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Strategies of organic farming in fruit crops

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Abstract

Organic agriculture has grown out of the conscious efforts by inspired people to create the best possible relationship between the earth and men. Since its beginning the sphere surrounding organic agriculture has become considerably more complex. A major challenge today is certainly its entry into the policy making arena, its entry into anonymous global market and the transformation of organic products into commodities. During the last two decades, there has also been a significant sensitization of the global community towards environmental preservation and assuring of food quality. Ardent promoters of organic farming consider that it can meet both these demands and become the mean for complete development of rural areas. After almost a century of development organic agriculture is now being embraced by the mainstream and shows great promise commercially, socially and environmentally. While there is continuum of thought from earlier days to the present, the modern organic movement is radically different from its original form. It now has environmental sustainability at its core in addition to the founders concerns for healthy soil, food and people. In recent years, the market for organic farming has significantly increased in response to concerns over food quality and environmental matters. Organic food is quite attractive for consumers and is often associated to quality, healthy and natural products in opposition to the more processed and artificial conventional food.

Keywords: biofertilizer, Fruits, Mulching, Organic farming, Panchgavya

Introduction

Organic farming is a holistic production management system which promotes and enhances agro-ecosystem health including biodiversity, biological cycles and soil biological activity and this is accomplished by using on farm agronomic, biological and mechanical methods in exclusion of all synthetic off farm inputs (Codex, 2007^[5]; FAO, 2012^[8]). It emphasizes the use of management practices in preference to the use of off farm inputs, taking into account that regional conditions require locally adapted systems. Organic farming refers to the way of agricultural products (food and fiber) are grown and processed. It excludes the use of chemical fertilizers and pesticides, plant growth regulators, and livestock feed additives. Genetically modified organisms (GMOs) are not allowed in organic farming. As far as possible, organic farmers depend on crop rotation, green manures, compost, mulching, biological pest control and mechanical cultivation to maintain productive soil and control pests (Diver, 2000^[7]). In the case of livestock, antibiotics are forbidden and instead preventative measures for keeping animals healthy and productive are used.

Management Principles

Organic farming management is an integrated approach, where all aspects of farming systems are interlinked with each other and work for each other. A healthy biologically active soil is the source of crop nutrition, on-farm biodiversity, controls pests, crop rotation and multiple cropping maintains the system's health and on-farm resource management with integration of cattle ensure productivity and sustainability. Organic management stresses on optimization of resource use and productivity, rather than maximization of productivity and over exploitation of resources on the cost of resources meant for future generations. A living soil is the basis of organic farming. A live, healthy soil with proper cropping patterns, crop residue management and effective crop rotation can sustain optimum productivity over the years, without any loss in fertility. Organic farming envisages a comprehensive management approach to improve soil health, the ecosystem of the region and the quality of produce. It includes all agricultural systems that promote environmentally sound production of food and fibers. These systems take local soil fertility as a key to successful production by respecting the natural capacity of plants, animals and the landscape; they aim to optimize quality in all aspects of agriculture and environment. A living soil can be maintained by continuous incorporation of crop and weed biomass, use of animal dung, urine-based manures (FYM, NADEP, vermicompost),

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biofertilizers and bioenhancers, special liquid formulations (like vermiwash, compost tea, etc.) during a crop's duration.

Strategies

1. Soil Management

- A) Crop rotation:** Crop rotation involves planting different crop species at different times and locations on the same field. Rotating crops improve the tilth or structure of the soil. This practice reduces soil erosion and pest build up, promotes soil fertility and spreads out financial risk in case a crop fails. Crop rotations result in an increase in soil microbial activity which may increase nutrient availability and including phosphorus. Yields are usually 10 to 15% higher with the practice of crop rotation than monoculture (Frick and Johnson, 2006) ^[9].
- B) Cover Cropping:** A cover crop is any crop grown to provide a cover for the soil. They can be annual, biennial or perennial herbaceous plants grown in a pure or mixed

stand during all or part of the year. This practice helps loosen compacted soil through root growth, improves water filtration and prevents soil erosion by wind and water. Cover crops also help suppress weeds by keeping the sun from reaching weed seeds and reduce insect pests and diseases (VanTine and Verlinder, 2003) ^[19].

- C) Green manuring:** Green un-decomposed material used as manure. A cover crop that is tilled into the soil while it is still green is referred to as a green manure. It helps to add organic matter and nutrients to the soil. When a green plant is incorporated into the soil, it contains high amounts of nitrogen and moisture and becomes a food source. It is obtained in two ways: By growing green manure crops or by collecting green leaf (along with twigs) from plants grown in wastelands, field bunds and forest. Addition of this improves soil structure, increases water holding capacity and decreases soil loss by erosion.

Table 1: Biomass production and N accumulation of green manure crops

S. No	Crop	Age (Days)	Dry matter (t/ha)	N accumulated
1.	Sesbania aculeata	60	23.2	133
2.	Sunnhemp	60	30.6	134
3.	Cow pea	60	23.2	74
4.	Pillipesara	60	25.0	102
5.	Cluster bean	50	03.2	91
6.	Sesbania rostrata	50	05.0	96

- D) Green leaf manuring:** Application of green leaves and twigs of trees, shrubs and herbs collected from elsewhere. The important plant species are - Neem, Mahua, Wild indigo, Glyricidia, Karanji (*Pongamia glabra*) calotropis, avise (*Sesbania grandiflora*), subabul and other shrubs. It improves soil structure, increases water holding capacity and decreases soil loss by erosion, reduces weed proliferation and weed growth, helps in reclamation of alkaline soils and root knot nematodes can be controlled.
- E) Animal manures:** Manure can be applied to the field in either a raw or composted form. Raw manure contributes nutrients to the soil, adds organic matter and encourages biological processes in the soil. Composting of manure is best, since the heat created during composting may kill most of the contaminants, thus the risk of pathogens related to food safety is minimized or eliminated. Farmers should have the soil tested before adding either raw or composted manures (VanTine and Verlinder, 2003) ^[19]. Composting reduces biomass volume thus facilitating ease of transportation. For organic certification, manure from factory animal production units will not be permitted. USDA standards require a 90-120 day period from the time manure is applied to the time of harvest (Birnbaum, 2003) ^[4].

- F) Mulching:** Covering the ground with a layer of loose material such as compost, manure, straw, dry grass, leaves or crop residues. It reduces moisture loss and conserves water, improves soil structure, reduces soil temperature, reduces or stops weed growth, reduces soil compaction, provides essential nutrients needed for good plant growth, protects plants from the cold when applied in the fall, provides a clean and pleasant surface for caring for plants and harvesting fruits. Mulching can be done at almost any time of the year (Best in June - July, for winter protection - November). Straw, hay, wood chips, ground bark, sawdust, leaves, grass clippings, and pine needles are common mulching materials. These should be applied to a depth of 5 to 15 cm and cover the ground around a plant out to the drip line. Rehman *et al.* (2015) ^[15] studied the effect of different mulching materials on fruit size and yield of Strawberry and found that straw dust gave maximum fruit size and yield. The response of soil covers on guava cv. Sardar was studied by Das *et al.*, (2010) ^[6] and the results showed that among organic and inorganic mulches used, paddy straw was found to be effective to improve the fruit quality of guava.

Table 2: Recommendations for specific fruit crops

Fruits	Mulching Material	Time
Strawberries	Straw or pine needles	Mid November
Raspberries	Hay or straw mulch	June
Blueberries	Wood chips or partially composted sawdust	Every year
Apples, pears, peaches, plums and cherries	Straw or hay	May

- G) Composting:** It is a process of producing compost through aerobic decomposition of biodegradable organic matter. Compost is well decomposed organic wastes like plant residues, animal dung, and urine from cattle sheds, waste fodder etc. It increases organic matter in the soil

which improves maximum yield potential, offers slow release of major crop nutrients including phosphate, potash, magnesium and sulphur, improves soil structure for better workability and better crop establishment, increases water infiltration and retention and the organic

action of compost can help to inhibit pests and diseases within the soil and also easy and safe to apply as a product.

Some improved manures (Anon., 2012) ^[2]

- Microbially enriched compost
- Phosphate rich compost
- Phospho-potassic compost
- Nitro-phospho-sulfo compost
- Concentrated manures
- Mineral rock fortified EM compost
- Micro-nutrient fortified compost

Organic Inputs for Microbial Composting

NSDL: It is a consortium of beneficial microbes and their nutrients which enhances the rate of conversion of bio-waste to compost very fast (*Organic Inputs from Morarka group for certified organic production as per USDA, European Union and NPOP Norms*). Kaur *et al.* (2007) ^[10] conducted experiment to study the effect of organic manures on growth and yield of litchi cv. Rose Scented and concluded that FYM @ 100 kg/tree significantly increased tree spread, stem girth, panicle length and fruit yield and also reduced cracking of fruits.

H) Vermicomposting: It is a biological process in which earth worms convert organic matter and dung into manure in optimum environment. The manure prepared is vermicompost. It is rich in essential plant nutrients, provides excellent effect on over all plant growth, free flowing, easy to apply, handle, store and do not have bad odour, it improves soil structure, texture, aeration and water holding capacity and prevents soil erosion, rich in beneficial microflora, it minimizes the incidence of pests and enhances the decomposition of organic matter in soil.

Earthworm species: *Eisenia fetida*, *Eudrilus eugeniae*, *Perionyx excavatus*. Effect of different doses of vermicompost on days taken for flowering, yield attributing characters and total fruit yield of 'Chandler' strawberry was studied by Singh *et al.* (2005) ^[18] and was observed that the Vermicompost @ 10 t/ha was effective than other doses and control. Kumar and Kumar (2014) ^[12] studied the response of different organic manures on post-harvest quality of mango cv. Dashehari and reported that among these treatments, maximum TSS, titrable acidity and ascorbic acid content of fruits were observed with application of 75 kg vermicompost per tree. Study on comparative efficacy of bioorganic nutrients on plant growth, leaf nutrient contents and fruit quality attributes of kiwi fruit was conducted by Khachi *et al.* (2015) ^[11] and showed that with use of various sources of bio-organic materials under organic farming regime, there will be sufficient improvement in fruit quality and plant nutrient contents.

I) Weed management:

- Soil tillage.
- Balanced fertilization.
- Mechanical control - Manual weeding, Flame and Steam weeding.
- Soil solarization and fumigation.
- Organic mulches and raw manures.
- Higher seed rate, narrow spacing, crop rotation and intercropping etc.

- Use of bio-control agents (*Parthenium sp.* is controlled by *Zygogramma bicolorata* - Maxican beetle).
- Use of vinegar, pelargonate.
- Growing of weed tolerant crop species.
- Bio Herbicide – Corn gluten meal.
- Burn down chemical – Pelargonic acid.

McLean (2003) ^[13] conducted an experiment on evaluation of 4 rates of Eucalyptus mulch for weed control in a 'Tahitian' lime orchard and results showed that an increasing in mulch rate resulted in decrease in weed dry weight.

2. Plant Nutrition

A) Liquid Manures

- Foliar Spray:** Vermiwash, Cow urine, Panchagavya, Biosol, BD 500, BD 501, Protein hydrolysates, Botanical extracts, Fermented plant extracts, Sea weed extracts etc.
- Soil Enrichment:** Many variants of liquid manures (Sanjivak, Jeevamrat, Amritpani, Panchagavya, Dashagavya etc.) are being used by farmers of different states. Few important and widely used formulations are given below:

a) Panchagavya: Organic liquid fertilizer prepared using Ayurvedic formulation. The ingredients used are cow urine, cow dung, cow ghee, cow milk, cow curd, prepared over a period of 34 days. It increases resistance against pests and diseases and nematodes, microbial population of soil will be increased and reduces evaporation loss and enhances water use efficiency. Panchgavya contains many useful microorganisms such as fungi, bacteria, actinomycetes and various micronutrients. The formulation act as tonic to enrich the soil, induce plant vigour with quality production. Strength of various microorganisms detected in panchgavya is as follows:

- Total fungi 38,800/ml.
- Total bacteria 1,880,000/ml.
- Lactobacillus 2,260,000/ml.
- Total anaerobes 10,000/ml.
- Acid formers 360/ml.
- Methanogens 250/ml.

Physico-chemical studies have revealed that panchgavya possess almost all macro and micronutrients and growth hormones (IAA, GA) required for plant growth. Predominance of fermentative microorganisms such as yeasts and Lactobacillus helps improve the soil biological activity and promote the growth of other microorganisms. For foliar spray 3-4% panchgavya solution is quite effective. Four to five sprays ensure optimum growth and productivity: (a) two sprays before flowering at 15 days interval, (b) two sprays during flowering and pod setting at 10 days interval and (c) one spray during fruit/pod maturation. Application of panchgavya has been found to be very effective in many horticultural crops such as mango, guava, acid lime, banana, spice turmeric, flower-jasmine, medicinal plants like coleus, ashwagandha, vegetable like cucumber, spinach, okra, radish and grain crops such as maize, green gram and sunflower. Panchgavya has also been found to be reducing nematode problem in terms of gall index and soil nematode population. As due to application of panchgavya a thin oily film is formed on the leaves and stems, it reduces evaporation losses and ensures better utilization of applied water. Vermiwash is one of the effective liquid manures which acts as pesticide, disease curative and crop tonic and increase the yield of crops

in multiples. It has been tested against indigenous and Hapus mango fruit productivity in Kolhapur region of Maharashtra, India and increased fruit productivity and also reduced the incidence of insect-pests, bacterial and fungal diseases compared to control (Sathe and Patil, 2014).

Mix fresh cow dung 5 kg., cow urine 3 lit., cow milk 2 lit., curd 2 lit., cow butter oil 1 kg and ferment for 7 days with twice stirring per day. Dilute 3 lit of Panchgavya in 100 lit. of water and spray over soil. 20 lit. panchgavya is needed per acre for soil application along with irrigation water.

b) Enriched Panchgavya (Dashagavya) – Ingredients - cow dung 5 kg., cow urine 3 lit., cow milk 2 lit., curd 2 lit., cow deshi ghee 1 kg., sugarcane juice 3 lit., tender coconut water 3 lit., banana paste of 12 fruits and toddy or grape juice 2 lits. Mix cow dung and ghee in a container and ferment for 3 days with intermittent stirring. Add rest of the ingredients on the fourth day and ferment for 15 days with stirring twice daily. The formulation will be ready in 18 days. Sugarcane juice can be replaced with 500 g jaggery in 3 liter of water. In case of non-availability of toddy or grape juice 100g yeast powder mixed with 100 g jaggery and 2 liter of warm water can also be used. For foliar spray 3-4 lit. Panchgavya is diluted with 100 liter water. For soil application 50 lit panchgavya is sufficient for one ha. It can also be used for seed treatment.

c) Sanjivak – Mix 100 kg cow dung, 100 lit cow urine and 500 g jaggary in 300 lit of water in a 500-lit closed drum. Ferment for 10 days. Dilute with 20 times water and sprinkle in one acre either as soil spray or along with irrigation water.

d) Jivamrat – Mix cow dung 10 kg., cow urine 10 lit., Jaggary 2 kg., any pulse grain flour 2 kg. and Live forest soil 1 kg in 200 lit. of water. Ferment for 5 to 7 days. Stir the solution regularly three times a day. Use in one acre with irrigation water.

e) Amritpani - Mix 10 kg cow dung with 500 g honey and mix thoroughly to form a creamy paste. Add 250 g of cow desi ghee and mix at high speed. Dilute with 200 lit. of water. Sprinkle this suspension in one acre over soil or with irrigation water. After 30 days apply second dose in between the row of plants or through irrigation water.

3. Biofertilizers: The preparations containing living or latent cells of microbes capable of transforming the unavailable form of naturally occurring nutrients in to a form which can be easily assimilated by the plants. It can replace 20 – 50 % of chemical fertilizer N and 15 – 25 % of phosphatic fertilizers, they are cheap and highly cost effective, activates soil biologically and increasing natural fertility of soil and do not cause any harmful effect on soil and environment.

Table 3: Contribution of different biofertilizers in crop production

Biofertilizer	Nutrient fixation (Kg/ha)	% yield increase	Crop
A. Nitrogen fixing			
Rhizobium spp.	50-200	15-30	Leguminous crop
Azotobacter	20-30	5-20	Fruits & vegetables
Acetobacter	10-25	10	Fruits & vegetables
Azospirillum	10-20	5-20	Vegetables
Blue Green Algae (BGA)	10-40	5-20	Fruits
Azolla	20-30	25-30	All crops
B. Phosphate supplying (P₂O₅)			
Phosphate Solubilizing Micro-organism (PSM)	20-50		All crops
Phosphate Mobilizing Microbes-Mycorrhiza (VAM)	10-30		All crops

(NCOF Ghaziabad, 2012)

Types of Biofertilizers

For nitrogen: *Rhizobium*, *Azotobacter*, *Azospirillum*, *Acetacter*, *Cynobacteria*.

For phosphorus: *Pseudomonas*, *Bacillus*, *VA Mycorrhiza*.

For potash: *Fraturia aurentia*.

APSA-80* (All-purpose sprays adjuvant concentrate): APSA - 80 is a type of adjuvant or wetter. It can be mixed with insecticides, herbicides, fungicides and foliar fertilizers to increase the potency and effectiveness without harmful effects on the environment. It increases water penetration thus helps in reducing evaporative water losses and run off, reduces the frequency of irrigation, also effective for pest, disease and weed management.

C. Plant protection and health

1. Preventive Measures

- Selection of adapted and resistant varieties.
- Selection of clean and certified seed and planting material.

- Use of suitable cropping systems (Diverse cropping systems, crop rotation, green manuring and cover crops).
- Use of balanced nutrient management.
- Input of organic matter.
- Compost can reduce disease problems due to the presence of microorganisms.
- Application of suitable soil cultivation methods.
- Use of good water management.
- Conservation and promotion of natural enemies.
- Selection of optimum planting time and spacing.
- Use of proper sanitation measures.

2. Curative crop protection methods:

- Biological control with natural predators or antagonistic microbes.
- Natural pesticides based on herbal preparations or other natural products.
- Mechanical control with traps or hand picking.

Natural enemies	Eco-friendly pesticides	Cultural methods
<ul style="list-style-type: none"> • <i>Goniozes nephentidis</i> against coconut BHC • <i>Cryptolemus mortuizeri</i> on Grape mealy bug • <i>Acerophagus papave</i> on Papaya mealy bug • <i>Crysoperla comea</i> on Aphids • <i>Trichogramma chilonis</i> on Borers • Spiders against <i>Helicoverpa armigera</i> • Ladybird beetles against <i>Aphis gossypi</i> • Parasitic nematode for <i>Mylonchulus minor</i> 	<ul style="list-style-type: none"> • Neem Seed Kernel Extracts against grasshoppers, leaf miners, white flies, mealy bugs, cut worm, diamond back moth, tobacco caterpillar, aphids and mites • Powdered neem leaves are effective against <i>Callosobruchus chinensis</i>. • Vegetable oils against stored pest • <i>Bacillus thuringensis</i> formulations against caterpillars, coleopterans and DBM • <i>Verticillium lecanii</i> against aphids, thrips, and white fly • Neemastra • Brahmastra • Agnevastra 	<ul style="list-style-type: none"> • Trap crops (Okra and Marigold) • Timely cultivation • Traps

3. **Biopesticides:** *Trichoderma viridae*, *Trichoderma harzianum*, *Pseudomonas fluorescence*, *Beauveria bassiana*, *Metarizium anisopliae*, *Numeria rileyi*, *Verticillium sp.*, *Bacillus thuringensis stenebrionis*, *Bacillus thuringensis sandigo*, *Granulosis Viruses (GV)*, *Nuclear Polyhedrosis Viruses (NPV)* etc.
 4. **Botanical pesticides:** Many organic farmers and NGOs have developed large number of innovative formulations (Neem, Cow urine, Fermented curd water, Dashaparni extract, Neem-Cow urine extract, Mixed leaves extracts, Chilli- Garlic extract, Datura, Olive Leaf Extract etc.) which are effectively used for control of various pests. Although none of these formulations have been subjected to scientific validation but their wide acceptance by farmers speak of their usefulness. Farmers can try these formulations, as they can be prepared on their own farm without the need of any purchases. Some of the popular formulations are listed below:
 - a) **Cow urine** – Cow urine diluted with water in ratio of 1: 20 and used as foliar spray is not only effective in the management of pathogens and insects but also acts as effective growth promoter for the crop.
 - b) **Fermented curd water** – In some parts of central India fermented curd water (butter milk or *Chaach*) is also being used for the management of white fly, jassids, aphids etc.
 - c) **Dashparni extract** – Crush Neem leaves 5 kg, *Vitex negundo* leaves 2 kg., *Aristolochia* leaves 2 kg., papaya (*Carica Papaya*) 2 kg., *Tinospora cordifolia* leaves 2 kg., *Annona squamosa* (Custard apple) leaves 2 kg., *Pongamia pinnata* (Karanja) leaves 2 kg., *Ricinus communis* (Castor) leaves 2 kg., *Nerium indicum* 2 kg., *Calotropis procera* leaves 2 kg., Green chilli paste 2 kg., Garlic paste 250 g, Cow dung 3 kg. and Cow urine 5 lit. in 200 lit. of water ferment for one month. Shake regularly three times a day. Extract after crushing and filtering. The extract can be stored up to 6 months and is sufficient for one acre.
 - d) **Neem-Cow urine extract** - Crush 5 kg Neem leaves in water, add 5lit. of cow urine and 2 kg cow dung, ferment for 24 hrs with intermittent stirring, filter squeeze the extract and dilute to 100 lits., Use as foliar spray over one acre. Useful against sucking pests and mealy bugs.
 - e) **Mixed leaves extract** - Crush 3 kg Neem leaves in 10 lits. cowurine. Crush 2 kg custard apple leaf, 2 kg papaya leaf, 2kg pomegranate leaves, 2 kg guava leaves in water. Mix the two and boil 5 times at some interval till it becomes half. Keep for 24hrs, then filter squeeze the extract. This can be stored in bottles for 6 months. Dilute 2-2.5 lits. of this extract to 100 lit for 1 acre. Useful against sucking pest and pod/fruit borers.
 - f) **Chilli-garlic extract** - Crush 1 kg. Ipomea (besharam) leaves, 500 g hot chilli, 500 g garlic and 5 kg. Neem leaves in 10 lits. of cow urine. Boil the suspension 5 times till it becomes half. Filter squeeze the extract. Store in glass or plastic bottles. 2-3 lits. extract diluted to 100 lits. is used for one acre. Useful against leaf roller and stem/fruit/pod borer.
 - g) **Broad spectrum formulation** –
 1. In a copper container mix 3 kgs. fresh crushed Neem leaves and 1 kg Neem seed kernel powder with 10 lits. of cow urine. Seal the container and allow the suspension to ferment for 10 days. After 10 days boil the suspension, till the volume is reduced to half. Ground 500 g green chillies in 1 lit of water and keep overnight. In another container crush 250g of garlic in water and keep overnight. Next day mix the boiled extract, chilli extract and garlic extract. Mix thoroughly and filter. This is a broad spectrum pesticide and can be used on all crops against wide variety of insects. Use 250 ml of this concentrate in 15 lits. of water for spray.
 2. Suspend 5 kg Neem seed kernel powder, 1kg Karanj seed powder, 5 kgs. chopped leaves of besharam (*Ipomea sp.*) and 5kgs. chopped Neem leaves in a 20lit drum. Add 10-12 lit of cow urine and fill the drum with water to make 150 lit. Seal the drum and allow it to ferment for 8-10 days. After 8 days, mix the contents and distil in a distiller. Distillate will act as a good pesticide and growth promoter. Distillate obtained from 150 lits. liquid will be sufficient for one acre. Dilute in appropriate proportion and use as foliar spray. Distillate can be kept for few months without any loss in characteristics.
- Organic farming methods most commonly being adapted in fruit crops**
- Biodynamic farming

- Homa farming
- Glora biosol

Biodynamic farming: It involves certain principles and practices for healthy soil, plant and food for human beings and feed for animals. In this system, energies from *cosmos, earth, cow and plants are systematically and synergistically* harnessed. In this system, 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 better shelf life and also ecofriendly.

Biodynamic Preparations

- BD 500 (Cow Horn manure)
- BD 501 (Cow Horn Silica)
- BD liquid manures and pesticides
- Vermicompost
- Vermiwash
- Nadep compost

Biodynamic formulation-500 (BD-500): As per the established norms of biodynamic process while cow dung is full of astral and ethereal powers; the cow-horn shell has the potential to absorb astral powers. In this formulation the inherent potential of these two components is harvested in making a biologically active formulation. Mix 30 g of BD-500 in about 13 lits. of rain or fresh tube well water. Stir the solution with hand for one hour. Apply this suspension with the help of Knapsac sprayer on soil surface or as foliar spray. The best time of application is close to sunset. BD-500 application encourage the growth of beneficial microorganisms and earthworms, promote rooting process and harvest terrestrial forces for better crop growth and increased biological activity in the soil.

Biodynamic formulation 501 (BD-501): In this formulation fine powder of quartz silica is filled in empty cow-horn shells and kept buried in soil for six months during hot summer season. Opposed to BD-500, the silica filled horns are buried during March-April (*Chaitra Navratra*) and taken out during Oct.-Nov. (*Kwar Navratra*). BD-501 is used as foliar spray and is known to be promoting photosynthetic activity of the plants, resulting into better growth of the plants and better quality of grains and fruits. 1g BD-501 is sufficient for one acre. Mix 1g BD-501 in 13 lits. of water and mix by whirling for one hour. Apply this suspension in the field as fine mist spray. BD-501 should be applied in early morning hours when there is mild breeze. BD-501 is to be applied first at 3-4 leaf stage followed by two more application at an interval of 30 days. BD-501 also acts as prophylactic agent and helps in prevention of many fungal diseases such mildews and blights. Package of practice for organic/ biodynamic production for fruit crops (Pathak and Ram, 2008) ^[14]

Nutrient Management

- Application of organic manures (10-20 kg/tree) through NADEP, vermicompost, biodynamic compost (BD) or microbe mediated compost (MM) in descending moon period.
- Growing of legume for green manuring or as inter/ cover crops as per requirement as per moon constellation.
- Mulching after application of 100g CPP, spray of cow horn manure (BD 500) and release of earthworm in

presence of proper moisture as per calander.

- Need based foliar spraying of biodynamic liquid manure/ vermi wash/ cow pat pit (CPP) in ascending moon phase.

Pest management

- Spraying of biodynamic pesticide prepared from cow urine, neem, karanj (*Pongamia glabra*), Caliotropis, castor, *Thevtia nerrifolia*, Vitex spp. leaves.
- Nettle leaves extract sprays to control hard pests.

Disease management

- Two spray of cow horn silica (BD-501) at flowering and fruit development stage.
- Biodynamic tree paste/ cow dung paste for the control of gummosis and dieback.
- Spraying of horsetail (*Equisetum arvensis*)/ casuarina leaves extract for the control of fungal disease in ascending moon period.

Homa organic farming

It is the process of purification of the atmosphere through the agency of fire tuned to the specific biorhythm of sunrise/sunset. It came from the ancient most Vedic sciences of Bioenergy, Medicine, Agriculture and Climate Engineering.

Agnihotra materials:

- Copper pyramid of fixed size
- Ingredients (dried cow dung, cow's ghee, brown rice)
- Mantra (vibrations)
- Timesheet exact to the second of sunrise/sunset

Benefits of homa therapy in horticulture: Increases production in quantity and quality, reduces cost of labour to apply agrochemicals, improvement in taste, size, texture and nutrition and prolongs the shelf life and makes them fitter for export.

Benefits of Homa therapy in our lives: It improves our physical, emotional and mental health, we can live in a healthy environment (water, soil, plants and animals), we can live in harmony with nature, gives contamination free environment and minimum monthly expenses.

Agnihotra Products

Agnihotra ash: Before planting/sowing, seeds and bulbs are impregnated with a mixture of Agnihotra ash and cow urine. This strengthens the germinating plant and makes it more resistant to pests.

Gloria biosol: It is a very effective bio-fertilizer which can be produced in a homa atmosphere. Biosol liquid can be used for foliar application to nourish plants and soil. It is superior to Vermiwash as it contains high number of beneficial microorganisms and energy of Homa process. The research conducted by Anon. (2010) ^[1], on mango variety Haden, lemon variety Sutil and banana variety Isla showed that the yield has been drastically increased with Homa farming compared to conventional farming.

Fruits Processing

General principles - Organic products shall be protected from comingling with nonorganic products, and shall be adequately identified through the whole process. Certification programme shall regulate the means and measures to be allowed or recommended for decontamination, clearing or

disinfection of all facilities where organic products are kept, handled, processed or stored. Besides storage at ambient temperature, the following special conditions of storage are permitted.

Controlled atmosphere, cooling, freezing, drying and humidity regulation

Pest and disease control: For pest management and control following measures shall be used in order of priority. Preventive methods such as disruption and elimination of habitat and access to facilities. Other methods of pest control are: Mechanical, physical and biological methods Permitted pesticidal substances as per the standards and other substances used in traps. Irradiation is prohibited. Direct or indirect contact between organic products and prohibited substances (such as pesticides) should not be there.

Packaging: Material used for packaging shall be ecofriendly. Unnecessary packaging material should be avoided. Recycling and reusable systems should be used. Packaging material should be biodegradable. Material used for packaging shall not contaminate the food.

Labelling: When the full standard requirements are met, the product can be sold as "Organic". On proper certification by certification agency "India Organic" logo can also be used on the product.

Storage and transport: Products integrity should be maintained during storage and transportation of organic products. Organic products must be protected from comingling with nonorganic products and must be protected all times from contact with the materials and substances not permitted for use in organic farming.

Natural Preservatives: Neem Oil, Salt, Sugar, Lemon, Honey, Bee Propolis, Rosemary extract, Grapefruit seed extract, Citric acid, Alpha tocopherol, Potassium sorbate etc.

Edible Coatings and Films: Apple wraps, Cellulose-based coating, Nature seal (NS), Chitosan coatings, Corn-zein coatings, Mineral oil based coatings, Wax coatings (Paraffin and Bee wax), Milk Protein Coatings, Whey Protein Coatings, Casein coatings, Semperfresh, Aloe vera Gel etc. Sharmin *et al.* (2015)^[17] studied the shelf life enhancement of Papaya with *Aloe vera* gel coating at ambient temperature and observed that 1.5% *Aloe vera* gel coating extended the shelf-life of papaya upto 15 days compared to that of 0.5%, 1% *Aloe vera* gel coating and control.

Organic Certification in India

- National Programme for Organic Production (NPOP) aims to promote sustainable production, environmental conservation, reduction in the use and import of agrochemicals, the promotion of export and rural development (FAO, 2012)^[8].
- The certification is issued by testing centres accredited by the Agricultural and Processed Food Products Export Development Authority (APEDA, 2013)^[3] under the *National Program for Organic Production* of the government of India.
- Export of organic products was brought under government regulation, while imports and the domestic markets were not.
- INDOCERT- India's first local organic certification body.

India has 6 accreditation agencies for certification of organic products:

- APEDA.
- Tea Board.
- Coffee Board.
- Spices Board.
- Coconut Development Board.
- Directorate of Cashew and Cocoa Board.

Organizations promoting organic fruit production:

- International Federation of Organic Agriculture Movement (IFOAM).
- The Soil Association Certification Ltd (SAC) UK.
- The United Kingdom Register of Organic Food Standards (UKROFS).
- The California Certified Organic Farmers (CCOF) USA.
- Demeter Bund, E. V., Germany.
- SKAL, Zwolle, The Netherlands.
- Bio Suisse, Switzerland.
- Institute of Market ecology (IMO), Switzerland.

Major constrains in organic certification:

- High certification costs.
- Lack of support during conversion period.
- Availability and cost issues of organic inputs.
- Infrastructure constraints.
- Lack of research & development.
- Lack of structured domestic distribution channel.

Strategies and recommendations:

A. Focus on value added organic export

- Focus on specific varieties to maximize organic premiums at the farm level
- Direct deal with buyers

B. Incentives and promotional support

- Certification support.
- Support for inconversion organic farms.
- Awareness and training programmes.
- Support for production of organic agri inputs.

C. Creation of a Nodal Agency

- Creation of an organic market and knowledge repository.
- Awareness building.

Benefits of organic farming:

- Sustainable agricultural production system.
- Reduces the risk of crop failure.
- Reduces the cost of production and improves the soil health.
- It improves the soil physical and chemical properties.
- Reduces human and animal health hazards.
- Ensure optimum utilization of natural resources.
- Maintaining environmental health.

Future Strategies

- Emphasis should be given to organic farming research in fruit crops.
- Development of organic farming systems with diversified crops and enterprises.
- Integration of different supporting agencies.
- More effective ways of converting organic wastes into manures are to be evolved.

- Information on economic viability of organic farming system should be elucidated.
- Promotion of biofertilizers and biopesticides.
- Dependable marketing infrastructure for organically grown produce.
- Demonstrations for spreading the concept and technologies of organic farming.
- Popularize organic farming without compulsion of certification.

We need to focus on improving our resources and sustain it for next generation it could only be possible with organic farming. We lose everything - soil, resources, yield and health from poisonous chemicals. Organic farming looks difficult initially but economically feasible. Export of organic products leads to farmer income three folds. Input cost is minimized. Profit margin can increase by two folds as compared to chemical farming.

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