dry, warm	permeable rich in lime	pasture and meadow
Hybrid ryegrass *Lolium hybridum*	biennial or longer	high humidity	almost all	winter catch crop leys
Timothy *Phleum pretense*	perennial	fresh and damp	medium to good	pasture
Tall fescue *Festuca arundinacea*	perennial	wet and cold	heavy, cohesive	early mow pasture
Fiorin *Agrostis alba*	perennial does not compete well	wet, cold sites	damp	pasture
Annual ryegrass	annual not winter hardy	damp	high in nutrients cohesive	alternative to clover

Cover Crops and Associate Crops

Cover Crops

Every plant which covers the soil and improves soil fertility can be a cover crop. It could be a leguminous plant with other beneficial side effects, or it could be a weed chacterised by its rapid growth and enormous production of biomass. The most important property of cover crops is their fast growth and the capacity of maintaining the soil permanently covered.

The following chacteristics make an ideal cover crop:

- the seeds are cheap, easy to get, to harvest, to store and to propagate
- be of a rapid rate of growth and be able to cover the soil in a short time
- be resistant against pests and diseases
- produce large amounts or organic matter and dry material
- fix nitrogen from the air and provide it to the soil
- have a de-compacting root system and regenerate degraded soils
- easy to sow and to manage as a single crop or associated with other crops
- can be used as fodder, grains as food grains.

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Permanent Ground Cover

Design criteria for permanent ground cover include:

- establish of an almost permanent soil cover with plant canopy
- use of careful timing of sowing and planting can help to avoid uncovered soil being washed away during the rainy season
- on slopes crops should be sown in lines across the slopes (along contour lines) rather than vertically
- intercropping of fast growing species such as beans or clover to protect the soil in the initial stage of the main crop.

Associating Crops

Associating crops is defined as the growing of two or more crops in the same field at the same time. If suitable crops are combined, mixed cultivation can lead to a higher total yield per area. This is basically due to the more efficient use of space (over and under ground) and because of the beneficial interactions between mixed crops.

Further benefits of associating crops:

- Diversification: a greater diversity of crops can be grown in the fields. This helps the farmer to not become dependant on only one crop, and ideally to achieve a continuous supply of products from the field
- Reduction of pests and disease attack: The deterring or attracting effects of some plant species helps to prevent pest attack on other crops. The diversity increases disease resistance and makes it more difficult for pests and germs to find a certain species.
- Improving soil fertility management: Mixed cropping with legumes, like beans, improves nitrogen supply of the non-legumes in a later term.
- Weed control: Ideally associated crops cover the soil faster and grow more densely and thus suppress weeds more efficiently.

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There are different possibilities to associate crops:

- Mixed cropping: Two or more crops are sown at the same time sharing the same space, or they are sown at the same time in neighbouring rows. One crop may also be sown as a border crop.
- Cropping in lines: Two or more crops are sown at the same time in neighbouring lines with wide spacing.
- Graduate cropping: A second crop is being sown before the harvest of the first one.
- Combined cultivation of trees and annual crops.

IFOAM Training Manual for Organic Agriculture in the Tropics, 2003,
Complied by FiBL, ISBN 3-934055-25-7

Benefits of Undersowing Crops

Undersowing rye and wheat with cornflowers, corn cockle and phacelia brought the following benefits; grain yields were increase by around 12% to 15% and increased the availability of Phosphorus and left more available Phosphorus in the soil after harvest than had been there before.

M. Thun, *2005 Planting Calendar*, pg25.

Benefits of Cover Crops

- protect the ground from rain and sun
- control erosion
- add organic matter
- suppress weeds
- soak up and hold onto valuable nitrogen which might otherwise be leached and fix some nitrogen where legumes are used
- provide feeding, sheltering and egg laying sites for beneficial insects
- dry out boggy soils
- protect them from the impact of farm machinery
- reduce dust
- improve the diversity of the area.

Benefits of Associate Crops

- when suitable crops are combined, mixed cultivation can lead to a higher total yield per area
- more efficient use of space
- enhanced beneficial interactions between crops
- protect the ground from rain and sun
- control erosion
- a greater diversity of crops can be grown in the fields
- a continuous supply of products from the field
- reduction of pests and disease attack
- increased disease resistance
- makes it more difficult for pests and germs to find a certain species
- improved soil fertility management
- improves nitrogen supply if crops are mixed with legumes
- weed control.

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General Conclusions for Associating Crops:

- root competition should be minimal (especially during the phase with the highest demand of nutrients)
- the roots should occupy the soil volume in the best possible way.

Specific Conclusions for Mixed Cropping:

- crops with strong rooting should be associated or alternated with crops with a weak root growth
- plant distances should be such that nutrient competition between plants can be minimised.

Cover Crops or Associate Crops can be Used in the Following Ways:

- cover crops are grown and then turned into the soil to work as green manures in spring
- cover crops are grown as permanent swards under vines or in cropping and pasture management
- mixed cropping when two or more crops are sown at the same time sharing the same space, or they are sown at the same time in neighbouring rows. One crop may also be sown as a border crop
- cropping in lines when two or more crops are sown at the same time in neighbouring lines with wide spacing
- graduate cropping when a second crop is being sown before the harvest of the first one
- combined cultivation of trees and annual crops.

Management Considerations for Cover Crops

- soil preparation to establish seed bed
- good seed depth placement
- direct drilling techniques as used in pasture establishment are also appropriate to cover crops if competition is not too great
- seasonal considerations such as autumn planting after opening rains
- ease of establishment
- frequency of mowing or slashing
- competition against weeds while establishing
- expected effect on yields
- availability of suitable species
- costs of seeds
- availability of water
- availability of labour
- food security.

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Management Considerations for Associate Crops

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- roots should occupy the soil volume in the best possible way
- crops with strong rooting should be associated or alternated with crops with a weak root growth
- plant distances should be such that nutrient competition between plants can be minimised.

Criteria for Selecting Suitable Cover Crops

- the seeds are cheap, easy to get, to harvest, to store and to propagate
- be of a rapid rate of growth and be able to cover the soil in a short time
- can maintain permanent soil cover
- be resistant against pests and diseases
- will not host pests or diseases which could affect the crop
- produce large amounts or organic matter and dry material
- fix nitrogen from the air and provide it to the soil
- have a de-compacting root system and regenerate degraded soils
- easy to sow and to manage as a single crop or associated with other crops
- can be used as fodder, grains as food grains
- will not compete with the main crop for space, water and nutrients
- suitable to the length of growing season, frost, soil structure, rainfall and fertility (especially nitrogen).

Many Benefits of Cover Crops

by Tim Marshall

Cover crops, now part of acknowledged 'best practice' in agriculture offer many advantages. They protect the ground from rain and sun, control erosion, add organic matter, suppress weeds, soak up and hold onto valuable nitrogen which might otherwise be leached and fix some nitrogen where legumes are used. They provide feeding, sheltering and egg laying sites for beneficial insects, dry out boggy soils and protect them from the impact of farm machinery, reduce dust and generally improve the diversity of the area.

A desirable cover crop is one that is easily managed. Management considerations and activities include ease of establishment, frequency of mowing, competition against weeds while establishing, lack of disease host or pest harbor, the quality of the mulch produced and height of the crop, susceptibility to frost and cost. In most situations the cover crop will also need to survive without irrigation.

There are two basic strategies: growing a cover crop, which is then turned into the soil as a green manure in spring, prior to seed set and before water stress is critical, and the other is permanent sward. Organic growers may also use cover crops under vines, where you would normally find a herbicide strip. This area can be mulched too, but cover crops controlled with a 'dodge plough' or under vine cultivator such as a 'Clemens' device is a regular practice in many crops.

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A permanent sward is generally used on steep country, such as the Mount Lofty Ranges, near Adelaide, to control erosion. The crops used will depend on local conditions including length of growing season, frost, soil structure and fertility (especially nitrogen) and whether a permanent sward or green manure is required and rainfall.

Typically the crops are common agronomic plants such as annual ryegrass, perennial ryegrass (possible with sub-clover or medic), faba beans, chick peas, triticale or oats or possibly some brassicas (eg mustard, radish or rape). Other plants often used include vetch, Balansa clover, strawberry clover, lucerne and fescues.
Many of the larger seed companies produce local mixes specifically for cover crop establishment under vines, often in an irrigated or unirrigated mix depending on water limitations.

Organic growers often add to these mixes herbs, which diversify the cover crop. Some annual herbs and some perennial herbs are used in this way. Flowering plants which provide a nectar or pollen source for wasps and other beneficial insects are particularly appropriate to this task. Red clover, crimson clover, poppies, pennyroyal and many other flowering plants are ideal – better still if they set seed and become self-regenerating, without taking over.

Weed control and bed preparation are generally necessary. In a no herbicide regime this usually means cultivation. Usually cover crops will be established in autumn, after opening rains. If possible, one cultivation pass only should be used, to minimise the negative effects of tillage and contain costs. Good seed depth placement and contact between seed and soil are necessary for successful establishment.
Direct drilling techniques as used in pasture establishment are also appropriate to cover crops if competition is not too great.

Acres Australia, The National Newspaper of Sustainable Agriculture, Australia

Cover Crops and Green Manures

by Rod le Lievre

In Tasmania, we are in the midst of a dry spell, waiting for the drought to break. This is typical for autumn; it has become a period of waiting: we live in anticipation. Winter is generally the high rainfall period for most of Tasmania. Exposed soils are vulnerable at this time. The erosion caused by a sudden breaking of the drought, heavy downpours on dry ground, is the immediate threat. Then over the following weeks and months further erosion, compaction and leaching of the valuable soil profile needs to be guarded against.

Nature, left to her own devices, does her utmost to maintain ground cover. We would do well to emulate Her. Cover crops could be considered the backbone of any annual cropping system that seeks to be sustainable. The following article seeks to summarise the principal uses and benefits of cover crops and green manures. Brief descriptions and examples are provided for cover crops, green manures, living mulches, catch crops, and some forage crops. To impart a sense of the importance of these practices in sustainable farming, a summary is included of the effect of cover crops and green manures on: organic matter and soil structure, nitrogen production, soil microbial activity, nutrient enhancement, rooting action, weed suppression, and soil and water conservation.

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Green "manuring" involves the soil incorporation of any field or forage crop while green or soon after flowering, for the purpose of soil improvement. A cover crop is any crop grown to provide soil cover, regardless of whether it is later incorporated. Cover crops are grown primarily to prevent soil erosion by wind and water. In addition to providing ground cover and, in the case of a legume, fixing nitrogen, they also help suppress weeds and reduce insect pests and diseases. When cover crops are planted to reduce nutrient leaching following a main crop, they are often termed "catch crops".

Winter cover crop
A winter cover crop is planted in late summer or autumn to provide soil cover during the winter. Often a legume is chosen for the added benefit of nitrogen fixation. Cool-season legumes include clovers, vetches, medics, faber beans and field peas. They are sometimes planted in a mix with winter cereal grains such as oats, rye, or wheat. Winter cover crops can be established by drilling or broadcasting seed immediately following harvest.

C:N ratios above 25:1 can result in nitrogen being "tied up" by soil microbes in the breakdown of carbon-rich residues, thus pulling nitrogen away from crop plants.

Green Manure Crop
A green manure crop occupies the land for a portion of the growing season. These cover crops can be used to fill a niche in crop rotations, to improve the conditions of poor soils, or to prepare land for a perennial crop. Legumes such as peas, beans, clovers, or lupins may be grown as green manure crops to add nitrogen along with organic matter. Non-legumes such as oats and barley are grown to provide biomass, smother weeds, and improve soil tilth.

Living Mulch
A living mulch is a cover crop that is interplanted with an annual or perennial cash crop. Living mulches suppress weeds, reduce soil erosion, enhance soil fertility, and improve water infiltration. Examples of living mulches in annual cropping systems include no-till planting of seedlings into sub clover, clover drilled into small grains, and annual ryegrass broadcast into vegetables. Living mulches in perennial cropping systems are simply the grasses or legumes planted (or self seeded) as ground covers over the beds and in the alleyways between rows to control erosion and prevent leaching.

Catch Crop
A catch crop is a cover crop established after harvesting the main crop and is used primarily to reduce nutrient leaching from the soil profile. For example, planting cereal rye following corn harvest helps to scavenge residual nitrogen, thus reducing the possibility of groundwater contamination. In this instance, the rye catch crop also functions as a winter cover crop. Short-term cover crops that fill a niche within a crop rotation are also commonly known as catch crops.

Forage Crop
Short-rotation forage crops function both as cover crops when they occupy land for pasturage or haying, and a green manures when they are eventually incorporated or killed for a no-till mulch. Examples include legume sods of alfalfa, sweet clover, trefoil, red clover and white clover, as well as grass-legume sods like fescue-clover pastures. For maximum soil-improving benefits, the forage should not be grazed or cut for hay during its last growth period, to allow time for biomass to accumulate prior to incorporating.

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Organic Matter and Soil Structure

A major benefit obtained from green manures is the addition of organic matter to the soil. During the breakdown of organic matter by micro-organisms, compounds are formed that are resistant to decomposition – such as gums, waxes, and resins. These compounds – and the mycelia, mucus, and slime produced by the micro-organisms – help bind together soil particles as granules, or aggregates. A well- aggregated soil tills easily, is well aerated, and has a high water infiltration rate. Increased levels of organic matter also influence soil humus. Humus – the substance that results as the end product of the decay of plant and animal materials in the soil – provides a wide range of benefits to crop production.

Sod-forming grass or grass-legume mixtures are important in crop rotations because they help replenish organic matter lost during annual cultivation. However, several years of sod production are sometimes required before measurable changes in humus levels occur. In comparison, annual green manures have a negligible effect on humus levels, because tillage and cultivation are conducted each year. They do replenish the supply of active, rapidly decomposing organic matter.

Nitrogen Production

Nitrogen production from legumes is a key benefit of growing cover crops and green manures. The amount of nitrogen available from legumes depends on the species of legume grown, the total biomass produced, and the percentage of nitrogen in the plant tissue. Cultural and environmental conditions that limit legume growth – such as a delayed planting date, poor stand establishment, and drought – will reduce the amount of nitrogen produced. Conditions that encourage good nitrogen production include getting a good stand, optimum soil nutrient levels and soil pH, good nodulation, and adequate soil moisture.

The portion of green-manure nitrogen available to a following crop is usually about 40% to 60% of the total amount contained in the legume. It is estimated that 60% of the tissue N is released when the cover crop is incorporated as a green manure rather than left on the surface as a mulch. Lesser amounts are available for the second or third crop following a legume, but increased yields are apparent for two to three growing seasons.

Forage legumes are valuable in rotations because they generate income from grazing or haying and still contribute nitrogen from regrowth and root residues. A high percentage of biologically fixed nitrogen is in the top growth.

Percent Nitrogen in Legume Tops and Roots

Crop	Tops	Roots
	%N	%N
Soybeans	93	7
Vetch	89	11
Cowpeas	84	16
Red clover	68	32
Alfalfa	58	42

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Soil Microbial Activity

A rapid increase in soil micro-organisms occurs after a young, relatively lush green manure crop is incorporated into the soil. The soil microbes multiply to attach the freshly incorporated plant material. During microbial breakdown, nutrients held within the plant tissues are released and made available to the following crop.

Factors that influence the ability of micro-organisms to break down organic matter include soil temperature, soil moisture, and carbon to nitrogen (C:N) ratio of the plant material. The C:N ratio of plant tissue reflects the kind and age of the plants from which it was derived. As plants mature, fibrous (carbon) plant material increases and protein (nitrogen) content decreases. The optimum C:N ratio for rapid decomposition of organic matter is between 15:1 and 25:1. Adding some blood and bone to aid the decomposition process may be advisable with these high carbon residues. The lower the C:N ratio, the more N will be released into the soil for immediate crop use. The important point is that lush green manures are richer in nitrogen relative to carbon, especially in comparison to highly lignified crop residues like corn stalks. It will take a lot longer for soil microbes to break down corn stalks than fresh clover.

Nutrient Enhancement

In addition to nitrogen from legumes, cover crops help recycle other nutrients on the farm. Nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulphur (S), and other nutrients are accumulated by cover crops during a growing season. When the green manure is incorporated, or laid down as no-till mulch, these plant-essential nutrients become slowly available during decomposition.

Certain broad-leaved plants are noted for their ability to accumulate minerals at high concentrations in their tissues. For example, buckwheat, lupine, and sweet clover are noted for their ability extract P from soils. Likewise, alfalfa and other deep-rooting green manures scavenge nutrients from the subsoil and translocate them upwards to the surface rooting zone, where they become available to the following crop.

The breakdown of green manures in soil influences mineral nutrient availability in another way. During decomposition of organic matter, carbonic and other organic acids are formed as a by-product of microbial activity. These organic acids react with insoluble mineral rocks and phosphate precipitates, releasing phosphates and exchangeable nutrients.

Rooting Action

The extensive root systems of some cover crops are highly effective in loosening and aerating the soil. In Australian wheat experiments, the taproots of a blue lupine cover crop performed like a "biological plough" in penetrating compacted soils. When cover crops are planted after a subsoiling treatment, they help extend the soil-loosening effects of the deep tillage treatment. The rooting depths of several green manures grown under average conditions are listed in the following table.

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Typical Rooting Depths of Several Green Manure Crops

Depth (feet)	Green manure crop
5 to 7	Red Clover, Lupine, Radish, Turnips
3 to 5	Common Vetch, Mustard, Black Medic, Rape
1 to 3	White Clover, Hairy Vetch

Weed Suppression

Weeds flourish on bare soil. Cover crops take up space and light, thereby shading the soil and reducing the opportunity for weeds to establish themselves. The soil-loosening effect of deep-rooting green manures also reduces weed populations that thrive in compacted soils.

The primary purpose of a non-legume green manure – such as rye, barley or oats – is to provide weed control, add organic matter, and improve soil tilth. They do not produce nitrogen. Thus, whenever possible, annual grain or vegetable crops should follow a legume green manure to derive the benefit of farm-produced nitrogen.

Providing weed suppression through the use of allelopathic cover crops and living mulches has become an important method of weed control in sustainable agriculture. Allelopathic plants are those that inhibit or slow the growth of other nearby plants by releasing natural toxins, or "allelochemicals". Cover crop plants that exhibit allelopathy include the small grains like rye and summer annual forages related to sorghum and Sudan grass. The mulch that results from mowing allelopathic cover crops can provide significant weed control in no-till cropping systems. Living mulches suppress weeds during the growing season by competing with them for light, moisture, and nutrients.

When cover crops are planted to prevent leaching, they should provide a high percentage of ground cover as quickly as possible. Most grassy and non-legume cover crops, like oats and barley, fulfil this need well. The soil conservation benefits provided by a cover crop extend beyond protection of bare soil during non-crop periods. The mulch that results from a cover crop in no-till plantings increases water infiltration and reduces water evaporation from the soil surface. Soil cover reduces soil crusting and subsequent surface water runoff during rainy periods.

Elementals, Journal of Bio-Dynamics Tasmania, No. 77, March, 2005, pp 21-25

Resources

Natural Resources

- suitable available land
- adequate pasture for grazing
- access to high land for grazing at times of flooding
- water which is free from chemical contamination
- water usage for individual crops
- soil types
- clean air
- climatic factors
- vegetation.

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Site Resources

- infrastructure such as buildings, sheds, yards, stock handling facilities, fencing (both permanent and temporary), shelters, stables, roads and laneways
- power/energy, buildings/facilities, technology such as computers and associated hardware and software, telephones, internet services
- biodynamic preparations
- pest, weed and disease controls
- suitable seed varieties and vegetative materials, if saving seeds
- animal species suitable to biodynamic production
- availability of suitable breeds of stock including sires to avoid inbreeding
- mulching material
- materials for maintaining soil fertility such as;
    - composting
    - cow pat pit
    - liquid manures
- adequate food storage such as hay, feed storage, grain, silage; especially for times of imbalances such as drought, floods and fires (if sourced from on-site)
- plant and machinery, tools and vehicles for;
    - applying the biodynamic preparations
    - making biodynamic preparations
    - propagating plant material
    - planting and/or sowing crops
    - soil cultivation
    - weed control
    - harvesting
    - post harvest cultivation and treatment
    - cleaning, packaging and labelling materials and equipment
    - storage of produce
    - transportation of produce
- production facilities such as housing, sorting, drying and storage sheds
- availability and proximity of certified abattoirs
- availability of markets
- access to suitable remedies and veterinary treatments should this be required
- living accommodation
- toilets
- tea rooms.

Non Renewal Resources (Consumerable Resources)

- suitable seed varieties and vegetative materials, if not saving seeds
- mineral inputs and supplements
- shell grit for poultry
- mulching material
- power and gas
- telecommunications, information technology systems
- adequate food storage such as hay, feed storage, grain, silage; especially for times of imbalances such as drought, floods and fires (if sourced from out-side sources).

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Financial Resources

- available cash
- available credit
- capital assets
- financial considerations which include:
  - establishment costs
  - costs associated with production
  - yields and costs returned.

Personal Resources

- knowledge and skills in biodynamic management
- availability of time and enthusiasm
- access to information, expertise
- human resources which could include:
  - paid labour
  - contractors
  - suppliers
  - consultants.
- labour supply for all activities which would include harvesting and post harvest care e.g. milking, egg collection, watering, feeding animals, value adding.

Action to Limit Resources

- expanding equipment and machinery on-site
- expand and develop human labour resources
- use land for leasing
- expand range of biodynamic preparations made on-site
- improve seeds through selection criteria and breeding programs
- increasing the availability of organic materials can be increased through:
  - propagating from local sources of vegetation and seeds
  - propagating from plant material available on site
  - using trees as a source of local seed, shelter, shade, food
  - establishing plantings of deciduous trees to provide leaf mulch and/or organic matter
  - growing crops as a source of nitrogenous materials for composting
  - growing crops as a source of carbonaceous materials for composting
  - establishing plants for use in liquid manures
  - using local indigenous plants as a source of seed
- establishing habitats for beneficial bird and predator species
- creating and maintaining food sources for bees, birds and insects
- creating suitable storage facilities for all available organic materials.

Animals

Benefits from Animals in the Production System

- providing a source of manure for improving soil fertility, making the biodynamic preparations and for use in compost making
- improving and maintaining pastures
- controlling weeds through grazing
- recycling nutrients and organic materials
- producing products such as milk, eggs, fibre, meat, hides, young for sale
- adding to the system diversity, biology and interactions in the farm or garden
- serving as draught animals for tillage and transport
- produce young for breeding or for sale
- serving as a financial investment.

Animal Management

- Ensure the ethical treatment of all animals.
- Ensure good animal husbandry.
- Ensure access to required sunlight, fresh air and clean water at all times.
- Ensure frequent exercise and free movement.
- Allow sufficient space with appropriate density of animals to avoid overstocking, animal health problems and land degradation.
- Maintain adequate shade and protection from the environment.
- Use shelter appropriate for animal species.
- Maintain appropriate age and sex distribution within the herd.
- Ensure sufficient contact with other animals.
- Avoid other forms of stress on animals at all times. For example, take care when working animals in the yards. Avoid noisy motorbikes or over enthusiastic dogs.
- Set stock on dry stock units where possible, to avoid the pecking order syndrome which arises from frequent changes of paddock.
- Allow longer than normally accepted times before the weaning of young stock - particularly the dairy calves or lambs you intend to keep for fattening or breeding.
- Maintain good sanitation.
- Handle and restrain animals without causing stress, harm or injury to the animal or handler.
- Manage according to their natural instincts and behavior.
- Ensure daily routines for animal management are in harmony with natural rhythms
- Minimise physical injury through careful handling and well designed and maintained facilities.
- Limit or avoid stress e.g. animal production; weaning, marking.

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Feed and Water

- Use of high quality animal feed which is in accordance with the needs and natural diet of each species.
- Maintain access to fresh pasture which includes a good range of high quality food plants for balanced nutrition.
- Ensure access to mineral based nutritional supplements if required.
- Make quality silage and hay. Perfect your method. Cut your crop at the time of the appropriate moon rhythms.
- Have clean water available at all times. Take care not to have wet areas around troughs where diseases and parasites can breed.
- Provide access to a range of mineral licks.

Shelter and Housing for Animals

- should be specific to the type of animals to be sheltered
- provide adequate ventilation and sufficient natural light
- kept in a clean and dry condition
- allow freedom of movement and comfort
- give protection from climatic extremes and predators
- allow animals to be able to express their natural behaviour;
    - stand naturally
    - lie down easily
    - turn around
    - groom themselves
    - use dust baths
    - perch
    - nest
    - assume natural postures
    - make natural movements such as stretching and wing flapping.

Shelter

- good shelter from prevailing winds will cut down stress from wind chill, and also enable better grass growth over a longer period
- have good shade trees available to stock, particularly where ultraviolet light levels are high.

Beddings

- keep the floor soft, dry, and clean
- absorb the excrements of the animals
- need to be replaced from time to time.

Materials could be;

- straw
- leaves
- twigs
- husks
- or other locally available material.

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Stocking Rates

- stock your farm at a sensible and realistic density for your area.
- do not overstock.

Grazing Plans

- Avoid over grazing.
- Develop pasture grazing plans which prevents land degradation, compaction and manure concentration or pugging during wet periods.
- Adjust stocking rates and grazing patterns as required according to changing conditions, during adverse climate changes, droughts, food shortages.
- Consider the use of rotational grazing to maintain pasture quality and diversity of species.

Breeding

One of the fundamental tools in managing stock health is based on your breeding program. In the same way that pasture species developed for artificial conditions often do not perform under natural conditions, livestock selected under artificial conditions may not perform under their new environment. Time is needed for stock to re-adjust and regain their health.

Look to the genetic base of your animals. Some diseases are hereditary. Breed for health as well as for weight gain. Check that the sire with a good health record does in fact give you progeny of a good size.

Benefits of maintaining breeding programs for animals include:

- improvement in species health
- support sustainability of system
- ensure purity of species
- improve the adaptability to site conditions
- increase resistance to pests and diseases.

Allowable breeding practices:

- natural mating and raising of young
- artificial insemination.

Avoiding the use of breeding programs and methods which includes;

- embryo transfer
- genetic manipulation.

Disease Control

- Use preventative treatments for pests and diseases.
- Use of professional advise if necessary.
- Quarantine and isolate new or sick stock.
- Use herbal medicines. Strong drenches of garlic and cider vinegar are a great help with many internal parasites. Use homeopathic remedies where applicable.
- Make regular additions of herbs to fodder diet. Use, for example, rosemary, tansy, wormwood, thyme or sage. See Complete Herbal Handbook for Farm and Stable, by Juliette de Baraicli Levy for further information.
- Make regular additions of cider vinegar to water troughs and onto hay during the winter feeding out time.
- Develop the ability to be able to assess the health of your flock or herd with one glance. An early diagnosis of any problem makes for a greater chance of success with the cure.

Selection Criteria for Animals

- are suitable to soil conditions and land type
- are adaptable to the local microclimate
- are suitable to available food sources
- availability of suitable breeding animals
- have a good life span with continuous production
- high fertility
- have a good temperament
- glossy coats
- healthy skin
- alertness
- signs of stress
- good horn growth on cattle
- strong bone development
- general well being
- resistance to disease
- prevalence of illnesses
- recovery rates when illnesses do occur
- good reproductive capacity
    - amount of stillbirths
    - survival rates among young
- determining the availability of markets for animal products.

Causes of Stress in Animals

- unbalanced nutrition
- inadequate food
- incorrect feeding
- adverse seasonal and weather conditions
- lack of shelter
- inadequate or stagnant water
- incorrect sunlight
- stagnant air moisture
- insufficient space
- overstocking
- adverse soil conditions
- pest, insect and disease attacks
- incorrect species selection
- undesirable management practices
- wrong breeding approach
- wrong relationship of caretaker to livestock
- incorrect herd managements such as early weaning of young.

Minimising Stress in Animals

- adequate supply of fresh, clean water
- proper shelter
- clean bedding
- fresh air
- correct species selection with climatised genetics
- 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
- selection and use of the healthiest animals as a source of breeding stock.

Grazing Management

Dynamic rotational grazing is the cornerstone of Bio-Dynamic livestock management. The farm layout must be designed to allow at least 5 paddocks for each mob/herd normally managed on the farm (more required for dairy farms). (NB: this does not include any extra mobs/herds created especially at lambing/calving or mating times). Paddock size should cater to feed production capacity. Fencing should also account for wet and dry areas.

Pasture species should include as wide a variety as possible and include permanent species. Always seek the older plant varieties, as many of the modern varieties are hybrids developed for artificial pasture conditions. They often have big leaves and little root systems, which is not what you want in your pastures. Your experienced regional Biodynamic member can provide advice on specific species for your area. After your soil has developed Bio-Dynamic activity and structure, a further refinement to this process is the inclusion of pasture herbs in the sowing mix. (It is difficult to obtain such seeds, but can be well worth the effort. – Juliette de Bairacli Levy's book "Herbal Handbook" for the Farm & Stable", is a most informative read.)

Practical Notes, Bio Dynamic Agricultural Assoc. of Aust.

Overgrazing

To grasp the difference between grazing and overgrazing, picture a healthy perennial bunch grass plant with ground-level growths points in a fairly brittle environment, and imagine that a large animal bites all stem and leaf down to an inch or two above the soil. That is severe grazing, but not unusual or bad in that most herding animals evolved to grazing in such a manner in harmony with such grasses over millions of years. In the growing season, the plant receives a short-term set back while it uses energy from its crown, stem bases, or roots to re-establish growing leaf, but a long-term boost because the plant tends to end the season better off and less encumbered with old leaf and stem that its engraved neighbors. The growth points at the base remain intact and no old growth of the previous year stands in the way of regeneration. This defoliation is important in the more brittle environments to maintain the health and longevity of the plants, but even in the less brittle environments, removal of old material promotes grass health.

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If the bite comes in the dormant season when the plant has no further use for the leaves and stems of the past season, which have become a potential liability, it loses nothing and gains the advantage of unimpeded growth at the start if the new season. Severe gazing thus benefits the grazing plants. Plants surrounding it that were not grazed are hampered by old material when the next growing season starts. This is why so many people use fire. It removes all the dead matter and allows the ungrazed plants to grow freely once again.

Overgrazing occurs when a plant bitten severely in the growing season gets bitten severely again while using energy it has taken from its crown, stem bases, or roots to re-establish leaf—something perennial grasses routinely do. This can happen at three different times:

1. when the plant is exposed to the animals for too many days and they are around to regraze it as it tries to regrow;

2. when animals move away but return too soon and graze the plant again while it is still using stored energy to reform leaf; or

3. immediately following dormancy when the plant is growing new leaf from stored energy.

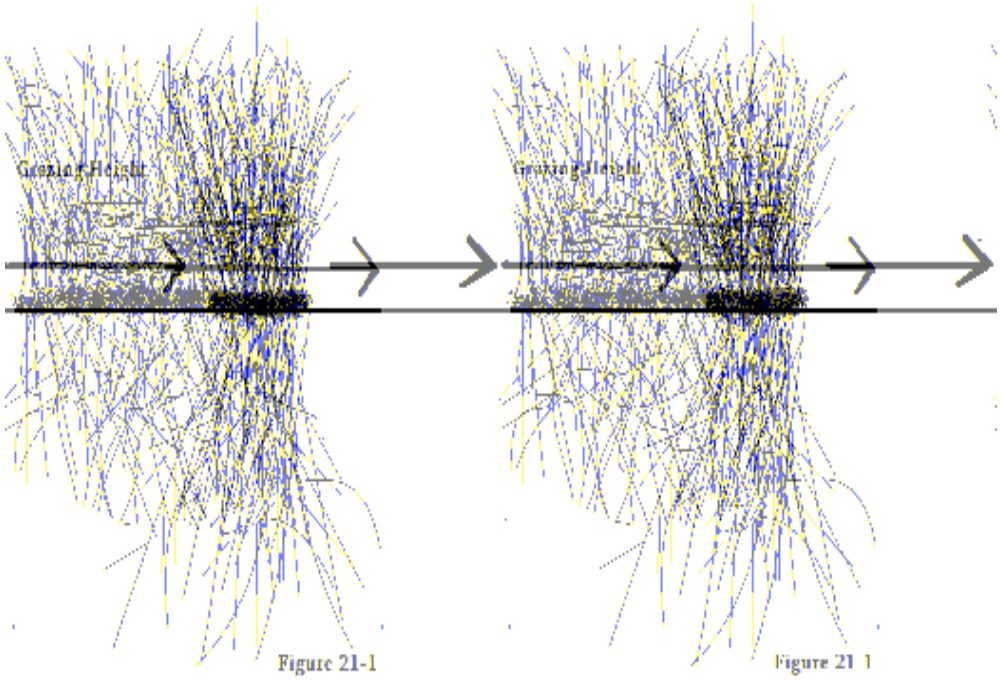
Any time a plant is severely defoliated, root growth ceases as energy is shunted from root growing to regrowing leaves. This movement of energy between leaves and roots and vice versa is important, not only to maintain the plant's ancient relationship with severe grazing animals, but also to sustain the plant over dormant nongrowing periods. At the end of the growing season, most perennial grasses transfer energy and protein from leaves and stems to stem bases, crown, and/or roots. This reserve carries the plant through the dormant period and supports the next year's first growth.

If bitten during the growing season, however, when such reserves have already been tapped to provide the initial growth of the season, grasses then have to utilize what little energy remains and will severely deplete roots to provide that energy. If subsequent bites are taken before roots have re-established, roots will die. Some scientists argue that energy for new growth is taken from what leaves and stems remain on the grazed plant and in the process some roots die to maintain root-to-leaf balance. Where the energy for new growth comes from, however, is not as important as what happens to the roots. No matter which theory you subscribe to, it is fairly evident that severe defoliation, repeated too frequently, causes root mass to decrease until eventually the plant dies.

Thus, a simply definition of overgrazing is any grazing that takes place on leaves growing from stored energy, at the expense of roots, rather than directly from sunlight. In other words, overgrazing is "grazing of the roots."

If the grass plant is of the runner type, rather then erect or bunched, there is less danger of overgrazing, even where animals linger or return too soon. As Figure 21-1 shows, when individual plant are severely grazed, a lesser percentage of leaf is removed than is the case with an upright plant, because of the plant's horizontal spread.

Continued over page



(Figure 21-1 because of its horizontal spread, less leaf is removed from an individual runner-grass plant when it is grazed severely, then is the case with bunched grass plant.)

So much leaf, as well as stems with growing points, remains below the grazing height of most animals that fewer roots are affected. This helps to explain why, as upright grasses are killed by overgrazing, there is a tendency for the space to be filled with a runner grass as long as there is sufficient moisture to sustain it, hence the runner grass mats so common close to water points and areas of very high animal concentration.

Although many perennial grasses can withstand high levels of overgrazing without actually dying, it is still damaging because it reduces the yield plant and reduces its root volume. If the above ground part of the plant grows less, it provides less material to feed the animals and less leaf and stem subsequently to cover soil as litter and mulch. Most soil cover comes from litter rather than the bases of living plants in the more brittle environments. If the root mass of the plant is reduced, less energy and organic material are available for soil life. As root mass decreases, soil compacts and loses the air spaces and structure so vital to an effective water cycle and to the well-being of micro-organisms living in the soil.

Allan Savory, *Holistic Management,* Island press, 1999, pp218,220

Trace Elements and Their Importance for Animals

Calcium and Magnesium: These two interact: Dolomite contains both and often can be applied safely and effectively. Deficiency effects in animals include soft teeth, bent or deformed bones, and nervous behaviour. Milk fever is attributed to a deficiency – make sure there is no chlorine or fluoride in their water. Overdose of calcium and magnesium will deplete copper, manganese, cobalt and zinc, and interfere with the absorption of iron.

Boron: Without this calcium and magnesium will not be correctly utilised. Sheep and goats become arthritic. Seaweed contains natural boron.

Cobalt: This is required for the synthesis of vitamin B12 in the gut. It is needed for healthy red blood cells and bone growth. Deficient animals will look as though they have a worm load, have poor appetite, scouring and below normal temperature. Seaweed will fix this too.

Copper: This is needed to help control internal parasites, and for producing keratin fro healthy hooves and horns. It is necessary to prevent ringworm, footrot and scald. It can be the reason for a low birth rate. The deficient animal may appear anaemic and dark animals will have a gingery tinge to the ends of the coat hairs. The winter coat takes a long time to shed. Too much copper prevents maturation of collagen and elastic connective tissues, and can lead to rupture of major blood vessels, osteoporosis, and skeletal deformities.

Iodine: This is needed for the thyroid gland and makes vitamins available to the body. High nitrate feedstuff can make iodine less available. Overfeeding peas, clover, lucerne and soya products can do this too. Give a seaweed supplement during the winter to maximise uptake. Deficiency shows as woody tongue and is seldom seen with cows sprayed with iodine teat spray.

Phosphorus: This can be unavailable if the soil is excessively acid. Closely related to calcium, it is required for healthy bones and teeth. A correct balance of phosphorus and calcium is necessary. Rock phosphate (applied to the soil) can put this right.

Potassium: Both chemical treatments and bracken can deplete the soil of this mineral. Potassium, sodium and chloride and three minerals essential for regulating body fluid. Deficiency can make giving birth difficult, and cause prolonged electrolyte loss – diarrhoea, vomiting. Potassium deficiency can result in renal failure and muscular paralysis, anorexia, retarded growth, lethargy, especially in cats. Cider vinegar in the trough, especially before lambing will overcome this.

Selenium: Deficiency of this can also be a result of chemical applications. Very easy to overdose and can be fatal. Deficiency causes muscular weakness. Lambs move slowly or lose the use of their legs. If they don't come right after vitamin E administered orally it is an indication that there is a selenium deficiency. It can be the cause of haemolytic anaemia and infertility. A seaweed supplement can be helpful.

Zinc: Needed for reproductive health; builds immunity and enhances liver function. It doesn't stop facial eczema but does help the body fight its effects.

Sulphur: Skin ailments and lice infestation or other parasites could indicate a shortage. The growing foetus needs sulphur and very small amounts can be added to a feed supplement.

Harvests, N.Z. BD Farming and Gardening, Vol 58, No. 2, p19

Supplements to Improve Wellbeing of Animals

Herbal remedies work best as tonics and preventatives which can combat worms and parasites effectively. They do not replace good farm management and should only be considered as short term treatments.

Recipe for Mineral Licks

Mineral licks are a valuable method to supply animals with valuable minerals, especially during the conversion period to biodynamic management.
Commercial licks tend to contain more quantities of sodium chloride then necessary so it is best to make your own.

Homemade Supplement (Recipe courtesy of Wal Engel)
1-2kg bentonite
4kg di-calcium phosphate
*2kg dolomite
1kg coarse salt
0.2kg copper sulphide
0.1kg sulphur
0.1kg zinc sulphide
0.1kg sulphur
0.1kg vitagran (powered seaweed)

Add to the above small quantities of the following;
Garlic (crushed)
Used vegetable oil
Apple cider vinegar
Molasses

This recipe can be modified to suit local conditions.

*do not use Dolomite in alkaline country.

Pat Coleby's Mineral Lick
25kg dolomite
4 kg copper sulphate
4kg yellow sulphate
4kg urea free seaweed meal

Add 1 kg sulphate if this element is deficient in the soil or if lice, ticks or other external parasites are a problem. Note that gypsum is a cheap source of sulphur.

Mix all the dry ingredients thoroughly.
Take 9 litres of water and into it put 3 tablespoons of borax, 1 litre cider vinegar, 1 dessertspoon of cobalt sulphur (if obtainable). Pour this onto dry ingredients and mix with a spade until it is like a slurry. Molasses can be added but stock will usually eat the mineral lick without inducement.
Keep in a rainproof trough.

Continued over page

Salt Lick
Dissolve 3 tablespoons of borax in hot water; add 1 dessertspoon copper sulphate, 1 litre organic vinegar.
Mix in with 9 litres of rainwater, l kg rock salt, 1 kg sulphur, 2-4 kg kelp (or more depending on soil deficiencies) – granulated or powered, and 20-25 kg dolomite. Add the liquid mix to dolomite for easier mixing, with a spade to make a slurry like concrete. Those animals new to this may prefer a little molasses.

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

General Tonic for Cattle

Weekly:

- a bowl with grated carrot
- pumpkin or courgette
- cider vinegar
- sea salt
- kelp
- dolomite
- molasses.

Monthly:

- garlic
- a few twigs from deciduous trees or shrubs maintained.

Marion Koppenol, *Harvests*, BD Assoc. N.Z., Volume 57, No. 1, 2004

Beneficial Herbs for Chickens

These herbs should be made available to chickens either in their run or their bedding.

- nettle seeds or mature nettles
- comfrey
- cabbage
- fennel
- dill
- vetch
- parsley
- chickweed.

Mineral Supplementation

The provision of mineral licks is a well recognised practice in both conventional and sustainable agriculture. It enables animals to obtain minerals that may be lacking from time to time in their feed. Animals are very intelligent at sensing what they need at a particular time

John Cashmore from Nyonger used the Hingee Rural formulations for some years, but of late has moved away from that system. He feels that some of the formulations are too expensive for the current economic climate. He feels that the Hingee formulations are more important for conventional stock, which need detoxifying and extra nutrition. The active feeder roots in John's biodynamic farm bring much more nutrition into his pastures, reducing the need for an expensive supplementation program. Also, the fact that they are formulations means that they re not truly self-selected minerals. For instance, an animal may have a particular need for copper or sulphate at some stage, but to get enough it may have to consume excessive amounts of the mixed supplement, getting more of other minerals than it requires.

John now supplies a range of minerals that he knows from experience are needed in his area, in separate containers in small weather proof shelters in the paddocks. These include copper sulphate, prilled (granulated) sulphur, food grade phosphorus, bicarb soda, gypsum, lime, starch, sugar and apple cider vinegar. Some of the minerals are combined with sugar, but they are provided individually to give adequate choice. Interestingly, the less than 250kg of food grade phosphate consumed by the entire flock in the last six years is the only phosphate applied to the 4800 acres!

The sheep consume more bicarb when they are on long grass or stubble – bicarb helps balance the pH of their digestive systems. Copper helps with worms while sulphur is very effective for lice (sulphur must always be granulated to avoid inhalation and resulting lung problems). Some sugar is needed with the sulphur to help them metabolise it. John advises caution with copper sulphate on its own, as there may be a danger of toxicity. He has a particular method based on experience over many years.

Under this system, the sheep are able to balance their diet themselves, everyday – this is not possible when formulated licks are supplied, the constituents selected by a scientist in some remote office. John finds the sheep are very healthy, and excrete exactly which minerals are lacking in the soil. They tend to camp on degraded areas and this greatly assists in the rehabilitation of the soil in these areas. John has not drenched any of his sheep in the last six years, and none have needed drenching.

'Nyonger', 4800 acre property in Western Australia, average rainfall 325mm (13 inches)

Biodynamic Growing, Bio-dynamic Agriculture Australia, No. 5, December 2005, pg22, 23.

Seeds

Written by Peter Brink

With open pollinated varieties seriously dwindling however, it now seems increasingly important that if we want to have any say in evolving and directing the quality and nutrition of our food plants, particularly where Biodynamic and Organic growing methods are concerned, then we'd better get serious about protecting and valuing our open pollinators while we still have the possibility. According to the UN Food and Agriculture Organization, more than 75% of the world's food plant diversity has been lost in the last 100 years.

How can we best protect Open Pollinating Varieties?

- When buying seed, every vegetable grower knows from the seed catalogues and seed packets whether varieties are F1 or OPV s (F1: hybrid, OPV: Open Pollinated Varieties)
- Once the crops are ready for sale, leeks, carrots and cabbages for example are sold as leeks, carrots and cabbage and not as King Richard (OPV), Siegfried (OPV) or Roxton (F1) leeks.
- Customers need to know how to distinguish the vegetable varieties they buy. So far we aren't able to tell whether a product is an F1 or an OPV.
- We might learn to appreciate the produce more if names were attached to each variety. It would enable us to shop for favourites by name.
- We need to be able to buy vegetables like we buy potatoes, apples and pears. These are usually sold by named variety but further indication of OPV or F1 status would be important. It would allow us to make the choice to positively engage in self-guarding our food plant diversity and further encourage the growing of open pollinated species.
- For producers, this would mean being willing to include the names of each variety and indicating whether these were F1's or OPV's when selling their produce. F1"s are favoured by many growers since higher yields can be obtained and thus a better income. Therefore some flexibility in pricing OPV's may be necessary in order to meet the growers' needs.
- For retailers and box schemes this would also mean that vegetables be sold by variety (as for potatoes) and labeled OPV or F1 accordingly.

If we really think about it, then isn't buying an F1 carrot or cabbage synonymous with buying something unethical or unsustainable? F1 hybrid varieties are quite perfect and uniform in appearance. They yield well for growers but from a cultural aspect they are dead-ends. If allowed to produce seed their offspring doesn't breed true-to-type.

Open pollinators breed true (i.e. similar in yield and appearance to the parent plant) and in doing so they allow for further seed saving and the possibility of being adapted to climate and location. This means they can provide the possibility for widening food-plant diversity. Open pollinators are the basis with which farming communities have worked for thousands of years. It is only relatively recently, in evolutionary terms, that they began to be used as the foundations for F1 hybrids. It is time we reconsidered the legacy our predecessors have left us and ensure that future generations are given something with which they too, can work further.

Sourced from *Elementals,* Journal of Bio-Dynamics Tasmania, #87, 2007, p38

Raising Seeds

- use of natural seed raising mediums
- observations of the best conditions for seed germination as the first factor
- hardening of plants before transplanting
- secondary factors, use of correct rhythms and lunar influences when planting
    - sidereal rhythm for the four plant influences of root, leaf, flower, fruit/seed
    - transplanting in the afternoon during descending moon phase
    - avoiding rhythms which could negatively affect seeds
- creating the conditions that ensure no cross-pollination of seeds can occur
- harvesting, cleaning, drying and preparing seeds for storage
- carrying out seed viability testing
- selecting and storing the best viable seed stocks that are required to meet production needs
- monitoring seeds on a regular basis
- establishing and maintaining record keeping for all seeds.

Seed Saving

Practices Required for Seed Saving

- Identify and select the healthiest plants as a source of seed.
- select plants which;
    - are suitable to biodynamic production
    - perform well under local conditions
    - are free from pests and diseases
    - have the greatest resistance to pest and disease problems
    - are slow to bolt to seed
    - are the healthiest and most vigorous
- Create conditions that ensure no cross-pollination of seeds can occur.
- Harvest, clean, dry and prepare seeds for storage.
- Carry out seed viability testing.
- Select and store the best viable seed stocks that are required to meet production needs.
- Monitoring seeds on a regular basis.
- Establish and maintain record keeping for all seeds.

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Selecting Plants for Seeds
Evaluating the chacteristics of the whole plant.
Selecting plants which:

- are suitable to biodynamic production
- perform well under local conditions
- are free from pests and diseases
- have the greatest resistance to pest and disease problems
- are slow to bolt to seed
- are the healthiest and most vigorous.

Selecting of plants as a source of seed requires:

- only allowing one variety of a species to flower at a time
- allowing a range of that variety to seed to ensure genetic diversity
- excluding plants with undesirable chacteristics before these flower.

Ensure no cross-pollination of varieties can occur through:

- leaving enough distance between species
- isolating selected species if necessary through the use of;
    - paper bags or panty hose to cover flowers
    - cages to isolate plants.

Harvesting Seeds

- leave seeds until they have fully ripened on the plant
- use appropriate daily and lunar rhythms (here reference to avoiding harvesting during constellations which favour fungal diseases)
- collect in dry weather.

Preparing Seeds for Storage
Preparing seeds requires:

- drying seeds slowly and away from light
- treating susceptible seeds for disease prevention and insect control.

Cleaning Seeds Prior to Storage:

- wet cleaning
- dry cleaning
- screening.

Wet Cleaning
Used for those plants that carry their seeds in moist flesh, such as tomatoes, rock melons, cucumbers and pumpkins.

- scoop the seeds out of the flesh into a large container of water
- rub them vigorously
- collect seeds with a sieve
- run water over them to remove the little bits of flesh
- dry on a plate or greaseproof paper for ten days or so
- label.

Continued over page

Dry Cleaning
Used for seeds maturing in a dry receptacle - capsule, pod, husk or case; as with beans, peas, sweet corn, popcorn, maize, radish, lettuce, carrot, onion, beet, okra and most garden flowers.

- Let the plant produce dry seeds on the bush. Should rainy weather set in, the whole plant can be pulled out when the pods are brown, and hung in a shed or under a verandah
- Dry pods also can be harvested individually as soon as they are ready on the bush
- Gently roll or crush, and winnow.

Screening

- Use different gazed stainless steel sieves mounted on wooden frames or kitchen colanders and sieves to sieve out either the seeds, or the trash.

Drying Seeds
Different ways to dry seeds are:

- Keep small quantities of seed in a bowl on the window-sill out of the sun and turn them occasionally.
- Spread seed out evenly on newspaper in a spot where they will not be blown away or spilled. Some people do this with wet seeds because they prefer to have them sticking to paper for planting out later.
- Hang small quantities in paper bags in a breezy spot.
- Lay larger quantities out on screens and turn them occasionally.
- Hang up large quantities of big seeds, such as beans, in thin hessian sacks to finish off drying.
- In very wet weather, set seed screens up high on racks in a warm room such as the kitchen, or above a water heater. Do not let the temperature reach more than 45˚C.

Generally large seeds need a much longer drying time than small ones. A simple test to see whether large seeds are dry enough for storage is to bite one of the seeds. If no impression is made with a reasonable amount of jaw pressure, then the seed is dry enough to store.

Diseases of Seeds in Storage
Disease that are spread in, or on, seeds need to be avoided.

Hot Water Treatment
This is a safe method of treating seeds for diseases such as black rot, black leaf spot and black leg in cabbage, which spread and develop only in humid weather, as well as bacterial canker in tomato and downy mildew in spinach.

- Soak the seeds in water held at a constant temperature of 50˚C for about twenty five minutes. Make sure that the temperature does not ride too high. This can be done with a thermometer checking a saucepan a saucepan full of water inside another saucepan, or, better still, in an electric frypan.
- After the water treatment, dry the seeds in a sieve. It is important that they are well dried again before storing.

Continued over page

Fermentation
The seeds or tomato and cucumber are fermented to rid the seeds of unwanted seed-borne diseases, by the action of bacteria and yeasts.

- Cut the fruits in two. Remove the seeds and pulp with a large spoon or cupped hands and put with a little water into a container. Leave this to sit at warm room temperature.
- After a few days, a foam or crust will form on the surface, indicating that the fermentation has occurred and the surrounding gelatinous pulp has dissolved.
- To obtain clean seeds, rinse with plentiful quantities of water. The debris and empty seed float, and are slowly poured out. The rest can be washed under a tap in a strainer. You will then obtain perfectly clean seeds.
- Spread out the wet mass of seeds very thinly and evenly on a non-stick paper to dry.

Storing Seeds
To maintain the viability of seeds keep a constant humidity (this is the most critical factor in longevity):

- place seeds in paper bags and then in dark coloured jars in a cupboard
- store seeds below 10% humidity with 5% being the optimum
- silica gel crystals, wood coal or rice should be added to help absorb moisture
- tape around the jar lid to help keep out moisture.

Temperature:

- for most seeds 5˚C is the ideal, but
- store in a fridge for long-term storage
- for short-term storage, put the containers of well dried seeds in a south facing room (southern hemisphere) or under the house.

Monitor seeds for:

- presence of insects
- moisture levels.

Appropriate containers for seed storage are:

- glass jars
- screw top jars and canisters.

Seed Viability Test
Seeds should be tested for the following outcomes:

- viability
- purity
- vigour
- disease identification.

Seed viability testing can be undertaken through:

- planting seeds directly in the soil
- planting seeds in controlled conditions either inside or outside to ensure constant warmth and moisture.

Continued over page

Testing seed viability in the soil:

- selecting between ten to one hundred seeds depending on the accuracy required from the test
- preparing the soil according to normal production requirements
- planting seeds during the appropriate seasonal and weather conditions
- planting seeds during the appropriate lunar rhythms
- watering well
- monitoring conditions
- leaving for an appropriate amount of time depending on germination times
- counting the number of seeds which have germinated to determine seed viability %.

Testing seed viability in controlled conditions inside:

- selecting between ten to one hundred seeds depending on the accuracy required from the test
- placing seeds on several layers of moist paper towel
- placing seeds in a plastic bag with small holes in it for up to one week at 25 to 25˚C
- unrolling paper to check the numbers of seeds which have germinated
- counting sprouted seeds to determine viability.

Testing seed viability in controlled conditions outside:

- selecting between ten to one hundred seeds depending on the accuracy required from the test
- planting seed in boxes in seed raising mix at the correct depth
- watering well
- covering box with a sheet of glass
- leaving for an appropriate amount of time depending on germination rates
- counting the number of seeds which have germinated to determine seed viability.

Sourced from Michel and Jude Fanton, *The Seed Savers Handbook for Australia and New Zealand,* The Seed Savers' Network, Australia, 1993, ISBN 0 646 10226 5

Biodynamic Fruit Tree Care

Fruit trees can be maintained in good health and vigour through adherence to the following guidelines.

Site Selection

- sheltered from strong winds
- sunny position
- good drainage; light sandy soils are ideal, clay soils; install drainage
- keep well clear (40-50 meters) of tall trees
- ensure good air circulation for the ripening of the fruit and to avoid fungal problems.

Site Preparation

- If the soil is compacted, deep rip when the subsoil is dry, so widespread cracking will occur. This allow root penetration and oxygen to reach the roots.
- Plant green manure crop(s). Apply manure concentrate when turning in green manures.
- Check soil pH and add lime (1/3 recommended rate) or dolomite if necessary. pH should be above 5.5.
- Make regular applications of BD500 in spring and autumn.
- Apply well rotted compost.

Establishing Trees

- space to allow plenty of air flow (5-6 meters apart); leave more room for larger trees and less for smaller trees.
- holes for planting should not be too large
- large trees should be planted 6-10m apart, medium trees 4-6m apart.
- dip trees and vines which have poor root development in mixture of clay, cow dung and equisetum.

Dip the bare root prior to planting in a mixture of either:

- 80% clay, 20% cow manure, stirred BD500
- 70% clay, 30% ripened compost, stirred BD500.

Biodynamic Treatment

- regularly slash between trees followed by application of manure concentrate
- occasionally disc between trees and plant with a green manure crop to build fertility
- apply BD500 spring and autumn
- apply compost at least every second year
- prune trees when dormant during descending moon (avoid period around the full moon)
- apply tree paste immediately after pruning
- apply BD501:
    - when trees have started sprouting
    - once fruit as set
    - 2 weeks before harvest
- apply BD508 regularly (every 2 weeks) especially during full moon periods and following rain.

Continued over page

Maintaining Orchards

- regular bi-yearly applications of compost
- use of a diverse range of cover crops or green manure crops under trees and vines and between rows
- suitable use of mulching
- applying biodynamic tree paste to enhance the vitality and strength of fruiting trees and plants.

Ley Mix for Orchards

- sub-clover, white clover, strawberry clover, rye grass, cocksfoot, pasture grasses, legumes, native grass covers
- chicory, calendula, oregano, various yarrows, nettles, valerian, borage, comfrey, tansy, plantain.

Around margins and banks

- Rosemary, thyme, feverfew, chrysanthemum, parsley, dill, coriander, calendula, cornflower, southernwood, nasturtiums, yarrow, wormwood, tansy, many varieties of sage, marigolds, daisies, wide range of native shrubs.

Sward Management

A diverse mix of legumes, grasses and herbs would provide the most beneficial sward between rows in orchard management. Deep rooted plant varieties access nutrients from the sub-soil, legumes provide nitrogen and the grasses provide organic matter when slashed or mulch mowed. The understorey can also be planted with a variety of herbs and will help to provide habitats for a range of predatory mites and wasps, ladybirds, lacewings, hoverflies and tachnid flies.

Suitable plants would include:

Deep rotted plants such as:

- Chicory
- Queen Anne's lace
- Dandelions
- Lucerne.

Grasses would include

- Rye
- Oats
- Prairie
- Native grasses.

Legumes such as:

- Lupins
- Red and white clovers.

Herbs such as:

- Dill
- Caraway
- Yarrow
- Dandelions
- Comfrey.

Continued over page

Tree Pruning (notes)

Pruning must:

- allow adequate space for the natural form and growth of the tree
- maintain the balance between old and new wood.

Process

- remove all dead, fractured, poorly attached, dying and diseased wood
- remove competing branches redirect growth patterns and avoid physical and structural damage to the tree.

Main Causes of Problems

- use of half rotted compost i.e. not fully decomposed which causes too strong a fertilisation.
- too little light and air movement
- incorrect species selection for soil type and climate.

Stress on Trees

Times of plant stress can include but are not limited to the following:

- bud burst
- flowering
- during over wet periods
- excessive weather conditions such as heat and wind
- drought conditions.

Recommended reading:

Pfeiffer, E., *Biodynamic Treatment of Fruit Trees, Berries and Shrubs*, Manfred Printing, 1976, U.S.A.

Information on beekeeping: www.biobees.com/ or www.warre.biobees.com/

Bio-Dynamic Fruit Growing

Warmonderhof Biodynamic Farm, Holland

Bio-Dynamic fruit growing is one of the more complicated forms of food production. There are many different factors that exert their influence making it virtually impossible to bring them together to form one clear picture. Hence we've separated these out into a number of topics. Once you've read these you'll have a reasonable understanding!

Pruning

Pruning is an extremely important activity for annual fruit growing. The objective is to achieve a proper balance between tree, leaf, fruit and light. The true pruning activity starts in November (Northern Hemisphere) and continues into May (NH). During this period tree pruning is approached in three stages.

During the first stage experts remove large branches and the central top of the tree with (pneumatic) scissors/shears. This is referred to as shape pruning as it determines the basic shape of the tree. In addition students of the Warmonderhof revisit these trees with hand pruning scissors to examine how the basic shape is determined and to correct this with additional pruning. This way the older smaller branches which are unlikely to have decent quality buds are removed; this is called maintenance pruning.

In April/May (NH) the tree is examined once more to assess the number of buds and to prune. This time to prevent too many apples from growing on the tree. The latter is called fruit wood pruning (bud thinning?) as one only prunes branches with too many flower/fruit buds. As one can imagine it take a while to examine and treat 80 000 trees.

Compost

B-D fruit growing uses a lot of compost. We use a wood/grass compost in which fungus is dominant. This compost is preferred over a bacteria dominated one because the roots of fruit trees love fungus. The purpose of the compost is three fold. First as a ground cover which is a lot easier to work with than the clay soils we have here in combating weeds in spring. Secondly, the compost serves as nutrition for the soil and roots of the trees and shrubs. And finally compost is an ideal environment for earthworms and micro-organisms. The earthworms are essential because the tunnels they create keep the soil airy. The micro-organisms ensure that nutrients become available, they form the soils ability to buffer the relationship with the trees with respect to the uptake and release of minerals and other nutrients. With respect to pear trees compost has a fourth purpose in that is to protect the root stock from the cold.

Compost is spread during the dry periods in winter preferably when the earth is frozen. This way damage to the grass cover is minimised (a compost trailer is heavy and quickly damages the grass cover). Berries and pears are most in need of compost and they are treated first. It is also important not to wait too long before composting young trees. This is a different compost, one which is inoculated with a mycorrhizae-fungus (similar to mushroom growing). This way a win-win situation is created as the added fungus benefits from the roots and the roots are fed by the fungus. In spring all the older trees also get a layer of compost, the main purpose of which is to create a workable mulch. Of course this also improves the soil, but because the roots of older trees run deeper in the soil they receive less benefit from the compost.

Growth

It is very important to control growth. The key word here too is balance. Balance between growth and production. This starts during the establishment of the orchard. How do you get a new tree to grow? Up until now no-one has been able to successfully grow an apple tree in soil where apple trees grew previously. I hope good BD compost is the answer.

Too little growth hampers production and vitality. Too much growth or growth which goes on for too long promotes pests and diseases. Too much growth can also be the result of incorrect pruning, uneven fruiting, and inappropriate fertilising. Where this is a problem it is possible to correct this through root pruning a dramatic action which can be fatal for the tree when not done properly.

Fertilising
When planting a tree ensure that good quality compost is present in the planting hole.

Use of compost
Promote mineralisation for example through the use of vinasse (by product of sugar beet) or feather flour. Anticipate future events based on test results of leaf and soil samples. Complement any extreme needs of the soil (during flowering).

Biodynamic Preparations
The use of preparations is a very tangible difference between organic and BD fruit growing. Preparations are a type of homeopathic remedy and based on the notion that water 'carries information'. By stirring and (diluting) the preparation in water, water more or less 'becomes' the preparation. Fruit growing uses the silica preparations (to strengthening flowers, leaves and fruit), cow horn and cow pit preparations (to promote growth), and valerian preparation (to increase temperature for example during frost periods at flowering time).

We use preparations to increase the overall resistance of the tree. As it is not possible to achieve 100% results it is not possible to treat for example Venturia Inaequalis with preparations.

Improve resistance
In addition to preparations there are a few other means by which to increase resistance. Some of which that spring to mind are algae, certain yeasts (for example brewers yeast), Equisetum arvense etc etc. Virtually every week someone gives us a 'tip' or treatment for Venturia Inaequalis. Up to now none of these have been effective.

Protection
First; preventing pests and diseases is always better than a cure!!!! As a professional organic fruit grower I can't afford to accept the concept of an acceptable level of risk biological or otherwise. This means that I regularly walk through the orchard observing closely what is happening in order to respond quickly to early pest or disease outbreaks. For example with Venturia Inaequalis which can start quickly during the flowering period it is easier to prevent it from happening then to wait till after the harvest.

I'll briefly describe some of the problems that can occur during fruit growing in the polder (the reclaimed areas in the centre of The Netherlands with very clay soil).

Venturia inaequalis - plant resistant varieties such as Santana, Collina en Topaz - plant varieties that are not susceptible such as Concorde, nr 251 en Autento - ensure the orchard is clean.

Clear fallen leaves for example by letting Turkeys roam underneath the trees, or by shredding leaves. Fewer leaves means less chance of fungus - ensure that worms and micro organisms are functioning at optimum levels (for example by applying compost, compost tea). These ensure leaves are broken down – strengthening leaves by using the silica preparation, algae spraying/misting etc – add calcium and sulphur during the time of year or season when fungus spores are released - take into consideration the expected spores release levels i.e. by using a warming system - ensure trees dry quickly after rain i.e. no windbreaks and an 'open' tree shape.

Canker (nectria) - obtain only very clean trees – closely scrutinise, cutting away the spot very precisely and make sure this isn't left in the orchard - if canker is discovered during the first two years of the trees establishment remove the tree (make this part of the purchasing arrangements with the supplier) - reduce growth after year three, fast growth creates a weaker tree - create an open tree shape, a tree with an open shape dries quicker - minimise friction of the tree and support stakes or wire. Tree wounds are sensitive to canker - add calcium - be careful when pruning in wet conditions as it results in wet wounds.

Storage molds reduce storage times - maintain distance between apples on the trees and the soil - dry harvested fruit as soon as possible - reduce canker pressure - Warm water treatment immediately after harvesting (2 minutes at 51 degrees C).

Caterpillars - avoid host plants and hiding places, no piles of old wood, no windbreaks - encourage the presence of as many natural enemies as possible especially earwigs (Forficula auricularia) – determine the right level for the use of pheromone traps - use pheromone traps/confusion if necessary - Keep Turkeys under the trees they will eat fallen apples and caterpillars.

True bugs: Heteroptera - green flowering - watch out for nearby potato fields (potatoes are a host plant for Heteroptera) - encourage the presence of natural enemies especially the earwigs (Forficula auricularia) - only under high pressure, use a very targeted spraying with plant or mineral oil.

Aphids (Venturia inaequalis). Balance is the miracle word here too. Big plagues have to be prevented and occur less quickly when natural predators are present - use as many natural predators as possible; here too the earwig plays a key role and under most circumstances can tackle the problem by itself. They are my big friends - other predators play an important role too such as: lady birds, Ischiodon scutellaris,, Ichneumonoidea, Heteroptera: Anthocoridae, Miridae etc. etc. As much as possible remove host plants such as Greater or Common Plantain (Plantago Major sub sp Major with respect to pink apple aphids)- there are possible solutions with neem & neem tree oil.

Rust: Gymnosporangium fuscum; here too - balance - spread out branches of older tees these almost always contain predator mites.

Vole: Arvicola amphibious or A. terrestris Voles, these are our latest problem. They use the tunnels of moles to travel to the tree roots which they subsequently eat. In the longer term this results in dead trees. The animals breed rapidly and quickly can take on plague proportions if not kept in check in time. Voles are a protected species and we need permission from the relevant authorities to deal with this species. Traps have been placed underground of the back part of the orchard at de Knooplaan 6. Gerrit Nagelhout checks these traps regularly and catches many a Vole.

Let's hope the orchard wins the battle.

Written by Wil Sturkenboom, Warmonderhof College, Holland, 2002-2007

Biodynamic Tree Paste

We are no longer offering the biodynamic tree paste for sale, mainly as it is a cheap and easy preparation to make, but costs a fortune to send through the post, so for those who want to have a go themselves here is the 'recipe' and some useful instructions.

The tree paste has proved a very effective way of maintaining healthy trees with a smooth bark, healing lesions, and protecting trees against pests, especially those which hibernate underneath the bark, or in the crevices e.g. sucking insects, scale, aphids, wholly aphids, etc. That is, provided that the job is done right. The principle is that the entire tree, trunk, branches, twigs, buds is thoroughly covered with the paste. This restores a healthy trunk and the many pests that hibernate and lay their eggs on the outer twigs and near the buds, for instance bud borer, aphids and scale are also counteracted by the paste. It is especially important that not only the under side of the branch is covered, but the entire branch, including the dead corners where the branching off takes place, and that no bark remains to give hiding places. Any lesion of the timber can be painted with the paste, which is a much better procedure than covering with tar, oil, asphalt or paint, as is usually done. Holes in the trunk should be cleaned out and filled with paste. If eggs, larvae and scale are covered with the paste, it will exclude the air from them and they will perish. Since this paste is entirely harmless, and in no way toxic, it is and ideal means of protecting the tree and avoiding poisonous sprays. We have even sprayed it on green foliage, when this was attacked by pests and fungi (rust for instance and mildew), so that the leaves were entirely 'painted yellow'. The rain washes it off eventually and leaves recover with a healthy green shine.

The original recipe for tree paste was:
1/3 Sticky clay
1/3 Cow manure
1/3 Fine sand.

This mixture is approximate, for the sticky quality varies and the proportions have to be somewhat altered accordingly. As much water is added as is needed so that the past can be easily applied and still stick to the tree. Add equisetum preparation (horsetail tea), extract of nasturtium plants against aphids, or other ingredients that one wants to apply. For many years it was the biodynamic practice to apply the paste, in the solution form, with a whitewash brush, by hand, to the trunk and larger branches. Nowadays on finds few orchardist's who want to paint a tree by hand and we admit it is rather a messy procedure, but hand application may still be the easiest method for a few trees but for a large orchard spraying is really the only way to do it.

The paste can be used in Autumn when the leaves have fallen off, or in Spring as a pre-emergence spray (before the buds open, but after the main frost period is over).

Ref: The biodynamic treatment of Fruit trees, berries and shrubs by Ehrenfried E. Pfeiffer.
Sourced from http://www.irishseedsavers.ie/article.php?artid=276

Biodynamic Viticulture

Notes from Biodynamic Workshop held at Richmond, Tasmania, 2007
By Graeme Roberts

It is not recommended to use raw manure on vines and fruit trees as it is too strong and acts like a chemical fertiliser. Always put raw manure through a compost heap to provide a balanced product.

In times of stress throughout the season, whether a prolonged wet or overcast period or prolonged dry period, the sugar levels in the sap falls and encourages insect attack. This is a good time to try foliar sprays to give the plant a boost. E.g. nettle sprays bring an iron influence which stimulates sap flow. Other foliar sprays to use are chamomile and calendula (made as a fresh tea) and seaweed.

Make every effort to put out tea sprays to destress plants – ideally this should be done before the stress event, such as a pending frost – otherwise during a prolonged stressful period.

Brian Keat's planting calendar provides a lot of information which can alert you to potential problem periods –so it is worth taking the time to learn how to "read the calendar". For example, a full moon, coinciding with the moon at perigee can bring much stronger water influences which causes excess sap flows and also influences some fungi to leave the soil and move up the vine to the watery leaf influences where the external conditions become more "soil-like" (dark and damp). This is probably a good time to put out the antifungal sprays like casuarina tea (508) or a 10% milk spray or sulphur.

Use the calendar as a planning tool and read ahead to work out the best times for each activity. Ideally, for grapes and fruit trees, try and carry out all activities on fruit days shown in the calendar.

Typical seasonal activities in the vineyard are:

Autumn – after harvest and at senescence (leaf drop) – do a final 501 spray for healing the scarring caused when leaves fall and to prepare the vine for next season.
Apply the soil sprays (500 and Manure Concentrate or Cow-Pat Pit) – twice if possible.
Apply compost in small amounts on soil – after harvest and after leaf fall.

Winter – do all the vineyard activities to prepare for next year.

Spring – apply soil sprays (twice when possible – refer to calendar for best times).
At the ten leaf stage – before flowering, when the growth to this stage still comes from the carbohydrates from last year's growth –apply foliar spray of seaweed, fish, nettle, casuarina.
At inflorescence and 10 days before capfall (flowering) apply 501 atmospheric spray – this strengthens the cell walls of the vine and gives good form and structure.
At capfall until flowering is finished – no sprays.

Summer – apply antistress sprays as required. Check fruit and leaves regularly.
After summer solstice – when upward growth stops and the energy starts going down into the fruit from the leaves and eventually into the root system – no more nitrogen sprays (fish, seaweed) – but antistress sprays of nettle and chamomile are OK.
Before harvest – if a sugar boost is needed due to poor ripening period – use the 501 atmospheric spray.

Some notes on wine making influences:

Picking – mornings (or a cool afternoon) on fruit days. Not in the middle of the day.

Tasting – compare tasting of wines on root, leaf, flower, fruit days. Root days can produce dull taste, while fruit days should be best.

Wine making – use sulphur only if you have damaged fruit.

Tannins – need to be just right at picking. Check tannin development by looking at and tasting the seed and stems of the fruit – check colour, taste and flavour.

Note – Very close planting means the grapes are more shielded and while the flavour of the fruit may appear alright the stalks and tannin could still be green and unripe.

Lees – are affected by the influences of the moon – e.g. full moon and perigee pull the lees up through the wine – so, don't rack wine at these times.

Racking – lees are stable at the bottom of the barrel at new moon – so rack at this time and ideally on fruit or flower days. Note: Racking on root days can produce dull flavours.

Elementals, Journal of BD Tasmania, #88, December 2007

Water

Water Use

Biodynamic guidelines for water usage requires:

- watering system must not overly exploit water source
- should not have a negative impact on plant health
- should not have a negative impact on soil structure
- watering should penetrate the root zone of plants
- there should be no water run-off
- measures should be taken to minimise evaporation
- water should not be used at a greater rate than it can be replenished.

Efficient Use of Water

Efficient water use of water can be achieved through the following:

- increasing soil humus and organic matter levels
- monitoring soil water levels to avoid over watering
- maintaining good soil structure
- minimising evaporation of water through;
    - watering in the afternoon/evening period
    - appropriate use of mulching
- recycling available water where possible
- ensuring water is not used at a rate greater than it can be replenished
- taking relevant measures to prevent erosion, salinisation and pollution of all water sources
- creating water traps such as ploughing along contour lines
- maintaining adequate water flows to sustain natural eco-systems
- maintaining adequate water flows to sustain water sources in the local area.

Spreadsheets for All Your Records

By Dan Kaplan for CSA Works

Dan Kaplan runs Brookfield Farm, a 400- share CSA in Amherst, MA and is a partner in CSA Works. To order disks with these spreadsheets send a donation of $25 - $50 to Brookfield Farms, 24 Hulst Ed, Amherst MA, 01002 or CSA Works 121 Bay Road, Hadley MA 01035. (specify Works or Excel).

Keeping track of seed inventory, planting dates, greenhouse schedules, field records and harvest records can be difficult on any vegetable farm. When you try to produce over 200 varieties of over 60 crops the task can be daunting. Trying to make sure that the 400 shareholders, whose money you've already spent, have full bags of delicious varied produce for 26 weeks, can be enough for a large migraine.

Using computer spreadsheets for crop planning and record keeping is an efficient way to manage a monstrous amount of information. I use Microsoft Works, in order to create many small spreadsheets, so that the information isn't too cumbersome. I turn these sheets into data generators and graphic displays. They can be used for any type of operation, not just a CSA. They are tools to answer the questions that we all have – how many pounds of beet seeds do I need to order to make sure all of my customers are happy in July? What date do I need to seed how many flats of broccoli in the greenhouse to have enough starts to plant on May 15th? Where did I plant my carrots last year?

Understanding this article is somewhat dependant on knowing a bit about computers and spreadsheets. You don't need to know tons, but we've assumed the basics . The words in CAPITAL letters are spreadsheet commands.

CROP PLAN

A	B	C	D	E	F	G	H	I
	200	SHARES		150	ON FARM			
CROP	UN	YD/350	DIST/WK	WKS	YIELD ND	1997 prod	ROW ND	BED ND
BEET	#	225	2	10	4000	5075	18	4
BROCCOLI	#	150	2	16	6400	2625	43	21
CARROT	#	375	2	22	8800	13315	23	5

It all starts here – trying to convert my wildest dreams into an actual bed count. (If I want make 200 shareholders happy with carrots this year how many beds do I have to grow?). Here's what the columns mean:

A = the crop
B = the unit in question
C = the yield per 350' row
D = the quantity of product distributed per week
E = the number of weeks for distribution of product
F = the total seasonal yield needed
G = the production last year
H = total rows needed to grow for the season
I = the total beds needed to grow for the season

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All of this is data, except columns F, H and I which are results generated by formulas derived from the data. In this case column F is the sum of (column D x column E) x the number of shares. The formulas are powerful because you can change some data and the results will automatically change. In this way, you can play around with different scenarios to see how they play out. For example, maybe I could plan on 3# of broccoli each week for distribution. How would that effect my acreage in production?

The yield estimate (C) is crucial – it is generating all of the results. Importantly, it includes a "fudge factor" of 10% which helps give the whole plan a bit of "wiggle room." It's important to have a plan, but the plan needs to be flexible enough to deal with the vagaries of weather and all of the other imponderables of being a farmer. I want to grow more then is needed – better to till it in then to have to hide at home during distribution to avoid my shareholders who want to know where their carrots are.

Field Plan

Once the crop plan is set, it's time to find a place in the fields to grow everything. CUT and PASTE columns A (crops) & I (total beds) from the crop plan onto a new worksheet. Then CREATE a new spreadsheet to represent each field. Each row of these new spreadsheets represents an actual bed in an actual field. Then CUT and PASTE the crops from the worksheet onto the fields where you want them to "grow." INSERT columns before and after the crop on the new sheets and they look like this:

A	B	C	D	E	F	G
	4/23	CARROTS	nelson(4)		9/10	Oats/vetch
	5/16	CARROTS	nelson(4)		9/10	Oats/vetch
	6/6	CARROTS	napoli(5)		9/10	Oats/vetch
	4/23	BEETS	early wonder(15)		9/10	Oats/vetch
	5/16	BEETS	red ace(14)		9/10	Oats/vetch

A = field prep
B = planting date
C = crop
D = variety (seed plate number, if direct seeded)
E = season extension notes
F = planting date (for double cropping or cover cropping)
G = crop (for double cropping or cover cropping)

This is where I figure out planting dates and varieties. This is also the place to work out crop rotations – graphically – using CUT and PASTE. These commands allow experimentation and creativity. I make copies of each of field plan for all of apprentices so they know what is going where, when and how.

Field Planting Schedule

Now just COPY and PASTE columns A, B, C, D and E from each field plan onto a new spreadsheet which becomes a master plan. The data on this new sheet can be SORTED in many ways to generate more information. First, SORT by planting date. This is now field planting schedule.

Continued over page

It can be used to look ahead to figure out what needs to be plowed next week, what should be stale bedded, what should be seeded, etc.

A	B	C
4/23	BEETS	early wonder(15)
4/23	CARROTS	nelson(4)
4/28	BROCCOLI	regal
4/28	CABBAGE	wakefield

Seed order

SORT the master plan by crop and INSERT some columns after to make a Seed Order.

A	B	C	D	E	F	G	H	I	J	K
Crops	Variety	Rows	TP/350	PL ND	Seed/350	Unit	Seed need	Seed on hand	ADJ SD ND	Source
Beets	Red ace(14)	15		0	1.60	OZ	24.00	12.00	12.00	Johnny's
Beets	lutz(19)	10		0	1.50	OZ	15.00	8.00	7.00	FEDCO
Broccoli	green valiant	8		0	1400.00	SD	11200.00	4000.00	7200.00	FEDCO
Broccoli	regal	6	235	1692		SD	1692.00	0.00	1692.00	Johnny's
Carrots	nelson(4)	10		0	20000.00	SD	200000.00	60000.00	140000.00	Johnny's

A = crop
B = variety
C = number of rows
D = number of transplants needed for a 350' row
E = total plant needed (includes an extra 20%)
F = seeds to sow a 350' row
G = the unit of seeds in question
H = the total quantity of seeds needed
I = the viable seed on hand from last year (inventory)
J = the adjusted seed need (after inventory has been subtracted)
K = the source of the seed
L = the cost of seed (not shown)
M = the catalog number (not shown)

The estimate for seeds needed to sow a row (F) is crucial. This number generates our entire order and is the difference between being right and having to call Johnny's at 10am and ask them to Fedex another 1/4 pound of carrot seed since we just ran out. We can SUM the total cost of our seed as we're making it to ensure that we're within budget. And at the end of the day we can SORT the sheets by "seed source" (Johnny's, Fedco, etc.), PRINT out the relevant data, and send them what is now out seed order. It's also in instant record.

Greenhouse Schedule

From the seed order, COPY columns A, B, C, D and E onto a new spreadsheet, INSERT columns before and after and you now have a Greenhouse Schedule. This make for a quick and easy way to ensure all supplies are on hand and all of the crew knows what to do for the day.

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A	B	C	D	E	F	G	H
ACT	DATE	CROP	VARIETY	ROWS	TP/350	PL ND	Flats
	3/19	BROCCOLI-4/28	regal	6	235	1692	24
	3/19	CABBAGE-4/28	wakefield	2	350	840	12
	3/19	CH.CAB-4/22	blues	2	235	564	8

A = actual seeding date
B = greenhouse seeding date
C = crop (and planting date)
D = variety
E = number of rows to plant in field
F = plant needed for a 350' row
G = total plants needed (includes an extra 20%)
H = total flats needed (we're using 72s)

Planet Jr. Planter Plate Size Chart
Go back to the master plan, SAVE it as a NEW FILE, SORT it by crop, CUT out any crop that is not direct seeded, and now we have a chart which can be put in the seeding box and use for easy reference in the field.

BEETS	early wonder(15)
BEETS	red ace(14)
BEETS	lutz(19)
CARROTS	artist(4)
CARROTS	navajo(4)

Field Records
Planning in necessary, but the important part is really record keeping, so I can learn from year to year and make the plan better and better. Once all of this is in the computer, record keeping becomes quite simple. SAVE each field plan as a NEW FILE and they are now Field Records.

When I go out seeding I take a pen and a small notebook. After each bed I mark down the date, crop, variety and seed plate number. At the end of every week I sit down with the field records and enter in the information from the notebook. I turn the season extension column into a notes section. Each week, I take a "field walk" through my field records and enter any relevant information which might come to mind. At the end of the season I have a field record for every field.

A	B	C	D	E
	6/1	CARROTS	nelson(4)	reseed/thin
	5/12	CARROTS	nelson(4)	thin
	6/1	CARROTS	nelson(4)	reseed/thin
	6/1	BEETS	red ace(14)	reseed
	5/21	BEETS	early wonder(15)	reseed

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Harvest Record

We count boxes before they go in the cooler and mark it down on a weekly harvest record sheet. We compile these at the end of the season to make a yearly harvest record. This is the data that goes back into the crop plan for the next season, thereby completing the cycle of planning and learning.

DATE	Mon	Tues	Wed	Thurs	Fri	Sat	TOTAL	UNIT	
BEETS								LBS.	
BROCCOLI								LBS.	
CARROTS								LBS.	

There is no substitution for knowledge and understanding. These spreadsheets are just tools to hold information. They will only be useful if the information is correct for your situation. Sandy soils will yield different than loam, different seeders will need more seed to get each row just right, etc. However, it is helpful to rid my brain of lots information so that I can use it to think when the going get tough. When it is 95F and the irrigation needs to be turned on, the distribution has just started, the harvest crew is inexperienced, the truck just burned its clutch, and the tractor won't start – it's nice to know I have enough carrot seed in the hopper to get down to the end of the row. You know what I mean…

Key Performance Indicators

For cattle, sheep, pigs, laying hens, meat chickens, labour required

Cattle	
Cows Joined - Enterprise UNIT	0
Calving Percentage	0%
Steer Sale Price x	$0
Heifer Sale Price $0	$0
CFA and Cull Cow Sale Price $0	$0
Cull Bull Sale Price $0	$0
Bull purchase Price - Replacements $0	$0
Cow Purchase Price - Replacements $0	$0
Sheep	
Ewes Joined - Enterprise UNIT	0
Lambing Percentage	0%
Lamb Sale Price	$0
Ewe Purchase Price - Replacements	$0
Ram Purchase Price - Replacements	$0
Pigs	
Sows Joined - Enterprise UNIT	0
Farrowing Percentage	0%
Piglet Sale Price	$0
CFA and Cull Sow and Boar Sale Price	$0
Sow Purchase Price - Replacements	$0
Boar Purchase Price - Replacements	$0
Feed Purchase Price (Landed $ per Tonne)	$0
Average Feed Consumption - Sows (Kg/Head per day)	0.00
Average Feed Consumption - Piglets (Kg/Head per day)	0.00
Average Feed Consumption - Boars (Kg/Head per day)	0.00
Laying chickens	
Number of Laying Chickens - Enterprise UNIT	0
Sale Egg Percentage	0%
Brooding Quantity	0
Commission on Sales	0%
Average price per Carton (Dozen)	$0.00
Feed Purchase Price (Landed $ per Tonne) $0	$0
Day Old Purchase Price per Chicken $0.00	$0.00
Carton Purchase Price (Landed $ per Dozen) $0.00	$0.00
Box Purchase Price (Landed $ per Dozen) $0.00	$0.00
Sticker Purchase Price (Landed $ per Dozen) $0.00	$0.00
Feed Consumption of chickens to point of lay (Grams/head/day) 0	0
Feed Consumption of Layer chickens (Grams/head/day) 0	0

Continued over page

Meat chickens	
Number of Meat Chickens - Enterprise UNIT	0
Loss Percentage	0%
Growing Period - Days	0
Turnovers per annum	0
Sale Price per Meat Bird	$0.00
Feed Purchase Price (Landed $ per Tonne)	$0
Feed Consumption of Layer chickens (Grams/head/day)	0
Day Old Purchase Price per Chicken	$0.00
Killing and Delivery Charges per bird	$0.00
Labour required	
Total Base	0.00
Labour Units (Including casual staff)	0
Casual Required 0.00	0.00
Cost of base Labour pre Super, W / Comp. etc. $0	$0
Cost of base Casual or additional Labour per annum pre Super, W / Comp. etc $0	$0
Total base Labour Cost pre Super, W / Comp. etc $0	$0

Created by Mc Michael and Associates, mcmco@lisp.com.au