



Canadian Organic Growers

COG National Office, 323 Chapel Street, Ottawa, Ontario, K1N 7Z2

Tel: 613-216-0740, Toll free: 1-888-375-7383, Fax: 613-216-0743

E-mail: office@cog.ca, Web: www.cog.ca

Canadian Organic Growers Inc is Canada's national membership-based education and networking organization representing farmers, gardeners and consumers in all provinces.

COG Reference Series **#3, Non Toxic Lawn Management**

A well kept lawn can create a pleasant setting for your home, an oasis for leisure activities and a play area for children. Now that we know the human and ecological dangers of using synthetic fertilizers and chemical pesticides, we must aim at their elimination. Managing a non-toxic lawn may involve a little more work at first but don't have unrealistic expectations and bear in mind the following:

- healthy soils are the result of good management;
- healthy soils grow healthy plants;
- healthy grass out-competes most weeds;
- good lawn management itself helps control pests and diseases.

As your objective is a sustainable organic lawn, you must first decide whether its present size can be managed comfortably. You may prefer a smaller lawn, devoting more space to paved areas, vegetables, landscaping or ground covers instead. You may decide that relocating it elsewhere is more appropriate.

You must assess the ability of your present lawn soil to growing enduring turf in relation to its surroundings. The turf should be diverse in habitat, plant types and species - not just for good appearance, but to attract and conserve beneficial organisms that will increase natural pest control. Shallow-rooted trees and shrubs, such as beeches, maples and hemlocks are not desirable near turf.

It is important to be clear about weed and pest problems you are prepared to accept. The most important thing to be considered in lawn care is the fertility of your soil.

Soil Evaluation

Removing a square of turf and soil dug from the lawn can give you an idea of the depth, structure and tilth of topsoil, the earthworm and macro-organism population, ants and other beneficial insects as well as pests such as white grubs. It will also show the nature of the subsoil. Earthworms, in particular, are good indicators of soil fertility.

Soil testing and pH levels.

To create a viable soil you need to know its pH level - pH is the measure of acidity or alkalinity. Professional soil tests and analysis can help you understand what you are working with and to assess deficiencies. If the lawn area is large take two or three samples - if small, one should be enough. Your local agricultural office can give you information on where to get tests done; there are special tests for lawn and garden soils. Select as comprehensive an analysis as you can, one

if possible that includes the cation exchange capacity and the amount of organic matter present. There is a charge for a basic test and then every additional component you want costs a little more.

Unless you can find a soil testing lab that will express your soil deficits in terms of the organic amendments needed, you will find they are given in chemical terms which you will have to change into organic equivalents yourself. (Product labels and your supplier can help you. A conversion NPK table can be found in RS 13/01 **Improving Soil Fertility**.) Grasses generally prefer a minimum topsoil depth of 4 to 6 inches of rich sandy loam, a pH between 6.0 and 7.0 and at least 5% organic matter. The pH can be adjusted upwards by the addition of high calcium lime (dolomitic limestone, if your soil is deficient in magnesium) or a one-time limited amount of sifted wood ashes, say 25 lbs per 1,000 sq. ft. The pH can be lowered with horticultural sulphur available from some garden centres. Aluminum sulphate should NOT be used for lowering pH as it adds toxic aluminium to soils and is short lived compared with sulphur.

Organic Soil Amendments

As well as pH levels, your soil test will analyze your soil for the macro nutrients N, P and K, various micronutrients and other information which will help you to know what deficiencies need correction.

* **Nitrogen (N)** is the most important grass nutrient, it must be supplied to the plant in quantities sufficient to maintain growth without over-stimulation. Too little nitrogen can result in low plant density, lack of chlorophyll and severe incidence of diseases like red thread and dollar spot. Too much nitrogen can lead to excess, lush, leaf growth; poor root and lateral shoot development; reduced carbohydrate reserves; and poor tolerance to heat, drought and other stresses. N-high plants attract insects such as chinch bugs, and leaf spot and brown patch disease may become severe. Organic sources of N include composted manure, organic blood meal, fish meal, soybean meal, some organic bone meals and coffee grounds. Grass clippings, left on the lawn, and white clover in your lawn mixture will also provide nitrogen.

* **Phosphorous (P)** functions best when the soil has a pH of 6.0 - 7.0, and is best placed in the root zone in a complete organic fertilizer after aeration. Organic matter increases P availability. Too little P results in reduced growth, shallow rootedness and limited root development, dark to reddish leaf coloration and narrow leaf blades. Phosphorous is found in organic bone meal, fish meal, rock phosphate and compost.

Potassium (K) - Sufficient K in the plant tissues produces stiff stalks and may contribute to winter hardiness. Deficiencies may cause marginal browning and tip dieback on older leaves. Stunted growth, limp leaves and increased tillering (shoots growing from the base of a stem of a plant) are signs of poor K uptake. Balanced soils rich in clay or loam are higher in K than sandy or damp, muck soils. Excessive use of magnesium or calcium rich amendments may make potassium unavailable. Excessive K may result in magnesium deficiencies. Potassium sources are granite dust, greensand, kelp, sifted wood ashes (applied yearly at no more than 15 lbs per 1,000 sq. ft.) and compost.

Micro nutrients (trace minerals) and a microbial life stimulants can best be applied to your lawn in spring by foliar spraying with seaweed. Granite and rock dusts and kelp meal also provide trace minerals. Compost and composted manure add organic matter and minerals and are excellent soil conditioners.

Calcium is an essential plant macro nutrient found in leaves and stems. There is rarely a deficiency of calcium except in acidic soils which in conjunction with pH tests can be corrected with limestone.

Site Appraisal

Examine the depth of grass rooting, the amount of thatch and the colour and density of the turf. (Thatch is the layer of partially decomposed leaves, stems and roots at the soil surface.) Location, disease symptoms, the age of the lawn, the type of turf grasses and past use of pesticides and fertilizer use can all help you decide whether the existing lawn can be maintained by organic methods. (N.B. When buying property with an established lawn, check out as many evaluation factors as you can with the Agent.)

There are other factors to be considered in evaluating your lawn site, as follows:

- * **Drainage** - important especially if the lawn is sloped or the levels are uneven. Is there too much or too little drainage?
- * **Moisture** - Check average rainfall in your area. Shrubs and shallow rooted trees compete for water. Dense tree canopy also affects moisture.
- * **Air Circulation** - Good air circulation can prevent some lawn diseases. Completely unprotected turf can be affected adversely by high winds.
- * **Sunlight** - Turf grasses usually prefer full sun although light shade may make them last longer.
- * **Salt** - Salt is harmful to turf grass. Some lawns are damaged by de-icing roadways and walkways. Tall fescue and perennial ryegrasses are more tolerant of salt than most grasses and should be seeded into areas where there is a problem.
- * **Compacted grass** - Areas compacted from use patterns, human, animal or vehicular should be seeded to tough grasses. Compaction may also result from past and present construction using heavy machinery and can be improved by aeration.
- * **Weeds** - Turf normally out-competes weeds. Weeds can be indicators of soil conditions, especially adverse conditions. Their presence indicates conditions favorable to their growth such as hardpan, soil imbalance, lack of fertility or unsuitable grass for the location. Some weeds thrive in acid soil, others in alkaline soil. Cornflower has blue flowers in alkaline soil and pink ones when the soil is acid! Some weeds are beneficial (see **Turf Maintenance - Weeding** below). If your lawn is extremely weedy it may be better to tear it up and reseed it.

Turf Management

The transition to an organic lawn will take time especially if there are many problems to redress. You cannot expect miracles. Once a reasonable soil balance suited to turf grass has been achieved, the following regular maintenance techniques should be carried out:

- * **Top Dressing with Compost** - Top dress your lawn with sifted compost or composted manure any time between mid-June and late August. Compost is ideal to build soil and increase biological activity. Spread it evenly using a rake. An effective time to dress with compost is after aeration.
- * **Feeding with organic fertilizers** - If you do not have compost, in spring after the grass has started to grow actively, top dress your lawn with a 100% organic granular fertilizer that releases nutrients slowly. This should be done when turf growth is at its maximum. Granular organic blood and organic bone meal and kelp are excellent choices. Apply with a cyclone type spreader and use half the manufacturer's recommended rate for the first application, following it up with the other half two or three weeks later and a final full application in mid-September. Do not

apply in summer. Spreaders can be rented at retail outlets. Don't over fertilize, more is not better. Over-fed and over-watered lawns are more likely to have disease and thatch problems. In early spring an application of a seaweed/fish-based foliar spray with a hose end sprayer is a good practice. This can be done at the same time as you rake your grass. This procedure can be followed once a month thereafter. Seaweed spray is not a full fertilizer but a source of micro nutrients and a microbial life stimulant.

* **Raking** should be done in the late spring as a "spongy" lawn should not be raked. It is more than likely there were some leaves left over from the fall which will have matted and need removal. Rake again in fall when rapid recovery of grass is again possible. A special thatch rake is available to use when the thatch layer exceeds 1/2 inch; for large areas a thatching machine can be rented.

* **Mowing** - Sharp mower blades are essential to prevent tearing the grass. Such damage stresses plants and encourages turf diseases such as leaf spot. **Start mowing when the turf starts growing; stop mowing when the turf stops growing** - when it is still green. Mow lawns when they are dry to reduce disease and soil compaction and to encourage cleaner cutting and better spread of clippings.

Do not cut off more than one third of the leaf blade at any one time, and mow high. This helps keep grass temperatures moderate, lessens moisture loss and shades the soil which minimizes weed infestations, especially annual weeds, such as crabgrass, that require light to germinate. There is also greater leaf surface for photosynthesis, deeper roots, greater food (carbohydrate) production and quicker recovery from stress or injury.

To improve density, some experts recommend 1 to 2 early mowings at a two-inch cutting height to allow more light for emerging new leaf blades, to enhance tillering and spread of turf grasses.

Then raise the blades to 3 inches or more until the last mowing of the year in late fall, which should be at about 1.5 to 2 inches, to lessen matting and discourage winter disease pests such as gray snow mould. The very first spring mowing could be as low as 1.5 inches. Mow new lawn grass at a height of 3 to 2 inches to encourage tillering and spreading.

* **Clippings** - Turf can incorporate lawn clippings that are not excessive in length, they build soil and add nitrogen, other nutrients and organic matter. Wet or long clippings should be removed or passed over again with a mower to spread the clippings.

* **Watering during summer heat and drought is not essential to turf health.** Cool season grasses go through a natural and protective state of dormancy during hot, dry months, but when healthy and properly fertilized, survive to become green again when rain and cooler fall temperatures return.

The one time to irrigate is if there is profound drought in the fall of the year, at the most important growth period for turf grasses, (mid-August to mid-October), depending on local climate. Inadequate moisture during this period could seriously affect grass health.

If you overfeed your lawn with nitrogen, leaves will grow more quickly and require more water. Extra potassium and iron may enhance root growth and improve drought tolerance.

* **Aeration** - Compaction problems are relieved by aeration, which fosters healthy grass growth by allowing air and water to penetrate through the thatch layer to the root zone. The best natural aerator is the earthworm! Aerate your lawn two to three times a year as needed. Aerating machines can be rented or for small areas you can go over the lawn with a garden fork or a special hand fork sold for the purpose. There are spiked, walk-over sandals that can be bought for do-it-yourself aeration.

Aerate the lawn in one direction and repeat crosswise.

* **Overseeding** - Use an appropriate seed and lightly sprinkle it over thin areas. Prepare the soil first by scuffing up the area to be seeded and mixing in some rich soil or compost. Water regularly until the seed is established. It may be advisable to change to grasses more suited to the location.

* **Weeding** - An entirely weed-free lawn cannot be expected, although weeds do not normally out-compete grass. Hand weeding and reseeding of the bare patches is effective. Individual perennial weeds can be killed with flame burning. You should spend some time hand weeding your lawn in spring and fall. Weeds will be reduced as time goes on. For dandelions and plantain use a kitchen knife or a fork made specially for weeding, available at most garden centres. Not all weeds are harmful to turf, some support the growth of turf grasses and others attract beneficial insects.

Clover is drought-resistant, improves fertility and fixes nitrogen, thus, reducing fertilizer requirements. It has an extensive root system that gradually improves poor compacted soils and may help reduce crabgrass and other weeds.

Sheep Sorrel likes acidic soils which can be modified with lime.

Dandelions are actually beneficial to turf. Its long roots bring up trace elements and nutrients such as potassium to the surface which nourish the grass when mowed dandelion clippings decompose. Dandelion roots also aerate the soil. The flowers attract beneficial insects. Dandelions also boost the number of beneficial soil micro-organisms that combat fungal problems.

Dandelions can be controlled by slicing off the above ground leafy parts each time they leaf out (about 6 times per season!). They can be hand dug 4 or 5 inches deep.

Crabgrass, hairy or smooth, is a prolific annual that helps anchor soil. Appearing in early summer, it quickly fills up bare patches in lawns, spreads, produces seeds and is killed by frost. It outgrows grasses in summer, so do not fertilize then but do so when grasses are at maximum growth in spring and fall. Lawns should be seeded or overseeded in the fall when crabgrass seed is not germinating; include some endophytic grasses in the seed mixture as they have been shown to repel crabgrass. Crabgrass needs light to germinate so mowing high in summer provides shade which helps in control. Crabgrass plants supply large quantities of seed; which increases the problem in the future. Wherever possible pull small plants by hand in June before they are well rooted.

Lawn Insects

Lawn insect problems are not the same in all parts of Canada and dates of egg laying, emergence, as well as for treatments are different due to climatic conditions. The following discussion is written for Ontario and Quebec. For other provinces consult local government extension services and adjust the methods stated below accordingly.

When parts of a lawn turn brown in mid-summer despite abundant rain, it becomes obvious that something is wrong. This situation is so common and effective treatment has to be done so accurately, that it is good to be familiar with the problem. The damage is done either by grubs or by cinch bugs. There are three species of grubs, each identified by the name of the adult beetle.

The **European chafer** is the most common and devastating species in Ontario and parts of Quebec. The beetles are tan in colour and about 3 cm long when full-grown. After emergence from the soil in mid-June they congregate at night in large numbers in broad-leaved trees but do not feed to any extent on the foliage. They are seldom seen. Each female deposits 25 to 50 eggs during a period of two to three weeks. The thick white larvae have a brown head and are usually curled up in a C-shape. By feeding on the grass roots they trim them very short, causing the sod

to dry up. In late fall they move deep into the soil, pupate and emerge as adult beetles the following summer.

The **Japanese beetles** rank second as far as damage to lawns is concerned. The adults are oval in shape, 1.5 cm long, and metallic green to bronze in colour. In some areas they are a serious garden pest, feeding on the foliage and flowers of many plants, especially roses and peonies. Each female lays 40 to 60 eggs from mid-July to early August; the emerging larvae feed on the grass roots. The damage becomes obvious in August and September.

June beetle larvae are less injurious to turf grass than the two previous species. The beetles are attracted by electric light on warm evenings in early June when eggs are laid in the grass. It takes three years for the larvae to mature, hence very small first-year grubs can be found in late fall or in spring and large ones during the summer.

The grubs of all three species are so similar that identification is very difficult. Fortunately this is not necessary as the same treatment is effective for all. If grub damage is suspected, due to grass turning brown or the presence of skunks, racoons, moles or birds digging into the sod, search for grubs by lifting small patches of sod with a spade and digging into the soil 10 cm deep. Keep in mind that the larvae of the Japanese beetle and the European chafer are large enough to be found only after early August and in spring before mid-May. If more than five grubs per square foot are found treatment should be considered, although growing turf can tolerate more grubs.

Grub Controls - nematodes are a safe and effective method available to solve the white grub problem. They can be purchased through many local garden centres. These are microscopic worms, which penetrate the grubs, multiply inside the larvae and consequently kill them. This treatment is completely safe for humans, pets, birds and the environment. Beforehand the thatch, which consists of the accumulated dead grass clippings, should be raked out and the soil must be thoroughly moist. As the nematodes should not dry out, application during rainy weather or in the evening is desirable. The best timing is in late May when the soil temperature has reached 15 C. The application can be done with a watering can or pressure sprayer but the screen in the nozzle has to be removed. The temperature of the water should be between 15 C and 30 C. Determine the volume of water needed to cover the area by first applying plain water; then mix the required product in the same volume of water. Thorough irrigation afterwards is essential. Nematodes are tolerant of various soil conditions, namely sandy loam, loam or clay, whether these are acid or alkaline, but need warm soil. As we are dealing with a biological treatment, the effectiveness may vary depending on the conditions. The best results are obtained in warm, moist loam soil with low thatch.

Other controls - a few simple practices are helpful, such as shaking adult Japanese beetles from taller plants into a pail with soapy water or onto a ground sheet early in the morning when the beetles are sluggish. Also one should mow the grass no shorter than 5 cm as these beetles prefer laying their eggs in closely cropped turf.

Natural enemies of lawn-damaging insects can be encouraged by providing the right habitat for them. Parasitic wasps for instance can be encouraged to reproduce by providing continuously flowering plants of the parsley and daisy family (which also includes the dandelion). Other natural enemies are predator insects, toads, birds, shrews, skunks and moles.

Large areas can be dug or rototilled so that birds can eliminate some of the grubs; raking the soil will bring more up again. If the grubs persist, it may be better to grow something else instead - a flower or vegetable bed for a year or two, as the beetles prefer to lay their eggs in sod.

Do not overfertilize your lawn as lush growth is attractive to insects. Heavy thatch layers encourage insects. Keep lawns aerated. Diversity discourages insects. Mixed varieties of grasses, clovers, especially white clover, and perhaps wildflowers are more resistant to pests.

The **chinch bug** was first reported in 1971 and has now spread to most areas in Canada. The

newly hatched nymphs are bright red, 2 mm long, and turn to dark grey with a white band as they mature and are then 6 mm long. Both nymphs and adults suck the sap from the crown and stems of the grass and insert toxic saliva, which kills the plants. Populations of this insect congregate, creating localized dead patches, which gradually extend into large areas. Early detection and treatment is important in order to avoid the need for the entire lawn to be renovated. Light damage will appear in mid-July and severe injury in August, particularly in hot dry weather. Shady areas are less affected. If there were chinch bugs in the previous year, even in the neighbors lawn, an infestation can be expected. Excessive nitrogen application increases the problem. Thatch is a hiding place for these insects so it should be removed.

To diagnose the presence of chinch bugs, take a large coffee or juice can, remove the top and bottom lids and press or hammer it about 1 inch deep into the turf, at the edge of a dead spot so that both green and dead grass is within the circle. Fill the can with water and have additional water nearby for topping up. Kneel down and closely watch the surface. Particles of soil and debris float on the water and after a few minutes some of these objects are seen swimming around; these are the nymphs or bugs.

Small areas can be drenched with 75 ml of dishwashing detergent in 40 liters of water per 0.5 square meter. This makes the chinch bugs and nymphs crawl on the grass blades and after a short while onto a spread-out bed sheet, from which they can be destroyed by washing or other means. It is obvious that this procedure is only practical if the insect has been detected very early. On a smaller scale this method can be used for detecting their presence instead of using the can and water method.

If chinch bugs create a serious problem yearly, one should consider reseeding the entire lawn with resistant grasses containing the endophyte fungus. The most resistant are the perennial rye grass varieties Repel and Citation II. The endophyte fungus is gradually lost, hence the seed should be sown within 9 months of the test date on the package. Note: Endophytic grass is harmful to livestock.

Lawn Diseases

Diseases are usually not a problem in healthy grass. To help prevent disease avoid:

- excessive application of nitrogen;
- watering often but not thoroughly which promotes shallow rooting. Roots should grow deeply in search of moisture and nutrients, therefore, water only when really needed or better yet, do not water and allow grass to go dormant in hot, dry periods;
- mowing too short and with a dull blade causing ragged leaf ends;
- allowing excessive thatch to build up.

Diseases are most common in newly sodded lawns consisting of non-resistant Kentucky bluegrass growing in poor soil. There are no varieties which are resistant to all diseases but the perennial ryegrass varieties Barry, Citation and Manhattan II are resistant to Brown Patch and Dollar Spot. Manhattan II is also resistant to Snow Mold. The Kentucky bluegrass variety Bonnieblue is resistant to Dollar Spot, Leaf-rust, Melting-out and Snow Mold.

Symptoms of fungal diseases usually disappear when the weather changes and good management is practiced. Raking in the spring helps prevent Snow Mold. Fairy Rings are dark green circles caused by mushrooms growing on dead tree roots or buried lumber. The only remedy is to dig up the wood.

Turf Seed Mixtures

For overseeding or for new lawns, improved turf grass mixtures are available. Consult with your seed merchant. A lot of packet blends contain high maintenance grasses which you want to

avoid. Choose mixtures that are diverse in both lawn species and in selected, named cultivars which are generally improved varieties. There are cultivars with better mowing qualities, colour, texture and disease resistance. The latter needs to be geared to diseases most prevalent in your area or on a specific site. The importance of endophytic grasses has already been discussed. They are only available in fescue and perennial ryegrass species, but small amounts added to a blend would be valuable. For larger seed orders, it is easier to get the cultivars you want and blend to suit your site. Small lawn owners do not have much choice.

Improved versions of Kentucky Bluegrass, perennial ryegrass, fescue and some white clover make a good blend. Bentgrasses are high maintenance grasses and should not be part of any home lawn, and Rough Bluegrass should also be avoided as it can be invasive. It does grow well on wet, fine textured soils.

New Lawn Establishment

The information given on site evaluation and turf maintenance applies to new lawns. They have one big advantage over established lawns in that you can start with the best organic basis. If it is a lawn on new property, all the topsoil in the area should be removed, stockpiled, kept dry and not run over with equipment. It should be re-applied on completion of construction and rough grading.

If the topsoil is insufficient or hard-to-work, add Triple-Mix (for organic growers if possible), available in one cubic metre bales delivered by soil or sod suppliers (see yellow pages). It consists of compost, manure and topsoil and is superior to topsoil from a farmers' field which may contain weed seeds. For heavy clay the addition of a good quantity of builders' sand is also recommended.

After the first rototilling add phosphorous in the form of organic bone meal or other organic fertilizer. As phosphorous is not water-soluble it should be worked in by a second light rototilling or raking. If used liberally it will last for many years.

To improve soil before lawn establishment, use green manures or cover crops. Include clover for fixing nitrogen and an annual ryegrass in the mix, and seed in the spring. In the fall these crops are then cut and incorporated into existing soils. Cover crops also crowd out perennial weeds and act as temporary lawns.

Seeding: Once soils have been properly amended, roll the site; apply seed (see Turf Mixtures) in two perpendicular passes at one half the recommended application rate each, to apply the total amount of seed as evenly as possible; and incorporate the seed lightly into the soil and roll again. If practical a thin scattering of screened compost is helpful. Keep soil moist until germination but do not over water which would spoil the loose texture and expose the seed.

Sodding: This a quicker way to establish a lawn. The disadvantages are lack of diversity in species and varieties. Sods are usually composed of a high maintenance turf species and are not organically grown. The above procedures should be followed before and after installation.

Final Comments

Some of the matters discussed may seem complicated but for the average home owner good turf management as outlined above is generally effective. For those with large lawns, record keeping, identification and monitoring are important. There are organic lawn care businesses in most towns for those who do not want to care for their own lawns. Discuss procedures with

them and tell them what you require but remember 'natural' lawn care is not necessarily the same as organic.

*With consent of the editor the sections on chinch bugs and white grubs have been copied from an article by Bill Brandis in the magazine of the Royal Botanical Gardens "Pappus", Vol. 19, No. 2.

Reading List

Biological Control of Turfgrass Diseases. Eric B. Nelson. Cornell Cooperative Extension, Information Bulletin 220. Ithaca, NY. 1992

Common Sense Pest Control. Olkowski, W. et al. Taunton Press, Newton, CT. 1992.

Ecological Lawn Management. Dr. Stuart Hill and Barbara Walsh. EAP Publication - 68. Ecological Agriculture Project, McDonald College, Montreal. http://www.eap.mcgill.ca/Publications/eap_foot.htm/

Natural Lawncare Program. City of Seattle. <http://www.cityofseattle.net/util/lawncare/>

Sustainable Maintenance Tips. Halifax Regional Municipality Naturally Green. http://www.region.halifax.ns.ca/pesticides/Sustainable_Main.html/

Sustainable Turf Care. ATTRA. Appropriate Technology Transfer to Rural Areas, Fayetteville, AR. <http://www.attra.org/attra-pub/turfcare.html/>

Weed Control in Lawns and Gardens. Publication 529. **Diseases and Insects of Turfgrass in Ontario 1996.** Publication 162. **Grubs in Lawns.** Publication #97-023. **The Gardener's Handbook - An Integrated Approach to Insect and Disease Control.** Publication #64. Ontario Ministry of Agriculture and Rural Affairs <http://www.gov.on.ca/OMAFRA/english/products/hort.html#Ornamentals/>

Weeds and What They Tell. Ehrenfried Pfeiffer. Biodynamic Farming and Gardening Association, Kimberton, PA. 1990 reprint.

Updated by COG, 2002.

For reference series copies write to Office Manager, Canadian Organic Growers, 323 Chapel Street, Ottawa, Ontario, K1N 7Z2

Tel: 613-216-0740, Toll free: 1-888-375-7383, Fax: 613-216-0743, E-mail: office@cog.ca

Copyright 2004 Canadian Organic Growers. No portion of this publication may be reproduced without written permission of Canadian Organic Growers. COG is a non-profit charitable organization.