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Problems & Prospects

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2007

5 Biodynamic Farming in Organic Crop Production

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Organic Farming is assuming importance in proportion to the burgeoning health consciousness. It has come out of the exploitative agriculture that has been followed in all these years, resulting into damaging impacts on environment, human and animal health, soil and water resources. It is well known now that increased use of chemical pesticides and fertilisers have created chain of problems of soil, environment and water. The intensive chemical agriculture that has been followed after green revolution successes is causing heavy pollution of our food, drinking water, air; the life expectancy has improved, but the quality of life has substantially deteriorated. The rural economy is getting ruined because of over-dependence on external agricultural inputs such as hybrid seeds, fertilisers, pesticides, PGRs etc. Fortunately, alternatives to chemical agriculture are available in organic and biodynamic farming approaches. Though a small percentage of farmers are expected to take up organic farming, especially at the preliminary stage, consumer demand for organically produced food products provide new market opportunities for farmers and farm-business around the world. The tremendous demand for organically produced food at the international market is evident from the growing retail sales of the organic products in the developed countries. U.S, Europe and Japan are the biggest markets for the organically grown products. The retail sales of organic products in US and Europe are to the tune of \$ 8 billion and \$ 8.4 billion respectively. Japan is also a major importer of organic products. In several developed countries, organic agriculture has come to represent a significant portion of food system (Austria, Switzerland) and many other countries such as Japan, Singapore, France, United State of America etc. are experiencing growth rates that exceed 20 percent annually (FAO Committee on Agriculture - Agenda Item 8, pages 1-12). In fact, Government of India has been clearly aware of the importance of organic and bio-dynamic farming approaches and the Ninth Five year plan document laid emphasis on 'Environment and sustainable agriculture', promotion of organically produced commodities, particularly in plantation crops, spices and condiments. The Plan document emphasised

the use of biofertilizers, biocontrol agents and organic manures with infrastructural support.

Organic farming is a production system, which excludes the use of synthetically compounded fertilizers, pesticides and growth regulators. It relies on organic manures produced from farm wastes and other biomass. It also encompasses a conglomeration of various techniques and practices like intercropping, mulching, cover cropping, trap cropping etc. Organic farming also employs various biological pest control methods, which eliminates the use of synthetic chemicals even at the storage levels. A thorough understanding of agro ecological parameters of the locality is required to make organic farming a sustainable and feasible production system. Eventually, this helps to adopt the locally suitable methodologies with a proper and appropriate combination of various resources available on the farm. Being a holistic production management system, organic farming will promote and enhance environmental quality including biogeochemical cycles and soil floral and faunal activities. The stress has to be on improving the on-farm management rather than off-farm external inputs.

Biodynamic Farming

Biodynamic farming is an alternative variant where the chemical fertilisers are totally replaced by microbial nutrient suppliers such as bacteria, algae, fungi, mycorrhizae, and actinomycetes. Biological pest management of crops is undertaken by employing predators, parasites and other plethora of natural enemies of pests, in addition to all the rest of option such as pheromone and other lure traps, organic formulations including kerosene emulsion, neem seed kernel extract, tobacco decoction, garlic-neem oil emulsion that help to avoid resorting to chemical pesticides. These agents could be augmented into farms or promoted through such activities that favour their flourished activities to maintain the pest population below an economic threshold (but not killing or complete elimination of the pests from the ecosystem). Composting, green manuring, crop rotation, intercropping, mixed cropping etc. as well as bird perches, trap crops promote such biological activities. Although interpreted differently by various proponents, organic farming, biological farming, regenerative farming, biodynamic farming, low (external) input sustainable agriculture (LEISA/ LISA) and sustainable agriculture connote the same ideology that provide

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integrated efforts to maintain agro-ecosystems with futurism.

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*. Steiner taught the Agriculture Course lectures in response to the observations from farmers that soils were becoming depleted following the introduction of chemical fertilizers at the turn of the century.

Biodynamic agriculture is an enhanced organic farming system that had undergone much advancement over the years. 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 environmental, social, and financial aspects of the farm. In addition to the basic practices of organic farming, biodynamic agriculture uses a set of nine preparations, numbered from 500 to 508, in various farming operations. The preparations are the fermented mineral, cow manure and european herbal extracts. The herbs such as yarrow (*Achillea* sp.), chamomile (*Chamomilla* sp.), stinging nettle (*Urtica* sp.), dandelion (*Taraxacum* sp.), oak bark (*Quercus* sp.) and valerian (*Valeriana* sp.) are fermented in a unique way from which the preparations are made. These preparations act as catalysts and stimulants to activate the soil dynamics and the plant metabolism in a desired way to yield a quality produce.

Biodynamic agriculture parallels organic farming in many ways, especially with regard to cultural farming practices, but is set apart from organic agriculture with special practices that influence the biological aspects of the farm like the use of special compost preparations, special foliar sprays, planting by astronomical calendar, peppering for pest control, homeopathy and farm scaping.

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, kinetics, 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.

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

Biodynamic preparations are intended to help, moderate and regulate microbiological processes as well as enhance and strengthen the life forces on the farm soil. The preparations are used in homeopathic quantities, meaning they produce an effect in extremely diluted amounts. This in turn improves the soil quality and health, enhance the solar energy harvesting potential of plants, thus enhancing the growth, yield and quality of crops. Following are some of the beneficial influences of biodynamic preparations.

1. Improves physical, chemical and biological environment of the soil and suppresses soil borne pathogens and pests
2. Enhances photosynthetic capacity of plants

3. Ensures better plant establishment
4. Increases organic matter use efficiency

Biodynamic preparations help to suppress and control the pests and pathogens through natural processes by increasing the competitive and antagonistic activities of microorganisms.

Biodynamic Preparations in Nutrient Management

1. Biodynamic Composting

Biodynamic composting is a very unique method of converting the wastes into humus like mass. This method comprises the use of special herbal preparation in homeopathic doses. These preparations enhance the composting process and in turn enrich the compost. The time of composting may vary from 3 to 4 months.

Materials required

Two main types of wastes are utilized in this method of composting

- (a) Nitrogenous: The materials with high nitrogen content *e.g.* Green plant materials, kitchen wastes, dung and animal manures etc.
- (b) Carbonaceous: These are the more stable materials having high carbon content *e.g.* Straw, dried leaves and crop residues after harvest, dried seaweed etc.

Site

The following criteria are to be taken care of while selecting the site for composting.

1. Composting site should be protected from water logging, direct sunlight and wind.
2. Ideal place would be under the shade of trees but heavy feeding trees should be avoided near the composting yard.
3. Site selected for composting should be demarked permanently as it would build up desirable organisms in the soil beneath and hastens the ongoing composting process.

Size of the heap

The size of the heap should be 5 m long, 2 m wide and 1 m high. The length can be extended based on the availability of materials. Such extended heaps are called windrows.

Procedure for Biodynamic Composting

- (a) Clean the area by removal of grass and other weeds with a spade.

- (b) Mark the area 5 m lengthwise and 2 m width.
- (c) An inverted V channel is made with the help of dried stacks at the centre of the marked area running lengthwise. This tunnel will facilitate aeration.
- (d) Spread all the carbonaceous materials above the inverted V shaped tunnel within the demarked area (5 m length x 2 m width) to a height of 6 inches.
- (e) Cow dung slurry or biogas slurry is spread over the carbonaceous layer in a very thin layer.
- (f) Over the slurry, the nitrogenous materials are evenly spread to a height of 6 inches (plants of *Ipomea*, *Erythrina*, *Sesbania*, *Pongamia* etc.)
- (g) Again a layer of cow dung slurry or biogas slurry is spread over the nitrogenous layer.
- (h) Likewise a homogenous blend of carbonaceous and nitrogenous layers with dung slurry in between is made up to a height of 1.5 meters. On an average 40% carbonaceous and 60 % nitrogenous material are ideal.
- (i) The compost can be enriched with lime, rock phosphate or any such natural materials depending on the soil status.
- (j) The compost heap (5 m x 2 m x 1.5 m) is plastered with the slurry made out of cow dung and soil (1:1).
- (k) On the compost heap 6 holes (each 30 cm depth) are made diagonally opposite directions and one set each of Biodynamic preparations 502-506 are placed into each hole in the compost heap with help of straw or any biomass and are plugged into the heap. While one set of BD preparation 507 (10 ml of 4% solution) is stirred (clockwise and anticlockwise) in 5 litres of clean water for 15 minutes, 2 litres of the preparation is poured in the hole and rest is sprinkled over the entire heap. These preparations bring in order and balance in the decomposition of the compost materials.
- (l) After 2 months turning the compost heap would enhance the composting process. The compost would be ready in three months.

Important Points in Biodynamic Composting

- i. **Moisture:** Moisture content varies greatly with different wastes. Much water is required during the initial decomposition

stage. Lesser the moisture, slower will be microbial activity and composting process is delayed. About 50-60% moisture is required for proper composting as excess moisture will create anaerobic conditions and will not be congenial for the composting process. A simple method for farmers to test moisture is to squeeze a handful of material; it should be like a sponge, where water can just be squeezed out.

ii. **Air:** Adequate air supply is essential to encourage a right kind of microbial population (aerobes).

The compost heap should neither be too loose nor too firm. A loose heap would lead to the loss of humus and fast mineralization. A firm heap would bring in anaerobic conditions. To facilitate optimum aeration an inverted V shaped tunnel made of dried sticks or stubbles can be placed at the base running the length of the heap.

iii. **Temperature:** The optimum temperature results from the right balance of water, air and composting materials. The heat is produced primarily from the breakdown of the nitrogenous materials. Too much of the nitrogenous materials will create an overhot condition causing volatilization (nutrient loss to atmosphere). The temperature of the compost heap should go up to 60-70°C for 3-4 days and then gradually cool. The high temperature kills all the pest pathogens and weed seeds.

2) Cow Pat Pit Manure (CPP)

The manure obtained from Cow Pat Pit is a very useful medium or vehicle for spreading the influence of the compost preparations 502-507 over a large area of farmland, orchard or garden.

Materials Required

1. Cow dung - 65 kg of fresh dung is collected from lactating cow which is fed with a good quality fodder.
2. Egg Shells - Eggshells are added into the CPP as a calcium source. About 300 gm of crushed eggshells powder is required for one pit.
3. Borewell soil/Basalt rock/ Blur granite dust - Borewell soil is added as a silicon source. About 300 gm. of borewell soil is required for one pit.
4. Biodynamic Preparation - 2 sets each of biodynamic preparations 502-506 and 20 ml solution of preparation 507 is required.

Method

1. Dig a pit and line the 4 sides of the pit with baked bricks. The size of the pit with baked bricks lining should be 3 feet x 2 feet x 1 feet (0.9 m x 0.6 m x 0.3 m) dimension. The bottom of the pit should not be lined.
2. A site with good drainage and not prone to dry out should be chosen. A vegetable garden is ideal.
3. Sprinkle water to turn the cow dung into dough like consistency.
4. The above-mentioned minerals and crushed eggshells are sprinkled over the cow dung.
5. The bricks lining is moistened with water before placing the dung mixture.
6. Mix the dung for 10-15 minutes and place it in the pit to a height of about 15 mt. The dung should not be tightly packed.
7. Insert two sets of preparations 502-506 by making holes over the dung layer. Two sets of preparation 507 (20 ml of 4.5 solution) are stirred for 15 minutes in 2 litres of water and sprinkled over the cow dung from the top.
8. Place a wet jute sack over the cow pat pit to maintain moisture. The pit should be in a well-shaded and aerated area.
9. After one month the manure is gently aerated with a garden fork for uniform mixing.
10. Cow Pat Pit (CPP), manure matures in 35-40 days.

Storage: The Cow Pat Pit manure is stored in earthen pot placed in a dark room. Avoid the cow pat pit from drying.

Application: Cow Pat Pit manure can be applied along with preparation 500. It requires 15 minutes of stirring. The common practice is to make a spray solution of CPP with BD 500. After 45 minutes of stirring of BD 500 solution 100gm of CPP is added to the solution and both 500 and CPP are stirred for 15 minutes. The spray solution is then sprayed. CPP is also used as foliar spray (10%), plastering the cut ends of the plants after pruning and in seed treatment similar to biofertilizers.

Benefits

1. Fastest way to get the effect of all biodynamic preparations to the soil.
2. An array of beneficial microbes is build up which reduces many plant diseases.

3. Provides nutrients and stimulates plant growth.

3) Liquid manures

Liquid manure is the fermented preparation obtained by active fermentation of plant or animal residues with the aid of biodynamic preparations.

Liquid manures are of two types,

1. Plant based liquid manures are prepared from green plants, tree leaves and tender stems of plants.
 - Green manuring plants like - sunhemp, daincha, *Sesbania*, *Erythrina* etc. and other leguminous plants
 - Tree leaves - Leaves from neem, pungam, subabool and leaves of other local medicinal trees
 - Tender stems - *Lantana*, *Calotropis*, and local plants
 - Weeds - *Parthenium*, stinging nettle, and other weeds before flowering

A mixture of different plants results in good quality liquid manure.

2. Animal based - comprises of cattle dung, sheep and goat droppings, fish manure etc.

Method of Preparation

The basic principle is to allow the materials to ferment over a certain period.

1. A non-corrosive drum of capacity of 200 litres or more of food or water storage grade plastic is taken.
2. The plant materials for liquid manures are chosen based on the availability.
3. The plant materials are shredded properly and 30 kg of the plant material is put into the drum.
4. Cow dung (30 kg) is also added to the drum.
5. The drum is filled with good quality of water up to the brim.
6. One set of biodynamic preparations 502-507 is added.
7. Initially the mixture has to be stirred every day for one week. After that the stirring has to be done once a week with a long stick to aid fermentation and extensive stabilization of adour.
8. Liquid manure is ready in a month for use.

Use: The liquid manure has to be diluted with water prior to application. The dilution has to be one part liquid manure and ten parts water.

Advantages

1. Act as tonic or stimulant to plants.
2. Is used as insecticide and fungicide when neem, *Vitex*, *Calotropis*, stinging nettle are used as raw materials for liquid manures
3. Improves the nutrient utilization.

3. Preparation 500 (Cow Horn Manure)

This preparation is the most basic preparations in biodynamic agriculture. It is commonly known as Preparation 500, the biodynamic field spray. Cow horn manure is prepared by burying a cow-horn filled with fresh cow dung of a lactating cow. Such horns are buried in soil during autumn and winter period and are lifted out in the early spring in accordance with the planting calendar. In other words, the horns are buried in September-October and lifted during March-April during descending moon. The manure when knocked out of the horn gets transformed into sweet smelling colloidal humus.

About 35g of BD 500 is required for one-acre land. The required quantity of the preparation is placed in a vessel containing good quality water and stirred rhythmically in clockwise and anticlockwise direction alternately for one hour. First, the movement is clockwise, till a vortex is formed, then the movement is reversed till another vortex is created, again the movement is reversed, and so on for one hour.

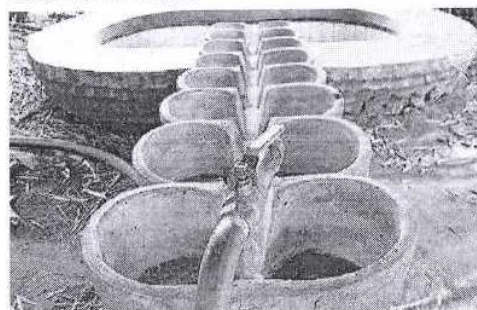


Figure 1. Special water energizing troughs being used by biodynamic farmers

The stirred preparation 500 is immediately sprayed on the land with the help of a sprayer or a broom. The broom is dipped into the bucket containing stirred preparation 500 and is splashed on the desired area.

4. Preparation 501 (Cow Horn Silica)

This is made from a crystal of quartz (Silicon dioxide, SiO_2). The crystal is ground up into a fine powder as smooth as talcum

powder. It is moistened with water, put into a cow horn and buried in the soil during spring and summer. It is important to have good quality quartz crystals, well formed and clear, which should allow the light to flow right through. A good clear crystal will cause the refraction of light in the same way as the prism.

Preparation 501 is also stirred in a similar manner like preparation 500. It is stirred for one hour, using one gram in 13.5 litres of water and sufficient for one acre land. It is applied in the morning in a fine mist, using a high-pressure spray, allowing the mist to be suspended briefly in the air so that the sunlight can shine momentarily through the mist on the plant; the fine mist is allowed to drift over the crop. For smaller area knapsack sprayer is used with their fine nozzles turned skywards to produce misting effect.

As a general rule, 501 should be sprayed at the early stage of the plant and after the fruit set. Preparation 501 is generally sprayed in the morning during spring and early summer and sometimes in the autumn if the lushness of growth demands it. As the season advances during summer, 501 is sprayed progressively early in the morning.

Because of the stimulation of the light, it is advised not to use 501 in drought conditions and should only be used once in the spring on pasture as overuse can accentuate drought conditions. Due to the enhancement of photosynthesis of the plant, the starches, sugars and cellulose are improved. The quality of grain produced is greatly increased.

5. **Preparation 502** - Prepared from yarrow (*Achillea millefolium*) blossoms using stock bladder of deer. Benefits the plants with the release of locked elements especially potash and sulfur from the soil and atmosphere.
6. **Preparation 503** - Prepared from German white chamomile (*Chamomilla officinalis*) blossoms using the intestine of cows. This helps in breaking the protein in the compost and making it in available form to the plant.
7. **Preparation 504** - Prepared from stinging nettle (*Urtica dioica*). The whole plant in full bloom stage is used for the preparation and this gives sulfur, potash and calcium to the plants.
8. **Preparation 505** - Prepared from oak bark (*Quercus robur*) using the skull of sheep or goat. This provides calcium in the live form.

9. **Preparation 506** - Prepared from the flowers of dandelion (*Taraxacum officinale*) using the mesentery of cow. This helps to mobilize silica from air to plant.
10. **Preparation 507** - Prepared from the flowers of valerian (*Valeriana officinalis*). This preparation increases the plant leaf activity as well as the general microbial and earthworm activity in the soil.
11. **Preparation 508** - Prepared from the silica-rich horsetail plant (*Casuarina/ Equisetum arvense*) and used as a foliar spray to suppress fungal diseases in plants. Horsetail is best seen as a prophylactic (disease-preventing, not disease-curing) spray with a mild fungus-suppressing effect. Take 10kg of casuarina needles, chop and boil in water for half an hour. Take the extract at and drench the nursery at 20 times dilution before seed sowing.

Biodynamic Preparation in Pest Management Methodology

- i) Collect 30kgs of plants (leaves and tender parts) like neem, *Calotropis*, *Pongamia*, *Parthenium*, *Lantana* etc. that possess pesticidal activity; chop into small pieces and put into 200-litre barrel.
- ii) Add 30kgs of cattle dung into the barrel and fill it up with water.
- iii) About 5kgs of local soil is added into the barrel to facilitate faster degradation. Even 1 set of biodynamic preparation (502-507) can be added into the barrel.
- iv) The barrel is stirred every day for 7 days. The preparation is ready by 30 days.
- v) The concentrated solution can be diluted ten times in water and used as a foliar spray.
- vi) These sprays are very efficient in managing a variety of pests.

Use of Planting Calendar

The life patterns of all living organisms are woven into the cosmic rhythms. The present scientific world may not accept the fact regarding the influence of the cosmic rhythms and the constellations on the life forms. Human life, as well as animal and plant life, is strongly dependent on the rhythms of the earth. The plant and animal life is instantly influenced by the sidereal and synodic relationships of the sun, earth, moon and other planets. On the basis of such influences the planting calendar is prepared for agricultural operations during different timings of the year.

i) **Moon Opposite to Saturn:** It occurs approximately once in 29.5 days.

Activities to be Undertaken

1. Seed sowing, transplanting, grafting, pruning and layering.
2. Spraying BD501 (Cow horn silica) to manage pests.
3. Spraying liquid manures and foliar sprays.

ii) **Full Moon:** This occurs every 29.5 days

Activities to be Undertaken: 1. Soak seeds two days before sowing. 2. Apply liquid manures and CPP (Cow Pat Pit) manure. 3. Spraying bio pesticides to control pest and disease. 4. Drench the animals for internal parasites (48 hours before).

iii) **New Moon:** This happens once in 27.5 days

Activities to be carried out: 1. Avoid sowing seeds. 2. Cutting timber.

iv) **Ascending periods:** The moon moving in an arc from east to west and when this arc gets higher everyday, the Moon is ascending

Activities to be Undertaken: 1. Sowing of crops. 2. Spray BD501. 3. Spray liquid manures and CPP

v) **Descending Periods:** The moon moving in arc from East to West and this arc gets lower everyday, the Moon is said to be in descending phase.

Activities to be Carried Out: 1. Transplanting of seedlings. 2. Spraying BD500 (Cow horn manure). 3. Making and spreading compost. 4. Pruning trees. 5. Land preparation activities.

vi) **Nodes:** These are the days when moon pass the sun's path. It creates negative influences on the growth of plants. Avoid all agricultural activities.

vii) **Apogee:** Moon's orbit around the Earth is an elliptic. The point where the moon is far away to earth is called Apogee.

Activities to be Undertaken: 1. Planting potatoes. 2. Irrigating the field.

viii) **Perigee:** Moon moves around the earth in an elliptical path. The point where the moon is closest to earth is called as perigee.

Activities to be Undertaken: Spray biopesticides to manage pest and disease

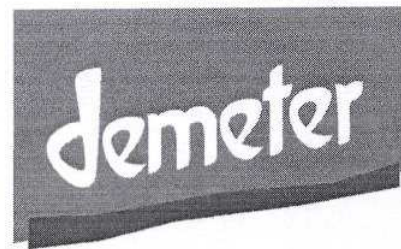
ix) **Seed and Fruit Days:** These days influence the growth of seed and fruit crops and good for sowing and harvesting for the same. E.g. paddy, wheat, brinjal, bendhi and tomato

x) **Root Days:** These days influence growth and development of root crops and good for sowing and harvesting for the same. E.g. potato, carrot and beetroot

xi) **Flower Day:** These days influence on growth and development of flowers and good for sowing and harvesting for the same. E.g. cut flowers, cauliflower, rose and jasmine.

xii) **Leaf Days:** These days help in the growth and development of leafy vegetables and good for sowing and for harvesting. E.g. green leaves, cabbage.

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, United States, Australia, and New Zealand.