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BIODYNAMIC FARMING & COMPOST PREPARATION

ALTERNATIVE FARMING SYSTEMS GUIDE

ATTRA is the national sustainable agriculture information center funded by the USDA's Rural Business -- Cooperative Service.

Abstract: *Biodynamic agriculture was the first ecological farming system to arise in response to commercial fertilizers and specialized agriculture after the turn of the century, yet it remains largely unknown to the modern farmer and land-grant university system. The contribution of biodynamics to organic agriculture is significant, however, and warrants more attention. The following provides an overview of biodynamic farming and includes additional details and resources on the specialized practice of biodynamic composting.*

By Steve Diver — NCAT Agriculture Specialist
February 1999

Introduction

Biodynamic agriculture is an advanced organic farming system that is gaining increased attention for its emphasis on food quality and soil health.

Biodynamic agriculture developed out of eight lectures on agriculture given in 1924 by Rudolf Steiner (1861–1925), an Austrian scientist and philosopher, to a group of farmers near Breslau (which was then in the eastern part of Germany and is now Wroclaw in Poland). These lectures, as well as four supplemental lessons, are published in a book titled *Spiritual Foundations for the Renewal of Agriculture*, originally published in English as *An Agricultural Course* (1).

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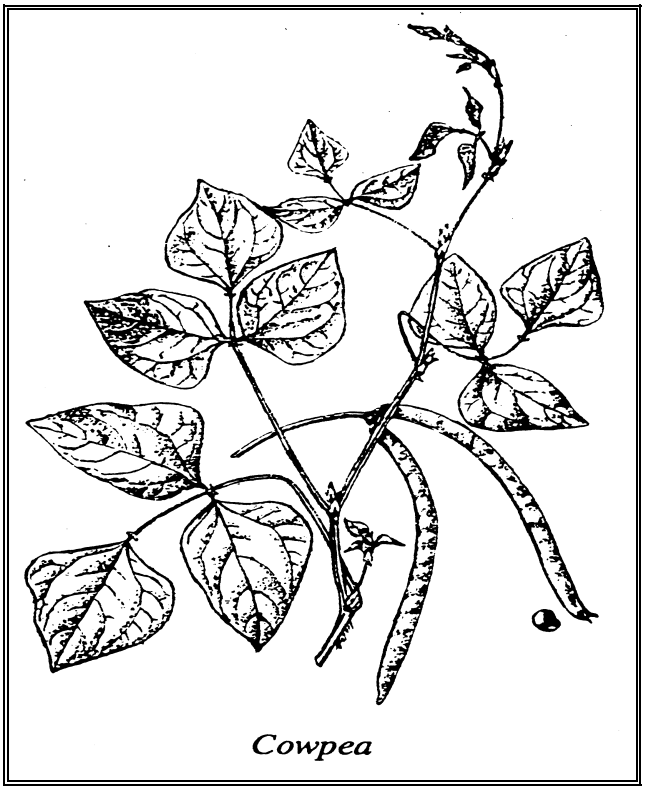


Cowpea

The Agriculture Course lectures were taught by Steiner in response to observations from farmers that soils were becoming depleted following the introduction of chemical fertilizers at the turn of the century. In addition to degraded soil conditions, farmers noticed a deterioration in the health and quality of crops and livestock. Thus, biodynamic agriculture was the first ecological farming system to develop as a grassroots alternative to chemical agriculture.

A basic ecological principle of biodynamics is to conceive of the farm as an organism, a self-contained entity. A farm is said to have its own

individuality. Emphasis is placed on the integration of crops and livestock, recycling of nutrients, maintenance of soil, and the health and wellbeing of crops and animals; the farmer too is part of the whole. Thinking about the interactions within the farm ecosystem naturally leads to a series of holistic management practices that address the enviromental, social, and financial aspects of the farm. A comparison of objectives between biodynamic and conventional agriculture systems in Appendix I summarizes these ideas in table format.

A fundamental tenet of biodynamic agriculture is that food raised biodynamically is nutritionally superior and tastes better than foods produced by conventional methods. This is a common thread in alternative agriculture, because other ecological farming systems make similar claims for their products. Demeter, a certification program for biodynamically grown foods, was established in 1928. As such, Demeter was the first ecological label for organically produced foods.

Today biodynamic agriculture is practiced on farms around the world, on various scales, and in a variety of climates and cultures. However, most biodynamic farms are located in Europe, the United States, Australia, and New Zealand.

While biodynamics parallels organic farming in many ways — especially with regard to cultural and biological farming practices — it is set apart from other organic agriculture systems by its association with the spiritual science of anthroposophy founded by Steiner, and in its emphasis on farming practices intended to achieve balance between the physical and higher, non-physical realms†; to acknowledge the influence of cosmic and terrestrial forces; and to enrich the farm, its products, and its inhabitants with life energy‡. Appendix II is a table that illustrates cosmic and terrestrial influences on yield and quality.

In a nutshell, biodynamics can be understood as a combination of "biological dynamic" agriculture practices. "Biological" practices include a series of well-known organic farming techniques that improve soil health. "Dynamic" practices are intended to influence biological as well as metaphysical aspects of the farm (such as increasing vital life force), or to adapt the farm to natural rhythms (such as planting seeds during certain lunar phases).

The concept of dynamic practice — those practices associated with non-physical forces in nature like *vitality*, *life force*, *ki*, *subtle energy* and related concepts — is a commonality that also underlies many systems of alternative and complementary medicine. It is this latter aspect of biodynamics which gives rise to the characterization of biodynamics as a spiritual or mystical approach to alternative agriculture. See the following table for a brief summary of biological and dynamic farming practices.

† The higher, non-physical realms include etheric, astral, and ego. It is the complicated terminology and underlying metaphysical concepts of Steiner which makes biodynamics hard to grasp, yet these are inherent in the biodynamic approach and therefore they are listed here for the reader's reference.

‡ Life energy is a colloquial way of saying *etheric* life force. Again, Steiner's use of terms like etheric forces and astral forces are part and parcel of biodynamic agriculture. Biodynamic farmers recognize there are forces that influence biological systems other than gravity, chemistry, and physics.

Bio-Dynamic Farming Practices	
Biological Practices	**Dynamic Practices**
Green manures	Special compost preparations
Cover cropping	Special foliar sprays
Composting	Planting by calendar
Companion planting	Peppering for pest control
Integration of crops and livestock	Homeopathy
Tillage and cultivation	Radionics

Dr. Andrew Lorand provides an insightful glimpse into the conceptual model of biodynamics in his Ph.D. dissertation *Biodynamic Agriculture — A Paradigmatic Analysis*, published at Pennsylvania State University in 1996 (2).

Lorand uses the paradigm model described by Egon Guba in *The Alternative Paradigm Dialog* (3) to clarify the essential beliefs that underpin the practices of biodynamics. These beliefs fall into three categories:

1. Beliefs about the nature of reality with regard to agriculture (ontological beliefs)
2. Beliefs about the nature of the relationship between the practitioner and agriculture (epistemological beliefs); and,
3. Beliefs about how the practitioner should go about working with agriculture (methodological beliefs).

Lorand's dissertation contrasts the ontological, epistemological, and methodoligical beliefs of four agricultural paradigms: Traditional Agriculture, Industrial Agriculture, Organic Agriculture, and Biodynamic Agriculture. A summary of these four paradigms can be found in Tables 1–4, Appendix III.

The Biodynamic Preparations

A distinguishing feature of biodynamic farming is the use of nine biodynamic preparations described by Steiner for the purpose of enhancing soil quality and stimulating plant life. They consist of mineral, plant, or animal manure extracts, usually fermented and applied in small proportions to compost, manures, the soil, or directly onto plants, after dilution and stirring procedures called dynamizations.

The original biodynamic (BD) preparations are numbered 500–508. The BD 500 preparation (horn-manure) is made from cow manure (fermented in a cow horn that is buried in the soil for six months through autumn and winter) and is used as a soil spray to stimulate root growth and humus formation. The BD 501 preparation (horn-silica) is made from powdered quartz (packed inside a cow horn and buried in the soil for six months through spring and summer) and applied as a foliar spray to stimulate and regulate growth. The next six preparations, BD 502–507, are used in making compost.

Finally, there is BD preparation 508 which is prepared from the silica-rich horsetail plant (*Equisetum arvense*) and used as a foliar spray to suppress fungal diseases in plants.

The BD compost preparations are listed below:

- No. 502 Yarrow blossoms (*Achillea millefolium*)
- No. 503 Chamomile blossoms (*Chamomilla officinalis*)
- No. 504 Stinging nettle (whole plant in full bloom) (*Urtica dioca*)
- No. 505 Oak bark (*Quercus robur*)
- No. 506 Dandelion flowers (*Taraxacum officinale*)
- No. 507 Valerian flowers (*Valeriana officinalis*)

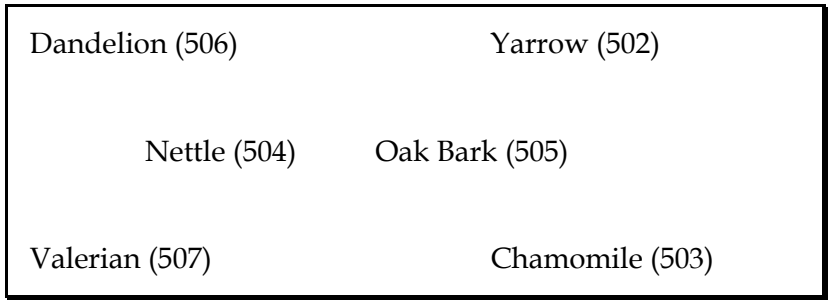
Biodynamic preparations are intended to help moderate and regulate biological processes as well as enhance and strengthen the life (etheric) forces on the farm. The preparations are used in homeopathic quantities, meaning they produce an effect in extremely diluted amounts. As an example, just 1/16th ounce — a level teaspoon — of each compost preparation is added to seven- to ten-ton piles of compost.

Biodynamic Compost

Biodynamic compost is a fundamental component of the biodynamic method; it serves as a way to recycle animal manures and organic wastes, stabilize nitrogen, and build soil humus and enhance soil health. Biodynamic compost is unique because it is made with BD preparations 502–507. Together, the BD preparations and BD compost may be considered the cornerstone of biodynamics. Here again, "biological" and "dynamic" qualities are complementary: biodynamic compost serves as a source of humus in managing soil health and biodynamic compost emanates energetic frequencies to vitalize the farm.

The traditional manner in which the biodynamic compost is made is rather exacting. After the compost windrow is constructed, Preparations 502–506 are strategically placed 5–7 feet apart inside the pile, in holes poked about 20 inches deep. Preparation No. 507, or liquid valerian, is applied to the outside layer of the compost windrow by spraying or hand watering.

Figure 1. Use of Biodynamic Preparations in a Compost Pile



Valerian (507) is mixed into a liquid; a portion is poured into one hole, andthe rest is sprinkled over the top of the compost pile.

More specific instructions on biodynamic preparations, placement in the compost, compost making, and compost use can be found in the following booklets, available through the Biodynamic Farming and Gardening Association (BDFGA) in San Francisco, California (4):

Blaser, Peter, and Ehrenfried Pfeiffer. 1984. *Bio-Dynamic Composting on the Farm; How Much Compost Should We Use?* Biodynamic Farming and Gardening Association, Inc., Kimberton, PA. 23p.

Corrin, George. 1960. *Handbook on Composting and the Bio-Dynamic Preparations*. Bio-Dynamic Agricultural Association, London. 32 p.

Koepf, H.H. 1980. *Compost – What It Is, How It Is Made, What It Does*. Biodynamic Farming and Gardening Association, Inc., Kimberton, PA. 18 p.

Pfeiffer, Ehrenfried. 1984. *Using the Bio-Dynamic Compost Preparations & Sprays in Garden, Orchard, & Farm*. Bio-Dynamic Farming and Gardening Association, Inc., Kimberton, PA. 64 p.

Dr. Ehrenfried Pfeiffer (1899–1961), a soil microbiologist and agronomic researcher who worked directly with Steiner, conducted extensive research on the preparation and use of biodynamic compost. For many years Pfeiffer served as a compost consultant to municipal compost facilities, most notably Oakland, CA, as well as countries in the Caribbean, Europe, and the Far East.

Pfeiffer's research into the microbiology of compost production led to the development of a compost inoculant, BD Compost Starter®, that contains all the BD compost preparations (502–507) plus stirred BD No. 500, as well as 55 different types of microorganisms (mixed cultures of bacteria, fungi, actinomycetes, yeasts). BD Compost Starter® is widely used by biodynamic farmers because it is easy to apply while building the compost pile. Today, the starter is prepared and sold through the Josephine Porter Institute (JPI) for Applied Biodynamics (5) in Woolwine, Virginia.

While use of BD compost preparations and/or BD Compost Starter® is universal in biodynamic composting, the actual construction and maintenance of compost piles — including frequency of aeration and length till maturity — may vary among farming operations.

The static pile method is the traditional biodynamic choice. In static piles materials are formed into a windrow, inoculated with BD preparations, covered with straw, and left undisturbed for 6 months to one year prior to use. A small amount of soil is commonly sprinkled onto the outside of the pile prior to covering with straw. Soil can also be added during the windrow construction process, when brown (carbon) and green (nitrogen) feedstock materials are laid in alternating layers.

On larger farms that handle massive volumes of compost feedstock, the piles are often managed with a compost turner, so the time to maturity is much shorter, for example 2–3 months. A new development is the aerated static pile (ASP), wherein ventilation pipes are inserted into a static pile to increase oxygen supply and reduce the length of time to compost biomaturity.

Contrasting viewpoints exist in the compost industry as well as amongst on-farm compost makers as to which method is best. When push comes to shove, most people agree that the best compost method is one that fits the individual farmer's situation.

Recent biodynamic research supports the static pile approach as a viable compost option. In the July–August 1997 issue of *Biodynamics* , Dr. William Brinton (6) of Woods End Agricultural Research Institute published "Sustainability of Modern Composting: Intensification Versus Costs and Quality." Brinton argues that low-tech composting methods are just as effective in stabilizing nutrients and managing humus as the management and capital intensive compost systems that employ compost turners and daily monitoring. These findings are particularly encouraging to farmers choosing the low-input approach to this age-old practice of transforming organic matter into valuable humus. The full report can be viewed on Woods End Institute's website at: <http://www.woodsend.org/sustain.pdf>.

At the other end of the compost spectrum are the high intensity windrow systems — for example the Controlled Microbial Composting system promoted by the Siegfried Luebke family of Austria and the Advanced Compost System promoted by Edwin Blosser of

Midwestern Biosystems in Illinois — that emphasize specialized compost turners, microbial inoculation, frequent turning, daily monitoring for temperature and CO_2, compost fleece to cover and protect the windrow, and qualitative testing for finished compost. In addition to efficient handling of organic wastes, premium-grade compost is a goal.

It should be noted these highly mechanized systems seem to fit operations that generate large volumes of animal manures or other compost feedstocks, such as a dairy farm or food processing plant. On-farm production of compost is often matched with sale of bagged or bulk compost to local horticultural operations as a supplemental income.

Ultimately, the choice of composting method will depend to a large extent on the scale of farming operation, equipment and financial resources on hand, and intended goals for compost end-use.

Research at Washington State University (WSU) by Dr. Lynn Carpenter-Boggs and Dr. John Reganold found that biodynamic compost preparations have a significant effect on compost and the composting process (7). Biodynamically treated composts had higher temperatures, matured faster, and had higher nitrates than control compost piles inoculated with field soil instead of the preparations. The WSU research is unique for two reasons: it was the first biodynamic compost research undertaken at a land-grant university, and it demonstrated that biodynamic preparations are not only effective, but effective in homeopathic quantities.

A summary of this research can be found on the USDA-Agriculture Research Service's Tektran Website at:

Effects of Biodynamic Preparations on Compost Development
http://www.nal.usda.gov/ttic/tektran/data/000009/06/0000090623.html

In related research, Carpenter-Boggs and Reganold found that biodynamically managed

soils (i.e., treated with biodynamic compost and biodynamic field sprays) had greater capacity to support heterotrophic microflora activity, higher soil microorganism activity, and different types of soil microrganisms than conventionally managed soils (i.e., treated with mineral fertilizers and pesticides).

A summary of this latter research can be found on the USDA-Agriculture Research Service's Tektran Website at:

Biodynamic Compost and Field Preparations: Effects on Soil Biological Community
http://www.nal.usda.gov/ttic/tektran/data/000009/06/0000090640.html

Because compost is often at a premium on farms, European biodynamic researcher Maria Thun developed Barrel Compost. Consisting of fresh cow manure that has been treated with the original preparations as well as egg shells and basalt rock dust — then allowed to ferment in a pit for about 3 months, finished Barrel Compost is diluted in water and applied directly to the fields as a spray. Use of Barrel Compost compensates to some degree for lack of sufficient compost. A variation on Barrel Compost is mixing stinging nettle with fresh cow manure in a 50:50 volume to volume ratio.

Some notable concepts and practices relating to soil and compost management from the biodynamic experience:

- **Microbial inoculation:** Dr. Ehrenfried Pfeiffer's work with composts in the 1940's and 50's led to the development of the BD Compost Starter®, one of the earliest compost inoculants in commercial use in the United States.

- **Soil in Compost:** The addition of soil to compost was an early biodynamic practice prescribed by Steiner. Dr. Pfeiffer discussed the reasons and benefits for adding soils to compost in the 1954 edition of *Bio-Dynamics Journal* (Vol. 12, No. 2) in an article titled "Raw Materials Useful for Composting." He said that soil is an essential ingredient to

- compost and should be added at 10%-20% of the windrow volume.

Mineralized Compost: The addition of rock powders (greensand, granite dust) to compost piles is a long-time biodynamic practice known as mineralized compost. The dusts add mineral components to the compost and the organic acids released during the decomposition process help solubilize minerals in the rock powders to make nutrients more available to plants.

- **Phases of Compost:** An outgrowth of Dr. Pfeiffer's compost research was a clearer understanding of the *Breakdown* and *Buildup* compost phases:

  The Breakdown Phase: In the breakdown phase organic residues are decomposed into smaller particles. Proteins are broken down into amino acids, amines, and finally to ammonia, nitrates, nitrites, and free nitrogen. Urea, uric acids, and other non-protein nitrogen-containing compounds are reduced to ammonia, nitrites, nitrates, and free nitrogen. Carbon compounds are oxidized to carbon dioxide (aerobic) or reduced methane (anaerobic). The identification and understanding of breakdown microorganisms led to the development of a microbial inoculant to moderate and speed up the breakdown phase. The BD Compost Starter® developed by Dr. Pfeiffer contains a balanced mixture of the most favorable breakdown organisms, ammonifiers, nitrate formers, cellulose, sugar, and starch digesters in order to bring about the desired results. The microbial inoculant also works against organisms that cause putrefaction and odors.

  The Buildup Phase: In the build-up phase simple compounds are re-synthesized into complex humic substances. The organisms responsible for transformation to humus are aerobic and facultative aerobic, sporing and non-sporing and nitrogen fixing bacteria of the azotobacter and nitrosomonas group.

Actinomycetes and streptomycetes also play an important role. The addition of soil, 10%

by volume, favors the development and survival of these latter organisms. The development of humus is evident in color changes in the compost, and through qualitative tests such as the circular chromatography method.

- **Compost & Soil Evaluation:** Biodynamic research into compost preparation and soil humus conditions has led to the development or specialized use of several unique qualitative tests. A notable contribution of biodynamics is the image-forming qualitative methods of analysis; e.g., circular chromatography, sensitive crystallization, capillary dynamolysis, and the drop-picture method. Other methods focus on the biological-chemical condition; e.g., The Solvita® Compost Test Kit and The Solvita® Soil Test Kit (8), colorimetric humus value, and potential pH.

Cover Crops and Green Manures

Cover crops play a central role in managing cropland soils in biological farming systems. Biodynamic farmers make use of cover crops for dynamic accumulation of soil nutrients, nematode control, soil loosening, and soil building in addition to the commonly recognized benefits of cover crops like soil protection and nitrogen fixation. Biodynamic farmers also make special use of plants like phacelia, rapeseed, mustard, and oilseed radish in addition to common cover crops like rye and vetch. Cover crop strategies include undersowing and catch cropping as well as winter cover crops and summer green manures.

Green manuring is a biological farming practice that receives special attention on the biodynamic farm. Green manuring involves the soil incorporation of any field or forage crop while green, or soon after flowering, for the purpose of soil improvement. The decomposition of green manures in soils parallels the composting process in that distinct phases of organic matter breakdown and humus buildup are moderated by microbes. Many biodynamic farmers, especially those who

follow the guidelines established by Dr. Ehrenfried Pfeiffer, spray the green residue with a microbial inoculant (BD Field Spray®) prior to plowdown. The inoculant contains a mixed culture of microorganisms that help speed decomposition, thereby reducing the time until planting. In addition, the inoculant enhances formation of the clay-humus crumb which provides numerous exchange sites for nutrients and improves soil structure.

Further information on this topic can be found in the ATTRA publication *Overview of Cover Crops and Green Manures* <http://www.attra.org/attra-pub/covercrop.html>.

Crop Rotations & Companion Planting

Crop rotation — the sequential planting of crops — is honed to a fine level in biodynamic farming. A fundamental concept of crop rotation is the effect of different crops on the land. Koepf, Pettersson, and Schaumann speak about "humus-depleting" and "humus-restoring" crops; "soil-exhausting" and "soil-restoring" crops; and "organic matter exhausting" and "organic matter restoring" crops in different sections of *Bio-Dynamic Agriculture: An Introduction* (9).

Seemingly lost to modern agriculture with its monocrops and short duration corn-soybean rotations, soil building crop rotations were understood more clearly earlier in this century when the USDA published leaflets like *Soil-Depleting, Soil-Conserving, and Soil-Building Crops* (10) in 1938.

Companion planting, a specialized form of crop rotation commonly used in biodynamic gardening, entails the planned association of two or more plant species in close proximity so that some cultural benefit (pest control, higher yield) is derived. In addition to beneficial associations, companion planting increases biodiversity on the farm which leads to a more stable agroecosystem. See the ATTRA publication *Companion Planting: Basic*

Concepts and Resources
<http://www.attra.org/attra- pub /complant.html> for more information.

Liquid Manures and Herbal Teas

Herbal teas, also called liquid manures or garden teas, are an old practice in organic farming and gardening — especially in biodynamic farming — yet little is published on this topic outside of the practitioner literature. A complementary practice is the use of compost teas.

In reality, herbal teas usually consist of one fermented plant extract, while liquid manures are made by fermenting a mixture of herb plants in combination with fish or seaweed extracts. The purpose of herbal teas and liquid manures are manyfold; here again, they perform dual roles by supporting *biological* as well as *dynamic* processes on the farm; i.e., source of soluble plant nutrients; stimulation of plant growth; disease-suppression; carrier of cosmic and earthly forces. To reflect their multi-purpose use, they are sometimes referred to as immune-building plant extracts, plant tonics, biotic substances, and biostimulants.

Further insight into foliar-applied plant extracts, liquid manures, and compost teas can be understood by viewing biological farming practices in the way they influence the *rhizosphere* or *phyllosphere*. (Those microbially-rich regions surrounding the root and leaf surfaces). Herbal teas and liquid manures aim to influence the phyllosphere; composts, tillage, and green manures influence the rhizosphere.

In addition to physical modification of the leaf surface to inhibit pathogen spore germination or the promotion of antagonistic (beneficial) microbes to compete against disease-causing organisms (pathogens), foliar-applied biotic extracts can sometimes initiate a systemic whole plant response known as induced resistance.

Horsetail tea is extracted from the common horsetail (*Equisetum arvense*), a plant especially rich in silica. Horsetail is best seen as a prophylactic (disease-preventing, not disease-curing) spray with a mild fungus-suppressing effect. During the months when green plants are not readily available, you can prepare an extract by covering dry plants with water and allowing them to ferment in a sunny place for about ten days. Dried equisetum, available through the Josephine Porter Institute for Applied Biodynamics (5) in Woolwine, Virginia, can also be used to make horsetail tea.

Stinging nettle tea is extracted from whole nettle plants (*Urtica dioica*) at any stage of growth up to seed–set. To make nettle tea, use about three pounds of fresh plants for every gallon of water, allow the mixture to ferment for about ten days, then filter it and spray a diluted tea. Dilution rates of 1:10 to 1:20 are suggested in the biodynamic literature. A biodynamic nettle tea is prepared by adding BD preparations 502, 503, 505, 506, and 507 prior to the soaking period.

Chamomile tea is derived from the flowers of true chamomile (*Matricaria chamomilla*) which have been picked and dried in the sun. Fresh flowers may be used too, but they are only available during a short part of the growing season. To prepare the tea, steep about one cup of tightly packed flowers per gallon of hot water. Stir well, and spray the filtered tea when cool. Chamomile is high in calcium, potash, and sulfur; it is good for leafy crops and flowers and promotes health of vegetables in general.

Comfrey tea is another tea commonly used in organic farming and gardening. Comfrey is a rich source of nutrients; it is especially good for fruiting and seed filling crops. It can be made by packing a barrel three-quarters full with fresh cut leaves, followed by topping the barrel full of water. It is allowed to steep for 7–14 days, then filtered and diluted in half with water prior to use.

The Biodynamic Farming & Gardening Association (4) can supply literature on herbal teas. Two pamplets you may be interested to know about are:

> Pfeiffer, Ehrenfried. 1984. *Using the Bio-Dynamic Compost Preparations & Sprays in Garden, Orchard, & Farm*. Bio-Dynamic

Farming and Gardening Association, Inc., Kimberton, PA. 64 p.
Koepf, H.H. 1971. *Bio-Dynamic Sprays*. Bio-Dynamic Farming and Gardening Association, Inc., Kimberton, PA. 16 p.

Compost teas are gaining wider recognition in biodynamic and organic farming for their disease suppressive benefits as well as for their ability to serve as a growth-promoting microbial inoculant. See the ATTRA publication *Compost Teas for Plant Disease Control* for more detailed information at: <http://www.attra.org/attra-pub/comptea.html>.

Planetary Influences

Lunar and astrological cycles play a key role in the timing of biodynamic practices, such as the making of BD preparations and when to plant and cultivate. Recognition of celestial influences on plant growth are part of the biodynamic awareness that subtle energy forces affect biological systems. A selection of resources are listed below. On examination of the variations in agricultural calendars that have sprung from the biodynamic experience, it is apparent that differing viewpoints exist on which lunar, planetary, and stellar influences should be followed.

Stella Natura – The Kimberton Hills Biodynamic Agricultural Calendar, available through BDFGA for $11.95, is the biodynamic calendar edited by Sherry Wildfeur and the most prominently known calendar of this type in the United States. It contains informative articles interspersed with daily and monthly astrological details, and lists suggested times for planting root, leaf, flowering, and fruiting crops.

Working with the Stars: A Bio-Dynamic Sowing and Planting Calendar, available through JPI for $12.95, is the biodynamic calendar based on Maria Thun's research and is more prominently used in Europe. Of the three calendars mentioned here, Thun's calendar relies more heavily on planetary and stellar influences. It contains research briefs as well as daily and monthly astrological details, again with suggested planting times.

Astronomical Gardening Guide, available through Agri-Synthesis in Napa, California (11) for a self-addressed stamped envelope, is the biodynamic gardening guide compiled by Greg Willis of Agri-Synthesis. This calender, which is a simple 2-sheet information leaflet, focuses on lunar phases.

Community Supported Agriculture

In its treatment of the farm as a self-contained entity or farm organism, biodynamics completes the circle with appropriate marketing schemes to support the economic viability of farms. The Demeter label for certified biodynamically grown foods is one avenue. A second outgrowth of this view is the Community Supported Agriculture movement.

Community Supported Agriculture, or CSA, is a direct marketing alternative for small-scale growers. In a CSA, the farmer grows food for a group of shareholders (or subscribers) who pledge to buy a portion of the farm's crop that season. This arrangement gives growers up-front cash to finance their operation and higher prices for produce, since the middleman has been eliminated. Besides receiving a weekly box or bag of fresh, high-quality produce, shareholders also know that they're directly supporting a local farm.

Farms of Tomorrow Revisited: Community Supported Farms, Farm Supported Communities (12) by Trauger Groh and Steven McFadden is a 294-page book that discusses the principles and practices of CSA's with insights to the biodynamic perspective and farm case studies. The ATTRA publication *Community Supported Agriculture* — located on the ATTRA website at <http://www.attra.org/attra-pub/csa.html> — provides a summary of ideas and business practices for CSA farms, accompanied by extensive resource listings.

Food Quality

A host of biodynamic researchers have looked into the quality of biodynamically grown foods. Though nutritional comparisons between foods

raised by organic and conventional production methods is controversial — certainly mainstream science adheres to the view that no differences exist — notable contributions from biodynamic researchers include image-forming qualitative methods of analysis (e.g., sensitive crystallization, circular chromatography, capillary dynamolysis, and the drop-picture method) and studies that report on nutritional analysis (13–15).

Research into Biodynamics

Research in Biodynamic Agriculture: Methods and Results (16) by Dr. H. Herbert Koepf is an 84-page booklet that presents an overview of biodynamic research from the early 1920s to the present. It includes testing methods, farm trials, university studies, and a complete bibliography. This pamphlet is especially useful because much of the research features German studies which are otherwise inaccessible to most Americans. It lists for $9.95 in the BDFGA catalog.

Dr. John Reganold published a study in the April 16, 1993 issue of *Science* — "Soil Quality and Financial Performance of Biodynamic and Conventional Farms in New Zealand" — that contrasted soil quality factors and the financial performance of paired biodynamic and conventional farms in New Zealand (17). In a comparison of 16 adjacent farms, the biodynamic farms exhibited superior soil physical, biological, and chemical properties and were just as financially viable as their conventional counterparts.

Agriculture of Tomorrow (18) contains research reports from 16 years of field and laboratory work conducted by the German researchers Eugen and Lilly Kolisko. Unlike much of the biodynamic research by Koepf, Reganold, Pfeiffer, and Brinton which focuses on compost and soil agronomic conditions, the Koliskos dive right into the esoteric nature of biodynamics: the moon and plant growth; the forces of crystallization in nature; planetary influences on plants; homeopathy in agriculture; experiments with animals to study the influence of homeopathic quantities; capillary dynamolysis; research on the biodynamic preparations.

Journals & Newsletters

Biodynamics, started by Dr. Ehrenfried Pfeiffer in 1941, is the leading journal on biodynamics published in the United States. Contents includes scientific articles as well as practical reports on: composts, soils, biodynamic preparations, equipment, research trials, laboratory methods, biodynamic theory, and farm profiles. Subscriptions are $35 per year for six issues, available through BDFGA (4).

Applied Biodynamics is the newsletter of the Josephine Porter Institute for Applied Bio-Dynamics, which makes and distributes biodynamic preparations. The journal features articles on use of the preparations, compost making procedures, and other biodynamic methods from a practical perspective. Subscriptions are $30 per year for three issues, available through JPI (5).

The Voice of Demeter is the newsletter of the Demeter Association, which is the official certification organization for biodynamically grown foods. It is published twice yearly as an insert to *Biodynamics*; separate copies are available by request from Demeter Association (19).

Star and Furrow is the journal published by the Bio-Dynamic Agricultural Association (BDAA) in England. Established in 1953, the *Star and Furrow* follows earlier publications of the BDAA dating back to the 1930s. Issued twice ('Summer' and 'Winter') per year, overseas (airmail) subscriptions are £6 British pounds. Contact:

Star and Furrow
Bio-Dynamic Agricultural Association
Rudolf Steiner House
35 Park Road
London NW1 6XT
England

Harvests is the current publication of the New Zealand Biodynamic Farming and Gardening Association (NZ-BDGA), published four times per year. The NZ-BDGA has published a newsletter or journal since 1947. Subscriptions are NZ$55 per year. Contact:

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Summary –Viewpoint – Conclusion

Biodynamics uses scientifically sound organic farming practices that build and sustain soil productivity as well as plant and animal health. The philosophical tenets of biodynamics — especially those that emphasize energetic forces and astrological influences — are harder to grasp, yet they are part and parcel of the biodynamic experience.

That mainstream agriculture does not accept the subtle energy tenets of biodynamic agriculture is a natural result of conflicting paradigms. In mainstream agriculture the focus is on physical-chemical-biological reality. Biodynamic agriculture, on the other hand, recognizes the existence of subtle energy forces in nature and promotes their expression through specialized "dynamic" practices.

A third view, expressed by a local farmer, accepts the premise that subtle energy forces exist and may affect biological systems, but holds there is not enough information to evaluate these influences nor make practical agronomic use of them.

The fact remains that biodynamic farming is practiced on a commercial scale in many countries and is gaining wider recognition for its contributions to organic farming, food quality, community supported agriculture, and qualitative tests for soils and composts. From a practical viewpoint biodynamics has proved to be productive and to yield nutritious, high-quality foods.

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Research and extension in biodynamics, publications, conferences and short courses.

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BDNOW! E-mail archives
http://csf.colorado.edu/biodynamics/

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http://www.biodynamics.com/discussion/

World Wide Web Links:

What is Biodynamics? by Sherry Wildfeuer
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http://www.bestbeta.com/biodynamic.htm/

Rudolf Steiner and the Science of Spiritual Realities, A Video Documentary
http://www.bestbeta.com/steiner.htm

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Woods End publishes noteworthy manuals on compost, soil organic matter, and green manures.

The electronic version of Biodynamic Farming & Compost Preparation is located at:
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February 1999

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APPENDIX I

Objectives in Biodynamic and Conventional Farming*	
'Biodynamic' objectives	**'Conventional' objectives**
A. Organization	
Ecological orientation, sound economy, efficient labor input	Economical orientation, mechanization, minimizing labor input
Diversification, balanced combination of enterprises	Specialization, disproportionate development of enterprises
Best possible self-sufficiency regarding manures and feed	Self-sufficiency is no objective; importation of fertilizer and feed
Stability due to diversification	Programme dictated by market demands
B. Production	
Cycle of nutrients within the farm	Supplementing nutrients
Predominantly farm-produced manuring materials	Predominantly or exclusively bought-in fertilizers
Slowly soluble minerals if needed	Soluble fertilizers and lime
Weed control by crop rotation, cultivation, thermal	Weed control by herbicides (cropping, cultivation, thermal)
Pest control based on homeostasis and inoffensive substances	Pest control mainly by biocides
Mainly home-produced feed	Much or all feed bought in
Feeding and housing of livestock for production and health	Animal husbandry mainly oriented towards production
New seed as needed	Frequently new seed
C. Modes of influencing life processes	
Production is integrated into environment, building healthy landscapes; attention is given to rhythm	Emancipation of enterprises from their environment by chemical and technical manipulation
Stimulating and regulating complex life processes by biodynamic preparations for soils, plants, and manures	No equivalent biodynamic preparations; use of hormones, antibiotics, etc.
Balanced conditions for plants and animals, few deficiencies need to be corrected	Excessive fertilizing and feeding, correcting deficiencies
D. Social implication; human values	
National economy; optimum input : output ratio regarding materials and energy	National economy; poor input : output ratio regarding materials and input
Private economic : stable monetary results	Private economic : high risks, gains at times
No pollution	Worldwide considerable pollution
Maximum conservation of soils, water quality, wild life	Using up soil fertility, often erosion, losses in water quality and wild life
Regionalized mixed production, more transparent consumer-producer relationship; nutritional quality	Local and regional specialization, more anonymous consumer-producer relation; interested in grading standards
Holistic approach, unity between world conception and motivation	Reductionist picture of nature, emancipated, mainly economic motivation

* Koepf, H.H. 1981. The principles and practice of biodynamic agriculture. p. 237–250. *In:* B. Stonehouse (ed.) Biological Husbandry: A Scientific Approach to Organic Farming. Butterworths, London.

Appendix II

Yield and Quality Under the Influence of Polar Opposite Growth Factors*

Earthly influence	Cosmic Influence
Include among others:	
Soil life, nutrient content of soil; water supply; average atmospheric humidity.	Light, warmth and other climatic conditions; and their seasonal and daily rhythms.
Vary locally according to:	
Clay, nutrient, humus, lime and nitrogen content of the soil; nutrient and water holding capacity; temperature and precipitation.	Sun; cloudiness; rain; geographical latitude; altitude and degree of exposure; aspect of land; annual weather pattern; silica content of soils.
Normal influences on growth:	
High yields protein and ash content.	Ripening; flavor; keeping quality; seed quality.
One-sided (unbalanced) effects:	
Lush growth; susceptibility to diseases and pests; poor keeping quality.	Low yields; penetrating or often bitter taste; fibrous woody tissue; hairy fruit; pests and diseases.
Managerial measures for optimum effects:	
Liberal application of manure and compost treated with biodynamic preparations; sufficient legumes in rotation; compensating for deficiencies; irrigation; mulching.	Use of manures; no overfertilization; compensating for deficiencies; suitable spacing of plants; amount of seed used.
Use of Preparation No. 500	Use of Preparation No. 501

* Koepf, Herbert H., B.D. Pettersson, and Wolfgang Schaumann. 1976. Bio-Dynamic Agriculture: An Introduction. The Anthroposophic Press, Spring Valley, NY. p. 209.

APPENDIX III

Table 1. Traditional Agriculture Paradigm*

Ontology	Epistemology	Methodology
Traditional agriculture varies from culture to culture, from region to region, sometimes from tribe to tribe within a culture and a region. It is often a complex, living and dynamic web of relationships, in which:	The traditional practitioner stands in relationship to farming that is characterized by customs, rituals, generational wisdoms, tribal rules, superstitions, religious mores and often other external values.	The traditional practitioner practices often rote patterns of seasonal preparations, planting, cultivation, and harvesting based on convention handed by parents, tribal elders and consistent with customs.
the earth is a living being within a living universe;		Innovations are not continually sought out and typically are slow in acceptance.
forces are at work in all that is both animate and inanimate;		Biodiversity is part of the traditional practices, stemming from the farmer's need for self-sufficiency with as much variety as possible.
celestial rhythms play a role in health and prosperity;		
animals and humans are an integral part of the whole		
the farm is not considered a distinct being; and		
although these elements form a whole, the image of health is not necessarily discernable		

Table 2. Industrial Agriculture Paradigm*

Ontology	Epistemology	Methodology
Industrial agriculture is an economic enterprise aimed at maximum short-term profit based on the most efficient use of resources and maximization of labor and technological efficiencies, in which:	The industrial practitioner stands in an exploitative business relationship with the "factory" farm. Observation, analysis and policy decisions are made on a bottom line basis.	The industrial practitioner is successful to the extent that economic profit is maximized. Consequently, methods and practices that lead to efficiencies of technology and labor are employed, assessed, and refined.
the earth is a relatively unlimited source of exploitable resources;	A technological framework shapes and restrains the thinking, problem identification and analysis of the practitioner.	Innovations are constantly sought out, but evaluated on the basis of their contribution to added profit from the business enterprise; which may come from increased output or decreased input.
substances are analyzed for a mechanical/manipulative use;	Biodiversity is seen to be economically inconsistent with efficiency. Monocrop production is the rule in the industrial paradigm.	
the influences of natural conditions are limited by technology;		
animals and humans are seen in the context of output of cash flow; and		
the farm is often seen as a machine or "factory" (mechanical perspective)		

Table 3. Organic Agriculture Paradigm*

Ontology	Epistemology	Methodology
Organic agriculture recognizes life as a complex ecosystem in which:	The organic practitioner stands in a benevolent appreciation of the complexity of the ecosystem and attempts to work within the framework of this ecosystem towards sustainability (zero-sum net gains or losses).	The organic practitioner seeks a sustainable subsistence, and restricts his/her activities to non-exploitative practices that "do no harm," and thus that support ongoing sustainability.
nature, on earth, is a living ecosystem; albeit purely material;		Organic production does not emphasize biodiversity as an essential principle, and monocrop production is common.
substances are analyzed for balanced, ecological use;		
natural conditions are accepted and adjusted to;		
domestic animals are often excluded for ethical values; and		
the farm is seen as an integral part of larger ecosystem (ecological perspective)		

Table 4. Biodynamic Agriculture Paradigm*

Ontology	Epistemology	Methodology
Biodynamics is a complex living and dynamic (spiritual) system of agriculture, in which:	The biodynamic practitioner stands in both a supportive and remedial relationship to this complex, living, dynamic farm individuality**.	From the diagnostic-therapeutic relationship follows that the biodynamic practitioner's activities are divided into supportive (preventative) maintenance and remedial (therapeutic) inteventions.
the earth is a living being in a living universe, characterized by a spiritual-physical matrix;	Observation, diagnosis and therapy development are the central themes of the practitioner's relationship with the farm.	In practice, there is a strong focus on balance, biodiversity, and plant and animal immunity.
substances are carriers of forces that create life;		
celestial rhythms directly effect terrestrial life;		
animals and humans emancipate from celestial rhythms; and		
the farm is a living, dynamic, spiritual individuality** (spiritual perspective)		

* Lorand, Andrew Christopher. 1996. Biodynamic Agriculture — A Paradigmatic Analysis. The Pennsylvania State University, Department of Agricultural and Extension Eduation. PhD Dissertation. 114 p.

** Where Lorand uses the terminology of Steiner (*individuality*), other authors instead use the term *organism*