



E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(6): 212-219
Received: 03-09-2017
Accepted: 05-10-2017

Ambreen Nabi

Assistant Professor, Division of
Vegetable Science, Sher-e-Kashmir,
University of Agricultural Sciences
and Technology of Kashmir,
Shalimar, Srinagar, Jammu and
Kashmir, India

Dr. Sumati Narayan

Assistant Professor, Division of
Vegetable Science, Sher-e-Kashmir,
University of Agricultural Sciences
and Technology of Kashmir,
Shalimar, Srinagar, Jammu and
Kashmir, India

Baseerat Afroza

Associate Professor, Division of
Vegetable Science, Sher-e-Kashmir,
University of Agricultural Sciences
and Technology of Kashmir,
Shalimar, Srinagar

Faheema Mushtaq

Associate Professor, Division of
Vegetable Science, Sher-e-Kashmir,
University of Agricultural Sciences
and Technology of Kashmir,
Shalimar, Srinagar, Jammu and
Kashmir, India

Shahnaz Mufti

Assistant Professor, Division of
Vegetable Science, Sher-e-Kashmir,
University of Agricultural Sciences
and Technology of Kashmir,
Shalimar, Srinagar, Jammu and
Kashmir, India

Ummiyah HM

Assistant Professor, Division of
Vegetable Science, Sher-e-Kashmir,
University of Agricultural Sciences
and Technology of Kashmir,
Shalimar, Srinagar, Jammu and
Kashmir, India

M Mudasir Magray

Assistant Professor, Division of
Vegetable Science, Sher-e-Kashmir,
University of Agricultural Sciences
and Technology of Kashmir,
Shalimar, Srinagar, Jammu and
Kashmir, India

Correspondence**Ambreen Nabi**

Assistant Professor, Division of
Vegetable Science, Sher-e-Kashmir,
University of Agricultural Sciences
and Technology of Kashmir,
Shalimar, Srinagar, Jammu and
Kashmir, India

Biodynamic farming in vegetables

Ambreen Nabi, Dr. Sumati Narayan, Baseerat Afroza, Faheema Mushtaq, Shahnaz Mufti, Ummiyah HM and M Mudasir Magray

Abstract

The term biodynamic is taken from Greek word bios meaning life and dynamics meaning energy. Hence biodynamic farming refers “working with the energies which create and maintain life” (Rai and Yadav, 2005). There are two main characteristics of BD farming (Dengel, 2004). Firstly by the use of particular farming inputs made from various herbal, mineral and raw materials processed in complex ways and finally applied in small and minimal doses on soil and crops. And secondly by the observation of rhythms in nature which go beyond the most obvious influences of sun, weather and season, but which include lunar, planetary and stellar constellations. Biodynamic differs from organic farming in a way that biodynamic farms aims to become self-sufficient in compost, manure and animal feeds and moreover an astronomical calendar is used to determine auspicious planting, cultivating and harvesting times (Sharma, 2001). Biodynamic farming has increased the mean yield of potato by 10.4% and 10.9%, in carrot 17.2% and 24%, in cabbage 14.3% and 28.3% and in French bean 24.5 and 22.5% under irrigated and rainfed conditions respectively (Selvaraj and Anita, 2006). Biodynamic production of cauliflower gave a yield of 42.58t/ha as compared with 23t/ha in control where as in cabbage yield was recorded as 55.16 t/ha under biodynamic production as compared to 22.83 t/ha in organic farming Pathak and Ram, 2001). Sustainable management of natural resources, ecological farming and the production of non-toxic food of nutritional qualities will have to find their way into mainstream society and practices if these inhabitants are to survive.

Keywords: Biodynamic farming, vegetables

Introduction

Modern agriculture largely depends on the use of fossil fuel based inputs, such as chemical fertilizers, pesticides, herbicides and labour saving but energy intensive farm machinery. While the applications of such high input technologies have undoubtedly increased production and labour efficiency. The use of pesticides has gone up 10 times since World War II but damage to crops by insect pest doubled. The residual amounts of these deadly pesticides on fruits and vegetables are harmful to humans when ingested. There is a growing concern over their adverse effects on soil productivity and environmental quality which is emerging to recognize that the farmer has a great social responsibility as a land owner than merely agribusiness considerations. There are several established approaches to ecofriendly farming systems. A common threat in all schools is an emphasis on biological systems to supply fertility and pest control rather than chemical inputs which has following impacts:

1. Compaction of soil structure.
2. Low organic matter content.
3. Poor water holding capacity.
4. Increase in salinity, sodicity and land submergence.
5. Adverse effect on flora and fauna of soil.
6. Deterioration in factor productivity.
7. Problem associated with residual toxicity.

So organic/biodynamic farming was developed. Biodynamic farming was spawned by the late Australian philosopher, literary scholar, architect, playwright, educator, social thinker and anthroposophist *Rudolf Steiner* and has grown and developed in popularity since 1922. He first formulated the organic approach to agriculture in the western world by linking unhealthy agriculture and an unhealthy social and spiritual life. In 1924 the Bio-Dynamic movement went under way from 8 lectures that *Rudolf Steiner* gave in Koberwitz, Poland.

Biodynamic farming means biological dynamics. It is a method of organic agriculture, which considers farm as a living system and where one activity affects the other. The term biodynamic is taken from the Greek word bios meaning life and dynamic meaning energy. Hence biodynamic farming refers to working with energies which create and maintain life.

In other words, Biodynamic agriculture is a method of organic farming that treats farms as unified and individual organism (Anon, 2007), emphasizing balancing the holistic development and interrelationship of the soil, plants, animals as a closed self-nourishing system (Burkitt *et al.*, 2007) ^[1].”

It includes organic agriculture's emphasis on manures and composts and exclusion of the use of artificial chemicals on soil and plants. The farming practices are sensed through experience and learning from other farmers. Biodynamic agriculture conceives of the farm as an organism, a self-contained entity with its own individuality. Emphasis is placed on the integration of crops and livestock, recycling of nutrients, maintenance of soil and the health and well-being of crops and animals, the farmer too is a part of the whole (Carpenter *et al.*, 2000a) ^[2]. Cover crops, green manures and crop rotations are used extensively. The approach also attempts to consider celestial influences on soil and plant development and to revitalize the farm, its products and its inhabitants (Chalker, 2004). Because of the difference in these contributing energies, planting your crop one day will be totally different than planting it another day. In fact planting during certain days of the moon cycle is important (Steiner 1993) ^[10].

Biodynamics is ecologically oriented on a wider scope and includes Sun, Moon, Planets, Subterranean features and Mental factor. There are four elements which include fire, earth, water and air. All natural things of the world are formed by these by transformation and intimate combinations. Each element has two specific characteristics, one principle and one that serves a connecting medium to the other elements. Biodynamics thinks of these elements because they are available to our senses. If we compare these to the 100+ elements of chemists and those are not there for us to experience everyday.

Principles of Biodynamics

1. Harvesting Cosmic Forces:- The earthy forces of Moon, Mercury and Venus soak into earth from the air above and the cosmic forces of Mars, Jupiter and Saturn upwards from the rocks below. They interact in the region of clay, so the plants are in regular rhythms. Each contributes to the life growth and farm of the plant. By understanding the gesture and effect of each rhythm, agricultural activities life soil preparation, sowing, intercultural operations and harvesting can be programme (Scilthuis, 2000) ^[7].
2. Biodynamic calendar: agricultural practices performed as per constellation are more effective and beneficial. Each constellation has dominant elemental influences and affects.
3. The biodynamic farming aims to restore humus status of the soil ecosystem to hold its fertility and productivity.
4. Also it helps to restore the soil for a balanced functioning of flora and fauna. Because soil is a living system where in the microbes can be fully established and maintained.
5. The biodynamic farming does not deny the role and importance of mineral nutrients of the soil like nitrogen, phosphate, potash, calcium, magnesium etc., and it considers the skilful use of organic matter as the factor for soil life.
6. It involves the skilful application of all the factors contributing to soil life and health. Because a plant grows under the influence of abiotic factors like temperature, oxygen, CO₂ light, water etc. And these energies are transformed in the plant systems into chemically active

energies by way of photosynthesis.

7. Biodynamic farming considers a plant as living entity which consists not only of mineral elements (like N, P, K, Ca, Mg, Cl, Fe, etc..) but also of organic matter such as protein, carbohydrates cellulose, and starch.
8. Biodynamic farming gives importance to enzymes and growth substances.
9. To restore the soil fertility, biodynamic farming gives priority to proper crop rotation. Soil exhausting crops should be cultivated alternatively with fertility restoring crops.
10. To restore the soil environmental conditions, forests, wind protection and water regulation are important.
11. Biodynamic farming also gives importance to maintain the soil structure (physical character like bulk density, pore space, water holding capacity and texture).

Characteristics of biodynamic farming

Biodynamic farming has following two characteristics. Firstly, by the use of particular farming inputs made from various herbal, mineral and manual raw materials processed in complex ways and finally applied in small and minimal doses on soil and crops. And secondly by the observation of rhythms in nature which go beyond the most obvious influences of sun, weather and season, but which include lunar, planetary and stellar constellations.

Biodynamic Preparations

Steiner prescribed eight different preparations to aid fertilization which are allowed for use in biodynamic agriculture and gave great details of these were to be prepared. The prepared substances are numbered 500 through 507, where the first two are used for preparing fields whereas the later six are used for making compost

1. Field Preparations

Field preparations for stimulating humus formation

Preparation 500: (horn manure) a humus mixture prepared by filling the horn of 9 cows with cow manure and burying it in the fertile soil (46-69 cm below the surface). The horns are placed in descending moon during autumn for incubation whole winter. In March-April, it is taken out again in descending period and used or stored in earthen pots at some cooler place. The cow is an earthy creature with a very strong digestive system. The cow horn has the ability to absorb life energies during decomposition of the dung.

Preparation 501: (Horn silica) Crushed powdered quartz prepared by stuffing it into a horn of a cow and buried into the ground in spring and taken out in autumn. It can be mixed with 500 but usually prepared on its own (mixture of 1 tablespoon of quartz powder of 250 litres of water). The mixture is sprayed under very low pressure over the crop during the wet season to prevent fungal diseases. It should be sprayed on an overcast day or early in the morning to prevent burning of the leaves.

2. Preparations 502-507: The compost preparation “the deliberate putting together of any number of organic substances for the sake of rotting them in such a way that a high-quality natural fertilizer agent, a medium or microorganism life, can develop” is called composting.

- It is any organic matter
- It should be mixed as well as possible
- Chop material very finely
- Material should have good C:N ratio

- Four elements should be present in a balanced relationship

Yarrow preparation: 502

Yarrow blossoms (*Achillea millefolium*) are stuffed into urinary bladder from Red Deer (*Cervus elaphus*), placed in the sun during summer, buried in earth during winter and retrieved in the spring. It stimulates the potassium, silica and selenium activating bacteria and helps combine sulphur with other substances, remedies weaknesses in flowering and fruiting and strengthens the plant against insect attack and aids the soil in connecting to the planetary rhythms.

Chamomile preparation: 503

Chamomile blossoms (*Matricaria recutita*) are stuffed into small intestine from cattle buried in humus rich earth in the autumn and retrieved in the spring.

Stinging nettle preparation: 504

Stinging nettle (*Urtica dioica*) plants in full bloom are stuffed together underground surrounded on all sides by peat for a year.

Oak bark preparation: 505

Oak bark (*Quercus robur*) is chopped in small pieces, placed inside the skull of a domesticated animal, surrounded by peat and buried in earth in a place where lots of rain water runs by.

Dandelion preparation: 506

Dandelion flowers (*Taraxacum officinale*) is stuffed into the peritoneum of cattle and buried in earth during winter and retrieved in the spring.;

Valerian Preparation: 507

- Valerian flowers (*Valeriana officinalis*) are extracted into water.

Lunar Effects

The Moon reflects light and has a gravitational effect on the Earth. Steiner proposed that this affects plant growth. The Moon has a roughly elliptical orbit so the gravitational pull varies throughout its 28 day cycle. Root growth is improved when Moon moves further out causing a decreased pull on the Earth and vice versa

- This force also causes the ocean tides.

- Planting of flower, fruit and vegetable seeds are best done 2 days before a new Moon because light and gravitational forces are more favourable in the seven days that follow.
- During the next seven days the Moon appears larger each night approaching a full Moon. The increased light stimulates foliage growth, but the gravitational pull increases so root growth is less favoured - young shoots thrive and the roots rest.
- For the seven days following the full Moon the light decreases slowing foliage growth, but so do the gravitational pull and the roots can develop. This is a good time to transplant seedlings as it gives the roots better conditions to flourish.
- In the last seven days of the lunar cycle the light continues to decrease, but the gravitational pull increases so both foliage and roots rest in the run up to the new Moon of the next lunar cycle.

1. The Ascending Period

During the ASCENDING period there exists a greater emphasis on the energy flow from the centre of the Earth to the cosmic periphery. This phenomenon, observed in spring tides, has a correspondence to the strength of the sap flow in a plant that can be harnessed by the gardener.

2. The Descending Period

During the DESCENDING period the lunar energy tends to flow down from the cosmic periphery towards the centre of the Earth. These forces are now biased to work more strongly into the lower reaches of the plant (everything that is in the soil).

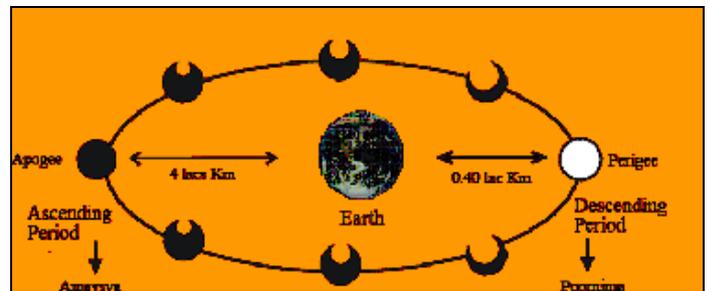


Fig 1: Planting calendar position of earth and moon for harnessing the cosmic forces

Table 1

Ascending moon	Descending moon
The earth is breathing out– the development occurs in upper parts of the plant e.g shoots	The earth is breathing in– the development occurs in below the ground parts of the plant e.g roots
Cosmic energy works above the rhizosphere.	Cosmic energy works below the rhizosphere.
Spring and summer seasons.	Autumn and winter seasons.
Suitable for	Suitable for
For foliar applications	Root development
Propagation activities	Transplanting.
Harvesting	Manure application
Sowing	Harvesting of tuber crops

- 3. Perigee (poornima):** When the moon is nearest to earth, at perigee plants are more prone to fungal diseases because of high moisture in the atmosphere.
- 4. Apogee:** When the moon is farthest from the moon, suitable for sowing tuber crops.
- 5. Rahu:** Lunar node in ascending period of moon, not suitable for agricultural activities.

- 6. Ketu:** Lunar node in descending period of moon, not suitable for agricultural activities. The biodynamic sowing and planting calendar is produced each year by the authors Maria and Mathias Thun. It is based on more than forty years of ongoing research into the influences of the moon, planets and constellations on plant growth. It is available from the biodynamic Agricultural Association.

How is biodynamic different from organic?

The biodynamic farming is more than just another organic farming.

1. Every biodynamic farms aims to become self-sufficient in compost, manures and animal feeds.
2. All external inputs are kept to minimum.
3. Compost is treated with special herb-based preparations.
4. Crop quality is improved using natural manure and quartz based preparations.
5. Ecological diversity is a goal of landscape management.
6. An astronomical calendar is used to determine auspicious, planting, cultivating and harvesting time.

Trade mark protection of term biodynamic

The term biodynamic is the trade mark held by Demeter Association of biodynamic farmers for the purpose of maintaining production standards used both in farming and processing food stuffs. The produce of this farming is guaranteed by presence of international certification trademark Demeter™ this assures for buyer that produce is bio dynamically grown. The Demeter™ appeared first in Germany around 1928. It is certification trademark of biodynamic farming. It is name of ancient Greek Goddess of fertility and abundance. It is intended to protect both the consumer and the producers of biodynamic produce.

The world wide movement has its centre at the Goetheanum in Dornach, Switzerland, the home of the school of spiritual, of which there are seven departments. The Biodynamic Agriculture Department is part of the Natural Science Section.

Is biodynamic food better for us?

Food produced from healthy soil and contented animals will make for healthy people. Research showed that biodynamic produce: Keeps fresh for longer, Flavour is better, Dry matter content is higher,

Nitrate content is lower and has greater vitality. There is also considerable evidence to show that eating biodynamic food increases vitality, reduces allergic reactions and brings about an all-round health improvement.

Table 2: Average difference in nutrient levels of biodynamic and organic crops compared to similar conventional crops

Nutrient	Biodynamic %difference	Organic % difference
Vitamin C	+47.6	+22.7
Iron	+33.9	+17.2
Calcium	+7.4	+30.8
Phosphorus	+6.6	+12.5
Sodium	+20.3	+19.6
Potassium	+7.9	+14.1
Magnesium	+13.2	+24.4
Beta carotene	+14.0	-0.3
Nitrates	-49.8	-33.9

Biodynamic method of vegetable farming

Biodynamic agriculture conceives of the farm as an organism, a self-contained entity with its own individuality. Emphasis is placed on the integration of crops and livestock, recycling of nutrients, maintenance of soil and the health and well-being of crops and animals, the farmer too is part of the whole (Carpenter, 2000b) [3]. Cover crops, green manures and crop rotations are used extensively. Companion planting is carried as follows.

- Cabbage and bush beans are grown with a border planting of dill and chamomile.
- Fall cabbage does well when proceeded by early potato.

- Beans grow well with everything.
- Celery grows well with carrots, parsnips, parsley and celeriac.
- Corn combines with bean, squash and cucumber.
- Onions with beets, lettuce, beans and any other member of carrot family.
- Spinach with strawberries
- Tomato and spinach, parsley and basil also with the row of asparagus.

Package of practices for biodynamic production for vegetables

Nutrient Management

- Green manuring with sunhemp/sesbania.
- Soil preparation and application of (5-10 tonnes) organic manures through NADEP, Vermi, Biodynamic Compost (BD) or Microbe Mediated Compost (MM compost) in descending moon period.
- Spraying of cow horn manure before sowing/transplanting during descending period of moon.
- Sowing in ascending moon period (48 hours before the full moon) and on exact constellation based on the part of the crop is to be harvested.
- Transplanting of seedlings during descending moon period and on exact constellation based on the part of the crop is to be harvested.
- Soaking of seeds/seedlings in cow pat pit solution (1: 7 ratio stirred for 30 minutes) prior to sowing.
- Two sprays of biodynamic liquid manure prepared from Cow dung, Cow urine, leguminous leaves or Vermi-wash for the better growth and fruiting.
- Intercultural operation/peppering/mulching for weed management and root development in soil.
- Harvesting and storage as per constellation.

Disease Management

- Two sprays of Cow Horn silica (BD-501) at two leaf stage and fruit development stage.
- Need base spraying horsetail (*Equisetum arvensis*)/casuarina extract for control of fungal diseases.
- Spraying of fresh cowdung/biodynamic liquid manures prepared from cow urine, neem and karanj (*Pongamia glabra*) for the control of bacterial diseases.

Treatment of pests and weeds

Biodynamic agriculture sees the basis of pest and disease control arising from a strong healthy balanced farm organism. Where this is not yet achieved it uses techniques analogues to fertilization for pest control and weed control. Most of these techniques included using the ashes of a pest or weed that has been trapped as picked from the fields and burnt. Steiner saw weeds and plants vulnerability to pests as a results imbalance in the soil. Pests such as insects or field mice (Apodemus) have more complex processes associated with them, depending on what pest is to be targeted. For example field mice are to be counted by developing ashes prepared from field mice skin when Venus is in the Scorpius constellation. Weeds are combated (besides the usual mechanical methods by collecting seeds from the weeds and burning them above a wooden flame. The ashes from the seeds are then spread on the fields which are intended to block the influences from the full moon on the particular weed and make it infertile. It is carried by following ways:

Spraying of biodynamic liquid pesticides prepared from cow

urine, neem, karanj (*Pongamia glabra*), *Caliotropis*, dhatura, castor, *Thevtia nerrifolia*, *Vitex spp.* leaves. Spraying of nettle leaves extract to control pests.

Biodynamic production of vegetables at cish, Lucknow, India



Treatments	Production (t/ha)
Biodynamic practices	55.16
Organic	22.83

Fig 2: Cabbage



TREATMENT	PRODUCTION (t/ha)
BIODYNAMIC PRACTICE	42.58
CONTROL	23.00

Fig 3: Cauliflower

Pea

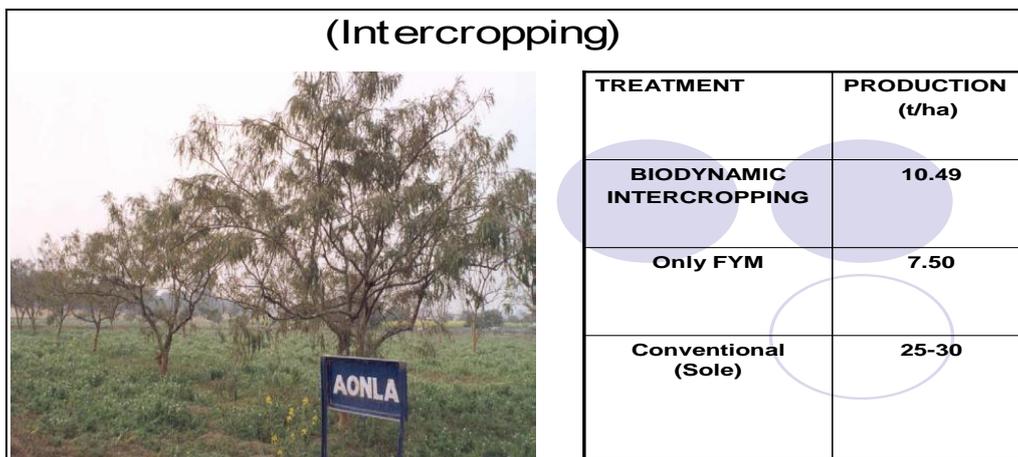


Fig 4: Turmeric

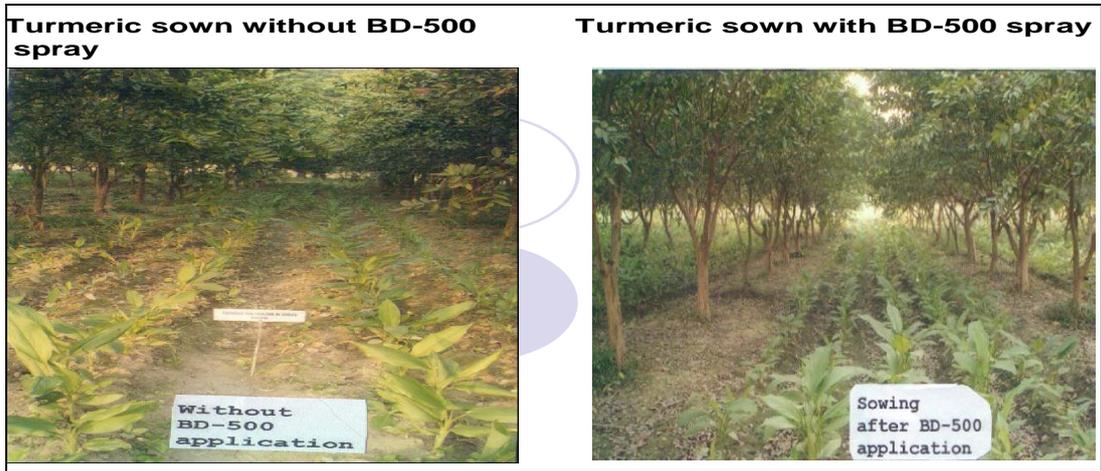


Fig 5

Biodynamic farming technologies developed by horticulture research station ooty
 Experiments were carried to study the effect of biodynamic farming system on potato, cabbage, carrot and French beans at horticulture research station Ooty and also in the farmers field during 2003-2006. the experiments consist of following four

treatments viz:
 Biodynamic
 Conventional
 Biodynamic+ Conventional
 Absolute Control
 The results obtained are given in the following tables.

Table 3

Yield performance of vegetables under biodynamic organic farming system at Horticultural Research Station, Ooty.

Treatments	Potato (t/ha)		Carrot (t/ha)		Cabbage (t/ha)		French Beans (t/ha)	
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed
Biodynamic	38.1 (10.4%)	21.2 (10.9%)	38.8 (17.2%)	22.2 (24%)	72.7 (14.3%)	40.8 (28.3%)	26.4 (24.5%)	17.4 (22.5%)
Conventional	34.5	19.1	33.1	18.6	62.3	31.8	21.2	14.2
Biodynamic+ Conventional	32.0	16.8	32.7	17.9	59.4	25.1	15.4	10.2
Absolute Control	23.1	12.7	20.6	14.1	40.9	15.1	12.2	7.8
CD at 0.05	3.83	2.42	3.65	2.98	2.63	3.41	2.03	1.90

Table 4

Effect of biodynamic organic farming system on the Nutritive value of carrot cv Karodu (Irrigated)

Treatment	Carbohydrate g/100 g	Protein g/100g	Vitamin C mg/100g	Carotene mg / 100 g
Biodynamic	20.4	1.5	19.5	8.2
Conventional	12.8	0.9	11.2	4.51
Biodynamic+ Conventional	12.0	0.9	11.0	4.48
Absolute Control	10.8	0.8	10.0	4.40

Table 5

Net profit in cultivation of biodynamic potato, cabbage, carrot and French beans

Sr. No.	Crop	Net Profit in Irrigated Season (Rs.)		Net profit in Rainfed Season (Rs.)	
		Biodynamic	Conventional	Biodynamic	Conventional
1	Potato	110000	45000	60000	16500
2	Cabbage	232450	100200	87100	6900
3	Carrot	290000	93200	125000	14100
4	French Beans	197000	50300	85000	16600

Advantages

- Yield potentials are equal or better than those harvested after application of recommended doses of agro-chemicals.
- Continuous improvement in physical, chemical and biological properties of soil.
- Produce quality with respect to nutrition, appearance and shelf life is better.
- Eco friendly.

Interferences from biodynamic systems

Biodynamic system is almost new, but the preliminary observations show encouraging responses. On the basis of these observations, the following interference are drawn;

- It appears to be a sustainable, economic and eco friendly.
- There is minimum risk of residual toxicity.
- There is improvement in soil fertility with quality produce including shelf life.
- Micro quantities of cow pit, BD-500, BD-501, will only be effective provided the soil is rich in organic matter content.
- Organic matter content of the soil can be maintained by incorporation of compost prepared locally from the organic waste by NADEP, Vermi, BD or Micro mediated (mm) compost.
- It will require a systematic approach.

Strategies for popularisation of biodynamic farming

- Invention of prevailing organic production systems

and their validation for vegetable crops.

- Various aspects of organic production of horticultural commodities need to be standardised.
- Promotion of establishment of demonstration for preparation of biodynamic compost, cow horn manures, cow's horn silica, cow pat pit (CPP), liquid manures and liquid biodynamic pesticides.
- Promotion for field demonstration for organic (biodynamic) preparations.
- Monitoring the soil fertility and quality produce over a long duration.
- Organising intensive training to farmers, NGO representatives, entrepreneurs and extensive workers for biodynamic preparations and their applications.
- Scientific explain for responses of the above materials with reference to soil physical, microbial properties and produce quality.
- State Agriculture universities should initiate few courses on 'Biodynamic Agriculture'.
- Facilitation for certification for biodynamic produce.
- Establish national standards governing the marketing of agriculture products.
- Assure consumers that organically produced products meet consistent standards.
- Market promotion for organic/biodynamic produce.

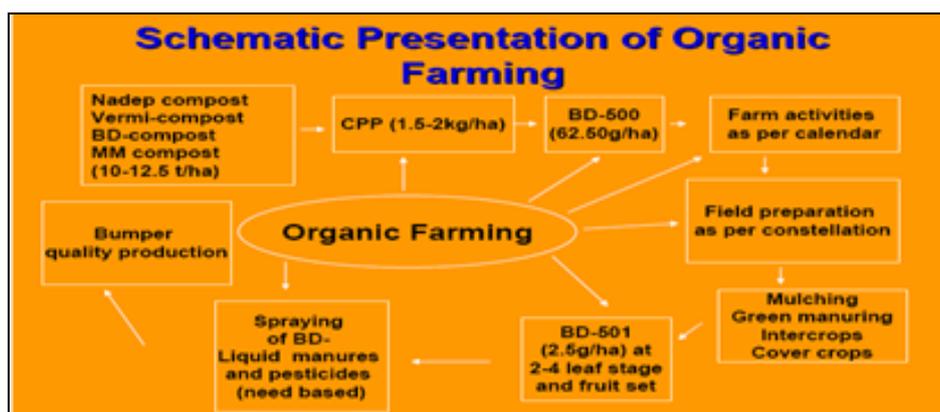


Fig 6

Conclusion

In the end it will not matter from where wisdom has originated, truth will prevail independent of passports and man-made borders. Sustainable management of natural resources, ecological farming and the production of non toxic food of nutritional qualities will have to find their way into mainstream society and practices if these inhabitants are to survive.

References

1. Burkitt LL, Small DR, McDonald JW, Wales WJ, Jenkin ML. Comparing irrigated biodynamic and conventionally managed dairy farms: soil and pasture properties. *Australian Journal of Experimental Agriculture*. 2007; 47(5):479-488.
2. Carpenter BL, Reganold JP, Kennedy AC. Biodynamic preparations: short term effects on crps, soils and weed populations. *American Journal of Alternative Agriculture*. 2000a; 15(3):110-118.
3. Carpenter BL, Reganold JP, Kennedy AC. Organic and biodynamic management: effects on soil biology. *Soil Science Society of American Journal*. 2000b; 64:1651-1659.
4. Dengel L. *Biodynamic Farming: a complex farming approach with superior results*, 2007. www.auroville.com.
5. Pathak RK, Ram RA. *Proceedings of Approaches for Sustainable Development of Horticulture*, 2001, 113-119.
6. Rai N, Yadav DS. *Advances in vegetable production*. Researchco Book Centre: New Delhi. 2005, 89-114.
7. Scilthuis W. *Biodynamic agriculture*. S and H Home Ag library. *Biodynamic agriculture*, 2000.
8. Selvaraj BR, Anita B. *Production and marketing of horticulture products in the nilgiris: a case study*. Horticulture Research Station TNAU, 2006.
9. Sharma AK. *A handbook of organic farming*. Agrobios: India, 2001, 25-29.
10. Steiner R. *Spiritual foundations for the renewal of agriculture: A course of lectures*. Biodynamic Farming and Gardening Association, 1993, 310.