ORGANIC VEGETABLES SEED PRODUCTION: A REVIEW

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ABSTRACT

Organic seeds are seeds which have been produced entirely through organic practices by a certified organic operation. In order to be sold as such, they must be produced by such a facility which has been certified by an accredited government agency. Organic seed is seed (planting material) produced by a crop that is planted and raised organically for at least one generation in the case of annual crops, and two generation in the case of biennial and perennial crops. Organic Farming has the twin objective of the system sustainable and environmentally sensitive. To achieve the objectives of organic farming, there is need to develop some rules and standards. With ever increasing population having huge requirements of vegetables and meager availability of organic resources, pure organic farming in India, requires some specific area and vegetable crops having high potential in national markets that can be diverted to organic farming for high quality produce. For Indian Agriculture, use of chemical fertilizers cannot be totally eliminated, rather can be reduced, or minimized. It has also been proved by various experiments that by conjoint application of inorganic fertilizers along with various organic sources are capable of sustaining higher crop productivity, improving soil quality and soil productivity.

KEY WORDS: Organic, seed production, vegetables

INTRODUCTION

Organic agriculture is derived as a production system which largely excludes or completely avoids the use of synthetically compounded pesticides, fertilizers, growth regulators, preservatives and livestock feed additives. Organic agriculture practices, thus, relay upon recycling of crop residues, animal manures, off-farm organic residues and wastes, biofertilizers, exploitation of native soil fertility, non-pesticidal methods of pest control and weed management. Organic agriculture is gaining movement in India due to the individual as well as group efforts to conserve environment and avoid contamination of farm produce from the use of chemical fertilizers and pesticides. The important view of organic food movement that promotes ecological soundness and sustainable use of natural resources also helps in maintenance of crop diversity.

The concept of organic farming is based on following principles

- Nature is the best role model for farming, since it does not use any inputs nor demand unreasonable quantities of water.
- The entire system is based on intimate understanding of nature's ways. The system does not believe in mining of the soil of its nutrients and do not degrade it in any way for today's needs.
- The soil in this system is a living entity.

- The soil's living population of microbes and other organisms are significant contributors to its fertility on a sustained basis and must be protected and nurtured at all cost.
- The total environment of the soil, from soil structure to soil cover is more important.

In today's terminology, it is a method of farming system which primarily aims at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (bio-fertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment.

In philosophical terms organic farming means "Farming in spirits of organic relationship". In this system everything is connected with everything else. Since organic farming means placing farming on integral relationship, we should be well aware about the relationship between the soil, water and plants, between soil-soil microbes and waste products, between the vegetable kingdom and the animal kingdom of which the apex animal is the human being, between agriculture and forestry, between soil, water and atmosphere etc. It is the totality of these relationships that is the bed rock of organic farming.

Seed

A seed is the fertilized matured ovule containing an embryo enclosed in a protective outer covering called the seed coat, usually with some stored food.

It is a characteristic of spermatophytes (gymnosperm and angiosperm plants) and the product of the ripened ovule which occurs after fertilization and some growth within the mother plant. The formation of the seed completes the process of reproduction in seed plants (started with the development of flowers and pollination), with the embryo developed from the zygote and the seed coat from the integuments of the ovule.

Organic seed

In the Organic Foods Production Act of 1990, the definition of an organic agricultural product is given as, "produced and handled without the use of synthetic chemicals." Also, "not produced on land on which any prohibited substances, including synthetic chemicals, have been applied during the three years immediately preceding harvest of the agricultural products." Organic seeds, therefore, are seeds which have been produced entirely through organic practices by a certified organic operation. In order to be sold as such, they must be produced by such a facility which has been certified by an accredited government agency. Organic seed is seed (planting material) produced by a crop that is planted and raised organically for at least one generation in the case of annual crops, and two generation in the case of biennial and perennial crops (Lammerts van Bueren, 2002). It is naturally that organic seeds are obtained by purchasing conventional non-treated seeds (C_1), which are grown organically for one season and then sold on to organic farmers as organic seeds (C_2). Lammerts van Bueren (2002) nominated the main problems in organic seed production.

1. Market problems are related to the limited area of organic agriculture and thus of the area of seed production per variety resulting in higher cost compared to conventional seed production. This will imply that the organic

assortment of varieties per crop will be limited.

2. Technical problems have to do with the lack of experience of the formal sector with organic seed production without chemical inputs.
3. Problems with quality standards. The main problems are: disease and pest management, and weed control. Among the diseases, the seed-borne diseases require special attention.

Organic seed production and distribution in European countries is presently a multibillion dollar business and at a great momentum with creation of organic seed producers and distributors database for European Union (EU). Presently organic seed production in India is mainly done by private company, which is highly valuable in global market. Organic seed production taken in crops like tomato, brinjal, okra, capsicum, bottle gourd, cucumber beans, cowpea, pumpkin, amaranth and lettuce.

Need for organic seed production

Why buy organic seeds?

- ✓ Because seed crops are heavy users of synthetic agricultural chemicals (they are in the ground longer and have less chemical restrictions than food crops).
- ✓ Because seed produced organically will yield plants that are more adapted to, and more likely to thrive under, organic growing conditions.
- ✓ Because increased demand will lead to an increase in variety selection and development, and increased availability of more organic seed.

✓ High Mowing Organic Seeds is committed to providing the highest quality, 100 per cent organic seed to growers. When you buy organic seed, you have the assurance that the seed was grown without synthetic chemicals and you are supporting farms and companies that are committed to organic agriculture with your purchase. There are much better ways to improve agriculture than genetic engineering and increasing chemical inputs, and to focus on "true progress" that leads to greater health for soils, farms and communities.

Organic seed is better for the environment

The importance of organic seed is often overshadowed by the importance of organic food; since food goes directly into our bodies, the methods by which it was produced feel more pertinent than the methods by which seed is produced. But whether or not seed crops are grown organically does have a significant impact on the environment and health of the surrounding communities. As the Organic Seed Growers and Trade Association asks: "Is it fair for those of us in organic agriculture to want our own farms and environments to be as free of toxins as possible, but expect seed production communities to carry a heavy toxic load so that we can plant cheap conventional seed?"

Organic seed is better suited to organic growing conditions

In the last 50 years, the majority of breeding work and development of new varieties has been done with conventional farming practices in mind. For example, in a conventional system, plants receive infusions of fertilizer delivered directly to the roots and are sprayed with a range of chemicals to protect from pests and diseases. While some conventional breeding programmes, do consider flavour, more often selections are based on traits like how fast it grows and how well it ships.

In organic farming systems, on the other hand, nutrients come from complex fertilizers such as compost, so plants need vigorous roots to seek out dispersed nutrients in the soil. Organic growers use less and milder applications for pest and disease protection, so plants are required to provide more of their own defense. In organic variety selection programmes, flavour and appearance consistently top the list of traits to evaluate. In recent years, more research has gone towards developing and evaluating varieties for organic farmers. High quality organic seed comes from varieties that have proven themselves under organic conditions.

Organic seed supports organic research

As more people use organic seed, the increased demand encourages more companies and universities to devote resources to research and development of organic varieties, and allows continued improvement of current organic varieties. When you buy organic seed, not only are you getting a "safe seed" and one that is grown in organic conditions like your own farm or garden, but you are supporting the future of organics. For more information about the benefits of organic seeds, watch the Organic Nation.tv's interview with Dr. John Navazio, "What's So Special about Organic Seeds". Dr. John Navazio, organic vegetable breeder, is responsible for several excellent varieties that we are proud to offer at High Mowing Organic Seeds.

The National Organic Programme (NOP) and NOSB have been asked to provide guidance concerning determinations of the commercial availability of organic seed made by accredited certifying agents (ACAs). The objective of this recommendation is to establish appropriate practices to be followed by certification applicants, certified operators, and ACAs for consistent, transparent, and predictable determinations of commercial availability that provide regulatory certainty.

In order to ensure consistent application of organic seed requirements, the NOSB recommends the following:

1. The establishment of a national database by an independent party to provide public access to current information on the availability of organic seed varieties. Producers using non-organic varieties not appearing on the database will need to provide justification for such use.
2. An organic variety is considered to be equivalent to a specific non-organic variety, if it meets the operation's required site-specific agronomic and marketing characteristics.
3. For an organic producer to receive an allowance to use non-organic seed or planting stock to produce a crop that can be sold or labelled "organic," the producer must provide records to the certifying agent as a part of the organic system plan demonstrating lack of "commercial availability."

Organic seed production

Organic seed production being a new challenging field needs experts and supplementary research activities in future to increase its quality and meet seed needs of farming communities.

Agronomic principles for organic seed production

A) Soil practices

Soil health is the foundation of organic seed production systems. Fertile soil provides essential nutrients to plants, while supporting a diverse and active biotic community that helps the soil resist environmental degradation. Organic producers face unique challenges in managing soil productivity.

Organic farmers rely on intuition and observation, advice from vendors, conventional soil tests, and their own experience to make decisions about the quantity and types of soil amendments to apply.

Methods used to build soils

Bare fallow

Bare fallow can be used with fallow periods occurring between harvested crops. Fallows commonly occur over the winter in temperate zones or during the dry season in Mediterranean or tropical zones. Use of bare fallow to accumulate water and, at times to control weeds only works to enhance the soil, where it concentrates resources enough to increase overall crop productivity. If bare fallow is used, soil erosion must be prevented.

Crop rotation varies plant species in time and space and is an important strategy for organic farmers. Goals are to keep the soil surface covered with a growing crop for most of the year. Key elements of rotations include the breaking of disease and pest cycles and the inclusion of soil building cover crops or cropped fallow periods.

Cover crops

Cover crops include annual, biennial, or perennial herbaceous plants grown in pure or mixed stands. Annual covers occupy the rotation for part of the year. Perennial crops may be referred to as lay or pasture phase or as a plant-fallow. Cover crops provide soil cover and can help loosen compacted soil through the growth of roots. They enhance soil physical condition and improved water filtration.

Judicious use of tillage

Tillage is an integral part of many organic systems. Management of soil tilth, organic matter, and fertility is an important aspect of a successful organic farming system. Current organic systems usually require tillage prior to planting and cultivation after planting, especially for corn and soybean production, to control weeds and reduce the incidence of seedling diseases and insect pests. However, tillage destroys the organic matter that is critical in improving soil fertility and soil water-holding capacity.

Organic amendments

Organic amendments can be an important resource. Soil fertility and physical condition can be effectively maintained with rotation and appropriate use of organic amendments. Application should be made based on soil testing and/or use of budgets.

B) Green manuring

These are annual fast growing crops, usually a legume combined with a grass, that are grown to build both organic matter and nitrogen levels to improve the soil. Green manures also provide living mulch that will protect soil from erosion and other weathering effects. Green manures usually perform multiple functions that include soil improvement and soil protection. Incorporation of green manures into a farming system can drastically reduce, if not eliminate, the need for additional products such as supplemental fertilizers and pesticides.

Limitations to consider in the use of green manure are time, energy, and resources (monetary and natural) required successfully growing and utilizing these cover crops. Consequently, it is important to choose green manure crops based on the growing region and annual precipitation amounts to ensure efficient growth and use of the cover crops.

C) Oil cake

After oil is extracted from oilseeds, the remaining solid portion is dried as cake, which can be used as manure. The oil cakes are of two types, a) Edible oil cakes, which can be safely fed to livestock; e.g. Groundnut cake, Coconut cake etc., and b) Non edible oil cakes, which are not fit for feeding livestock; e.g. Castor cake, Neem cake, Mahua cake etc. Both edible and non-edible oil cakes can be used as manures. However, edible oil cakes are fed to cattle and non-edible oil cakes are used as manures especially for horticultural crops. Nutrients present in oil cakes, after mineralization, are made available to crops 7 to 10 days after application. Oil cakes need to be well powdered before application for even distribution and quicker decomposition.

D) FYM

The farmyard manure seems to act directly by increasing the crop or seed yield either by accelerating the respiration process through cell permeability or by hormone growth action. It supply nitrogen, phosphorus and sulphur in available forms to the plants through biological decomposition. Indirectly, it improves the physical properties of soil such as aggregation, aeration, permeability and water holding capacity (Chandramohan, 2002).

The nutrient content of FYM varies with the constituents of FYM. The nutrient content of FYM in a study conducted by Sharma and Mitra (1989), who reported that FYM contained 26.1 per cent of C, 1.71 per cent of N, 0.24 per cent of P and 2.04 per cent of K on dry weight basis, the C:N ratio was 15:1 and the nutrients added from 2.5 t of FYM were 42.7, 5.9 and 51.1 kg N, P and K per ha., respectively. The FYM used in the trials of Sriramachandrasekharan *et al.* (1996) had 1.2 per cent N, 0.21 per cent P, 1.96 per cent K, and 26.90 per cent C with C: N ratio of 22.4:1.0.

E)Vermicompost

Organic matter, when subjected to decomposition with the help of earthworms, the resultant product is vermicompost and the process is known as vermicasting. The product is the result of organic waste consumed by earthworm, digested and excreted in the form of granules. Earthworms play a significant role in maintaining the soil productivity. Earthworms enhance the decomposition of organic matter and they also contribute 20-100 kg nitrogen per ha per year, besides other mineralized nutrients and plant growth factors. Earthworms help the growth of beneficial bacteria and actinomycetes by providing optimum conditions of temperature, moisture, aeration and phosphate. Vermicasting provides the vital macro elements such as N, P, K, Ca and Mg and micronutrients such as Fe, Mo, Zn, Cu etc. also acts as chelating agent and regulates the availability of metallic micronutrients to the plants. Vermicompost improves soil aeration, because they do not pack together when mixed in soil. This in turn promotes rapid plant growth. Earthworm castings improve the soil drainage, reducing waterlogged soil and root rot. The soil is water retention capacity also improves because vermicompost contains absorbent organic matter that hold only the necessary amounts of water needed by the roots.

The chemical analysis of vermicasts at Dharwad revealed that the per cent N, P_2O_5 and K_2O content was 0.8, 1.1 and 0.5, respectively (Giraddi, 1993). The vermicompost not only contains higher nitrate nitrogen at the start, but it also has greater nitrifying capacity than the corresponding soil. Nitrogen production from mucus, dead earthworm tissue and vermicasts amounted to 180 kg/ha per year.

F)Biofertilizer

Biofertilizers are defined as preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants' uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients.

Groups	Examples
N_2 Fixing Biofertilizers	
1. Free-living	*Azotobacter, Beijerinkia, Clostridium, Klebsiella, Anabaena, Nostoc,*
2. Symbiotoc	*Rhizobium, Frankia, Anabaena azollae*
3. Associative Symbiotic	*Azospirillum*
P Solubilizing Biofertilizers	
1. Bacteria	*Bacillus megaterium* var. *phosphaticum, Bacillus subtilis, Bacillus circulans, Pseudomonas striata*
2. Fungi	*Penicilliumsp., Aspergillusawamori*
P Mobilizing Biofertilizers	
1. Arbuscularmycorrhiza	*Glomussp.,Gigasporasp.,Acaulospora sp., Scutellospora sp.* & *Sclerocystis sp.*
2. Ectomycorrhiza	*Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.*
3. Ericoid mycorrhizae	*Pezizellaericae,*
4. Orchid mycorrhiza	*Rhizoctoniasolani*
Biofertilizers for Micro Nutrients	
1. Silicate and Zinc solubilizers	*Bacillus* sp.
Plant Growth Promoting *Rhizobacteria*	
1. Pseudomonas	*Pseudomonas fluorescens*

Organic certification

It is a certification process for producers of organic food and other organic agricultural products. In general, any business directly involved in food production can be certified, including seed suppliers, farmers, food processors, retailers and restaurants. Requirements vary from country to country, and generally involve a set of production standards for growing, storage, processing, packaging and shipping that include:

- ❖ Avoidance of synthetic chemical inputs (e.g. fertilizer, pesticides, antibiotics, food additives, etc) and genetically modified organisms;
- ❖ Use of farmland that has been free from chemicals for a number of years (often, three or more);
- ❖ Keeping detailed written production and sales records (audit trail);
- ❖ Maintaining strict physical separation of organic products from non-certified products;
- ❖ Undergoing periodic on-site inspections.

In some countries, certification is overseen by the government, and commercial use of the term *organic* is legally restricted. Certified organic producers are also subject to the same agricultural, food safety and other government regulations that apply to non-certified producers.

Purpose of certification

Organic certification addresses a growing worldwide demand for organic food. It is intended to assure quality and prevent fraud. For organic producers, certification identifies suppliers of products approved for use in certified operations. For consumers, "certified organic" serves as a product assurance, similar to "low fat","100% whole wheat", or "no artificial preservatives".

Certification is essentially aimed at regulating and facilitating the sale of organic products to consumers. Individual certification bodies have their own service marks, which can act as branding to consumers - a certifier may promote the high consumer recognition value of its logo as a marketing advantage to producers. Most certification bodies operate organic standards that meet the National government's minimum requirements.

The certification process

In order to certify a farm, the farmer is typically required to engage in a number of new activities, in addition to normal farming operations:

- **Study** the organic standards, which cover in specific detail what is and is not allowed for every aspect of farming, including storage, transport and sale.
- **Compliance** - farm facilities and production methods must comply with the standards, which may involve modifying facilities, sourcing and changing suppliers, etc.
- **Documentation** - extensive paperwork is required, detailing farm history and current set-up, and usually including results of soil and water tests.
- **Planning** - a written annual production plan must be submitted, detailing everything from seed to sale: seed sources, field and crop locations, fertilization and pest control activities, harvest methods, storage locations, etc.
- **Inspection** - annual on-farm inspections are required, with a physical tour, examination of records, and an oral interview.
- **Fee** – A fee is to be paid by the grower to the certification body for annual surveillance and for facilitating a mark which is acceptable in the market as symbol of quality.
- **Record-keeping** - written, day-to-day farming and marketing records, covering all activities, must be available for inspection at any time. In addition, short-notice or surprise inspections can be made, and specific tests (e.g. soil, water, plant tissue) may be requested.

For first-time farm certification, the soil must meet basic requirements of being free from use of prohibited substances (synthetic chemicals, etc) for a number of years. A conventional farm must adhere to organic standards for this period, often, three years. This is known as being in *transition*. Transitional crops are not considered fully organic. A farm already growing without chemicals may be certified without this delay. Certification for operations other than farms is similar. The focus is on ingredients and other inputs, and processing and handling conditions. A transport company would be required to detail the use and maintenance of its vehicles, storage facilities, containers, and so forth. A restaurant would have its premises inspected and its suppliers verified as certified organic.

Certification and product labeling

Being able to put the word "organic" on a food product is a valuable marketing advantage in today's consumer market. Certification is intended to protect consumers from misuse of the term, and make buying organics easy. However, the organic labelling made possible by certification itself usually requires explanation. In many countries organic legislation defines three levels of organics. Products made entirely with certified organic ingredients and methods can be labelled "100 per cent organic". Products with 95 per cent organic ingredients can use the word "organic". Both may also display organic seal. A third category, containing a minimum of 70 per cent organic ingredients, can be labelled "made with organic ingredients". In addition, products may also display the logo of the certification body that approved them. Products made with less than 70 per cent organic ingredients cannot advertise this information to consumers and can only mention this fact in the product's ingredient statement.

In India, Agricultural Processed Foods Export Development Authority (APEDA) under Ministry of Commerce is the controlling body for organic certification for export. Till date there are no domestic standards for organic produce within India. Currently 11 certification agencies have been authorized to undertake certification process under National Programme for Organic Production (NPOP). Although there is no system for monitoring the labeling of organic produce sold within India, this primarily affects the retail public. Commercial buyers for whom this is an issue have simply taken the export system as a de facto standard and are willing to pay premium prices for produce from growers certified under the NPOP. In 2006, India's organic certification process under NPOP has been granted equivalence with European Union. It has also been recognized for conformity assessment by USDA's NOP.

Certification and legislation of organic food in India

Certification is an important prerequisite for the acceptability of organic products or foods as organic by Government Regulatory Authorities, exporters, importers, as well as consumers across the world. To satisfy their requirement, a sound system of certification and labeling of the produce by a competent agency is highly essential. The organic certification is a procedure by which a third party between the producer and consumer gives written assurance that the product, process or service confirms to specific requirements. The farming unit for organic production has to be supervised and inspected at frequent intervals and at different stages of production before certification in order to ensure quality and authenticity.

The Certification Agency has to adopt very reliable methods such as soil tests, water tests, food quality tests and other natural quantitative indicators so as to ensure credibility of the system in order to prevent fraudulent labeling of the products. It is necessary to keep the records of all management practices and materials used in organic production for five years. The crops must be grown on the land, which has been free of prohibited substances for three years prior to harvest. Crops grown on land in transition to organic (during the last three years after switching from conventional farming) cannot be labeled as ***Organic***. Once the produce is certified as ***Organic***, the producer or the processors are entitled the symbol.

Worldwide, inspection and certification of organic foods is carried out on the basis of two largely overlapping sets of guidelines and norms namely, Statutory Certification Norms and the Voluntary/Civil Certification Norms. Generally the Voluntary/Civil Certification Norms are stricter than Statutory Certification Norms. Statutory Certification Norms are legal guidelines set by Government, which is related to certification of organic produce, regulatory governing import of organic foods, rules regarding equivalence between countries etc. On the other hand, various National and International forums and association such as Soil Association of UK, Organic Growers Association in various countries etc, set Voluntary/Civil Certification Norms. The most highly accepted voluntary certifications are from agencies like CODEX, IFOAM, Naturland, Demeter, Soil Association, etc.

In India, Statutory Certification Norms relating to organic foods regulates the organic exports only not the domestic organic food industries. Although in India, the External certification bodies have been introduced for inspection and certification programmes since 1987. But in March, 2000, the Ministry of Commerce launched the National Programme for Organic Production (NPOP), designed to establish national standards for organic products, which could then be sold under the logo '*India Organic'*. To ensure the implementation of NPOP, the National Accreditation Policy and Programme (NAPP) was formulated, with accreditation regulations announced in May 2001. These make it mandatory that all certification bodies, whether already engaged or proposing to engage in inspection and certification of organic crops and products, should be accredited by an accreditation agency. Foreign certification bodies operating in the country must also be accredited under the NAPP.

For Organic Certification Agency, International Federation of Organic Agriculture Movements (IFOAM), Germany has established the IFOAM Accreditations Programme. In India, IOAM (Indian Organic Agriculture Movement), a member of IFOAM, adopted the IFOAM International Standards, the basic production standards applicable under Indian condition were prepared, and farmers growing crops as per IOAM Standards are eligible to get the Certificate and the organic label. The farmers can sale the organic produce in the local as well as International markets on the basis of IOAM label.

The National Standard Committee has drafted both the concept and principles of basic standards of Organic Agriculture in 1996 in order to improve the socio economic condition of the farmers and also boost the International Trade.

At present in India, the following six authorized accreditation agencies has been approved by the Ministry of Commerce, Government of India. They are

1). APEDA (Agricultural & Processed Food Product Export Development Authority),
2). Coffee Board,
3). Spices Board,
4). Tea Board,
5). Coconut Development Board, and
6). Cocoa & Cashew nut Board.

In addition, there are four Certification Agencies accredited by APEDA such as

1). IMO Control Pvt. Ltd., Bangalore (Institute fur Marketecologie, Switzerland),
2).Skal International (The Netherlands), India, Bangalore,

3). SGS (Societe Generale de Surveillance, Switzerland) India Pvt. Ltd., Gurgaon and

4).ESCOCERT (Ecological Certification, France) International, Germany.

APEDA (Agricultural & Processed Food Product Export Development Authority) is an export promotion organization, involved in publicizing Indian Organic logo globally. Expo-Import Bank in association with APEDA is engaged in promotion of organic agriculture products by creating awareness through active participation in International Conferences. It has also engaged to identify exclusive Agri Export Zone (AEZ) for organic produce in some parts of country, such as organic pineapple in Tripura, where use of chemical fertilizers and pesticides is negligible.

National Programme for Organic Production (NPOP)

Organic products are grown under a system of agriculture without the use of chemical fertilizers and pesticides with an environmentally and socially responsible approach. This is a method of farming that works at grass root level preserving the reproductive and regenerative capacity of the soil, good plant nutrition, and sound soil management, produces nutritious food rich in vitality which has resistance to diseases.

India is bestowed with lot of potential to produce all varieties of organic products due to its various agro climatic regions. In several parts of the country, the inherited tradition of organic farming is an added advantage. This holds promise for the organic producers to tap the market which is growing steadily in the domestic market related to the export market.

Currently, India ranked 10th among the top ten countries in terms of cultivable land under organic certification. The certified area includes 10 per cent cultivable area with 0.50 million hectares and rest 90 per cent (4.71 million hectares) is forest and wild area for collection of minor forest produces. The total area under organic certification is **5.21 million hectares** (2012-13).

The Government of India has implemented the National Programme for Organic Production (NPOP). The national programme involves the accreditation programme for Certification Bodies, standards for organic production, promotion of organic farming etc. The NPOP standards for production and accreditation system have been recognized by European Commission and Switzerland as equivalent to their country standards. Similarly, USDA has recognized NPOP conformity assessment procedures of accreditation as equivalent to that of US. With these recognitions, Indian organic products duly certified by the accredited certification bodies of India are accepted by the importing countries.

National Standards for Organic Production (NSOP)

It has been formulated by Dept. of Commerce, Govt. of India for National Program for Organic Production (NPOP). Any production certified as per NSOP may use the term, *"Organic"*. A product can be labeled as, *"For Export only"* when it has been produced in India to an Organic Standard other than NSOP for example EU Regulations, IFOAM etc. Truthful label claims are allowed for domestically produced organic products that meet the NSOP and an International Organic Standards. Organic Certificates remained valid for one year/until the next decision is made. Organic Certification Standards invalid incase where you voluntarily or your certification is suspended by the Certification Agencies. The frequency of inspection is generally done once in a year. Additional inspections are conducted wherever found necessary. NSOP also formulated rules for misuse of the term, *"Organic"*. Any operation that knowingly sells per labels a product as, *"Organic"* except in accordance with the National Standards may be subject to a civil penalty.

India's first ever local Organic Certification Body, INDOCERT (Indian Organic Certification Agency), was established in March, 2002 with an objective to offer a reliable and affordable organic inspection and certification services to farmers, processors, input suppliers and traders. It is an independent, nationally operating nonprofit trust whose primary aim is in conducting inspections and granting certification for organic production methods. It provides certifications both for domestic as well as export market. INDOCERT also functions as a platform for training, awareness creation, information dissemination, and networking in the field of organic farming. It has been set up by a group of Indian NGO's and corporate organizations with the technical collaboration of FiBL, bio.inspecta, and the Swiss State Secretariat of Economic Affairs (SECO). INDOCERT has strong technical collaborations with two well reputed organizations from Switzerland: FiBL (Research Institute of Organic Agriculture) and bio.inspecta (the leading Swiss certification agency). Bio.inspecta assists INDOCERT for certification according to USDA national organic program (NOP) and JAS (Japanese Agricultural Standard for Organic Agriculture) through a re-certification procedure. It evaluates inputs used in organic production and confirms their compliance with the Indian National Organic Standards and the European Regulation EC 2092/91. Presently INDOCERT restricts its input approval scheme to fertilizers and soil conditioners and to inputs related to plant protection (pesticides, repellents etc). According to the year of production, INDOCERT label the products as organic as follows:

Crops	***Year Wise Label***			
	1st Year	2nd Year	3rd Year	4th Year
Annual	No label	In Conversion to Organic Agriculture	Certified Organic	Certified Organic
Perennials	No label	In Conversion to Organic Agriculture	In Conversion to Organic Agriculture	Certified Organic

- INDOCERT can provide applicants with sufficient information to enable the farmers to comply with the national standards. But it is prohibited from giving advice, or providing consultancy services to certification applicants or certified operations for the purpose of overcoming barriers to certification. In other words certification agents must explain the regulations but they cannot tell operators how to correct a noncompliance.
- . In order to improve extension works at the field level, INDOCERT is initiating the set up of an Indian Organic Advisors Association to provide technical advice for farmers, the association will function as a platform for advice, information

dissemination, and training in the field of Organic Agriculture.

Role of International Seed Testing Association (ISTA) in organic seed production

When buying seed for the organic seed/food production, the organic farmer wants to be assured that on one side the seed has been produced following principles for organic farming, and on the other side that it is of high quality, which is the precondition for a successful production process.

Seed quality determination

The quality of seed is determined in a seed testing laboratory at the end of the seed production process and before selling the seed to seed suppliers and farmers. The parameters are mainly the purity of the seed and the germination capacity of the seed, but also a wide range of other parameters can be evaluated in the seed testing laboratory. For organic production, two further aspects will clearly have major importance -the seed health of organically produced seed and the absence of genetically modified seeds.

ISTA for the determination of the quality of organically produced seed

For all these quality parameters (germination, purity, seed health, absence of genetically modified seed), ISTA has developed and is constantly improving suitable methods, which are published as the *International Rules for Seed Testing*. ISTA also monitors the use of the International Rules for Seed Testing through a unique quality assurance system for seed testing laboratories including a proficiency test programme and an audit programme. Therefore, by requesting ISTA International Seed Lot Certificates, the buyer of the seed can be assured that he receives true and reproducible results as to the quality of the seed on international level. The production process (organic or conventional) has no direct influence on the determination of the quality of the seed, meaning that ISTA International Seed Lot Certificates can be used for organic seed production. ISTA International Seed Lot Certificates are important for the determination of the quality of seed, no matter if seed is produced in a conventional or organic process.

ISTA can support in the production of high quality organic seed

ISTA wants to support the production of organic seed. The production of high quality organic seed may bring new challenges also for the methods for determining the quality of the seed. New methods may be required (e.g. for seed health testing). With 17 Internationally represented Technical Committees, ISTA has a unique pool of more than 250 experienced scientists and technicians in the area of seed quality determination, which are capable and prepared to work on this issue. Open questions can not only be addressed to these committees, but also scientist and technicians involved in the production of high quality organic seed are welcome to participate in these committees. Being a part of an ISTA Committee means to profit from the rich expertise in the committee. Interesting and fruitful discussions in the committees will help to bring the production of high quality organic seed forward quickly.

Organic seed production in vegetables

The organic vegetable industry is flourishing due to consumer's preference for organically grown produce over traditionally produced vegetables. As a result, an increase in the variety and selection of many vegetables in retail supermarkets and restaurants throughout many countries has occurred recently. With the new regulation requiring organic seed sources for organically labeled vegetables, many organic growers are searching for certified organic seed. Smaller seed companies have produced the majority of organically produced seed to date. The commercial seed sector is starting to provide a more diverse selection of cultivars, yet there are still many hybrids that are not yet available.

Organic farmers must use organic seed material if such seed are available. If not available, conventional seeds can be used. This request exists in all accredited standards for organic farming. In the EU-regulation on organic production methods, the derogation from the use of organic seed material will only exist until the end of 2003. After this date only organic seed material may be used according to the present formulation. Only a few countries in the EU have an organic seed production able to supply the market for organic seed material.

It takes many years to develop a well functioning market for organic seeds. It is therefore unlikely that the derogation for the use of organic seed material will not be extended, since a majority of countries in the EU will still have a need for conventional propagated seeds. However, it will be needed to have standards and control procedures ensuring that organic seeds will be used if available. This includes definitions of "availability". There is a need in both EU and in accession countries to develop criteria for seeds health in organic seeds and other seeds not treated with fungicides and to implement inspection procedures to control that conventional seeds are only used when organic seeds are not available.

There are 251 different varieties of organic seed commercially available to organic farmers and growers, 98 per cent of which are vegetable varieties and 1 per cent are cereal varieties. There are no grasses or herbage legumes available. Of the major crops, only few of the varieties most commonly used by organic producers are currently available as organic seed.

In general view that organic seed was in short supply. Based on 1997 data, demand for organic cereal seed is likely to double, demand for vegetable seed will triple, and demand for grassland seed will increase 7 or 8 times. With the current trend in organic seed production, these demands will not be met at the end of the derogation period unless a massive increase in production takes place.

The problems associated with organic seed production could be broadly placed within three categories: 1) Marketing, 2) Technical and 3) Standards. Many were only perceived problems (not actual ones) that could be overcome through education, training and discussion. However, organic seed production must go ahead and that there are no real obstacles to cause delay.

Comments and recommendations for future actions

1. Press ahead with organic seed production.
2. More rigorous policing of the current derogation is required.
3. Make a rapid commitment not to extend the current derogation. Major improvements are required in organic variety testing to identify which varieties should be produced as organic seed.
4. Further work is required on pest, disease and weed problems specifically related to organic seed production.

5.Research is required on the standards.

Why organic vegetable production?

Over 900 million people experience the hardship that hunger imposes, a figure which continues to rise even amidst the riches of the 21st century. As world food prices scale new peaks, food insecurity and famine once again dominate humanitarian headlines, barely three years since the last crisis. Engulfed within a vortex of population growth, economic instability and climate change, food security and nutritional security present a formidable challenge for national and global governance.

The vegetable crops have been well advocated in solving the problem of food security. They are rich source of minerals, vitamins, fibre and contain a fair amount of protein as well as carbohydrates. In addition to local market demand vegetables have the potential for both domestic and export market. The productivity of different vegetables in our country is comparatively lower than the world's average productivity. Again the per capita availability of vegetable (210 g/head/day) is still behind the recommended quantity (300 g/head/day). Thus, keeping an eye towards the population explosion and to feed the future generation we should develop a holistic approach to produce more vegetables from less land, less water with less pesticides and with less detrimental effect to soil and environment as well. Organic vegetable cultivation offers one of the most sustainable farming systems with recurring benefits not only to long-term soil health but also provides a lasting stability in production by making it resistance to all kind of stress (Saha, 2013). Consumer interest in organically grown vegetables has increased rapidly in recent years largely due to concerns relating to food safety, health and the environment (Saha, 2013).

Needs of organic farming of vegetable crops in India (Saha, 2013)

Most of the vegetable crops are eaten fresh or used for health care; hence any contamination (chemical residue) may lead to various kinds of health hazards.

- In India, majority of the vegetable growers are poor, small and marginal farmers.
- Decrease in land productivity due to ever increasing use of chemical fertilizers.
- There are not many scientific breakthroughs in improving quality and production of vegetable crops.
- The ever-increasing cost of production in chemical farming including investments in manufacturing fertilizers, pesticides, irrigation etc despite massive government subsidies is a major cause of concern, which is very low in organic farming.
- High environment pollution.
- Due to globalization, there is a need for keen competition in organic farming of vegetable crops.
- Organic Farming of vegetable crops generates income through international exports or by saving production costs.
- Organic Farming will also be able to secure a place of India in international markets by producing high value vegetable crops.
- Excessive use of chemical fertilizers as well as pesticides not only increases the cost of production but also poses threat to the environment quality, ecological stability and sustainability of production. We have gained quantity but at expense of quality.

Organic vegetable crop/seed production – Management

Discussions of organic farming often focus on which practices are allowed or prohibited by organic certification standards. However, the fundamental goal of organic farming is not the perfection of a set of rules, but the implementation of agricultural systems that are ecologically stable and reasonably productive without toxic interventions. This requires working with, rather than against, natural processes, even though they may not be fully understood.

Simply substituting organically-allowed fertilizers and pesticides for conventional materials does not create a more ecologically stable farming system. The 'substitution approach' usually raises production costs and reduces marketable yield since organic inputs often cost more and don't work as quickly as their synthetic counterparts. To succeed with organic farming you've got to 'buy into' a farming system that values long term yield stability and pest avoidance over maximum short term production. The attributes of such a farming system include: plant diversity, healthy soil, reliance on cultural practices for pest control, and minimal use of least-toxic external inputs. Essential organic vegetable production practices include: crop rotation, use of green manures and compost, pest prevention, and mechanical weed control.

Crop rotation is at the core of ecological stability on vegetable farms. Yet most vegetable growers, including many organic growers, do not practice rigorous crop rotation. Instead, they tend to follow a minimal rotation with the goal of moving plant families around the farm so that a field rests for a few years between related crops. In most cases this is done using a flexible 'seat of the pants' plan rather than a systematic one, so the rules get bent as needed to accommodate production constraints like weather, labour and equipment. In addition, rotation is mostly among the cash crops - little land is ever taken out of crop production.

Maximizing the rotation effect - which benefits soil fertility as well as insect, disease and weed control - is essential to successful organic vegetable production over the long-term. Cover crops and cash crops must be intentionally integrated into the rotation, ideally in equal proportions. At a minimum, I'd suggest that a quarter of a farm's tillable land should be 'resting' from vegetable production at any given time if an organic system is to succeed over the long-term. Putting together a clear and workable rotation plan that suits the farm's market, climate, and available equipment and labour is essential to 'going organic'. Obviously, a rotation plan must have flexibility in terms of which cash crops and cover crops get planted in a given year, and sequences will be refined and improved over time, but the basic rotation should never ignored.

Soil fertility management on organic farms is sometimes defined by the expression 'feed the soil, not the plant'. The implied goal is to build up reserves of nutrients in the soil and to establish a system of nutrient cycling. That is done in part by adding organic residues to the soil on an ongoing basis so that their decomposition releases nutrients sufficient to feed the crops while enhancing soil structure at the same time.

Rather than fertilizing crops with bagged nutrients and adding residues to the soil as an afterthought, the organic approach is to supply as much of the crop's needs as possible with residues, and make up the shortfall, if any, with purchased fertilizers. In some cases, organic crops will need significant amounts of bagged fertilizer in order to optimize yield and quality. For example, on light textured soils with low organic matter levels, during the transition to an organic system, or when organic residues are not available in sufficient quantities to meet crop nutrient needs. Over time, the addition of fertilizer inputs on organic farms tends to decrease if a rigorous soil-building program is adhered to.

Organic residues are those that contain carbon: cover crops or green manures, animal manures, crop residues, and off-farm residues such as yard waste, aquatic weeds, food by-products, etc. Compost is produced from a mixture of these ingredients. Ideally, an organic vegetable farm utilizes a variety of cover crops as well as a variety of other residues that have been composted to stabilize nutrients and minimize weed seeds and pathogens. Which residues are utilized depends of the cost of acquisition and handling, and the nutrient needs of the crops. Organic farms often have considerable expenses associated managing organic residues.

As with conventional management, managing the mineral nutrition of crops is critical to successful organic management. Organic farms should soil test regularly, lime to the proper pH, and broadcast phosphorus, potassium and magnesium as required. A variety of cost-effective materials are generally allowed under organic standards. Limestone is a source of calcium and magnesium, gypsum can be used to supply calcium, mined potassium sulphate supplies potassium. Correcting a severe phosphorus deficiency can be costly since rock phosphate is the material most likely to be applied in large quantities, although this is often a one-time expense.

Weed management is one of the most challenging aspects of organic vegetable production, even with rigorous crop rotation. If dairy manures are used to provide fertility, weed pressure can be particularly intense. In addition to cultural practices that limit weed pressure, such as composting of manures, use of black plastic mulch and cover cropping with smother crops, organic farmers must be equipped to mechanically cultivate weeds. Failure to cultivate effectively resulted in reduced crop yield, increased hand labour costs, or both. Just as a single herbicide or two cannot provide effective weed control, one or two cultivation implements will rarely provide satisfactory weed control. Experienced organic farmers rely on a variety of cultivation tools to cope with various weed and crop combinations.

Insect Management using organic methods is a lot like IPM (Integrated Pest Management), with an emphasis on cultural practices and without the option of using synthetic insecticides. At the core of organic IPM is: crop rotation to minimize overwintering pest problems and diversification to provide beneficial insect habitat. Other practices include timing of plantings to avoid peak insect pressure, trap crops to divert or concentrate pests away from cash crops, and exclusion of pests with floating row covers. The latter technique can be used, on a rather large scale, to prevent damage by flea beetles, cabbage ‘worms' and other foliage-eating pests. Monitoring and scouting for insect pests are critical in order to determine when cultural practices alone are not enough to provide sufficient insect control and application of an organic pesticide is necessary.

The arsenal of organic insecticides is growing, and the historical and undesirable reliance of organic growers on non-selective botanicals such as rotenone and pyrethrum is lessening. Newer botanicals such as *azadiractin* (neem extract), biologicals such as Bt., myco-insecticides such as *Beavaria bassiana*, and other materials including insecticidal soap, kaolin (clay) and a variety of plant-based repellents such as garlic and hot pepper sprays are available. Except for materials that are widely used in conventional farming, like Bt, there is a paucity of information about the efficacy of organic insecticides, and how to optimize their effectiveness. There is also very little information about economic and action thresholds appropriate for organic farming.

Diseases can have a significant effect on production of specialty seed crops. Seed growers must pay attention to diseases that affect the vegetative growth stage of the crop, as well as those that affect the reproductive growth stages (flowering and seed formation). Some diseases, such as *Verticillium* wilt of spinach, become symptomatic only when the crop enters the reproductive stage; these diseases are more important to seed growers than to vegetable growers (unless the vegetable crop also has a flowering stage, e.g., tomato or potato). While vegetable growers are concerned primarily with the pathogens that affect marketable yield and quality, seed growers must also learn how to diagnose and manage seed borne pathogens and the microorganisms that affect seed quality. Pathogens usually remain viable for longer in seed than in vegetative parts of the plant or in the soil. Seeds are a major means of survival of some plant pathogens and of introducing new pathogens to a field or region.

Disease management tactics are either preventive (actions taken to avoid or reduce the likelihood of disease problems) or curative (treatments that eliminate or reduce the effects of a particular disease after it has become established). Because there are few effective curative practices available to organic farmers, organic farmers focus their disease management efforts primarily on preventive cultural practices. Such practices include planting pathogen-free seed, planting in fields of low inoculum potential and in locations with good air movement, adopting wide row spacing, orienting the crop rows to maximize air movement between rows, and tying or staking seed crops to improve air circulation and reduce humidity in the canopy. If feasible, consider using drip or furrow irrigation instead of overhead irrigation, or irrigate earlier in the day to allow the canopy to dry before nightfall.

Some significant pathogens of seed crops are soil borne, such as *Fusarium* wilt of spinach. To manage soil borne pathogens, it is important to know the cropping history of the field and to adopt appropriate crop rotations. A rotation of 6 to 15 years, depending on the susceptibility of the spinach cultivar, is required to control *Fusarium* wilt in spinach seed crops. Some soil borne pathogens affect more than one crop, e.g., the fungus that causes *Verticillium* wilt of spinach can also infect potato, so it is important to avoid growing other crops in the rotation that may be alternative hosts to soil borne pathogens that affect the seed crop.

Strict management of, and screening for, seed borne pathogens of vegetable crops is critical to maintaining high seed quality. Even low levels of seed contamination can cause epidemics of some diseases when infected seed is planted in the field. For example, the tolerance level for contamination of crucifer seed with the causal agent of black rot, *Xanthomonas campestris* pv. *campestris*, is 0 contaminated seeds in 10,000 to 50,000 seeds (depending on the market or country in which the seed will be distributed).

Seeds contaminated with a pathogen can be treated physically (e.g. hot water) or chemically (e.g. bleach) to destroy inoculum or reduce the incidence of infection. Some physical and chemical treatments may reduce seed quality (germination, vigour, and/or longevity), so it may be important to test a particular seed treatment on a small sample of seed and check for possible phytotoxicity to the seed before treating an entire seed lot. Hot water treatment can only be used on some crops, such as brassicas, carrots, tomatoes, peppers, and lettuce, but even on those crops very precise parameters must be followed for hot water treatment to avoid damaging the seed. There are a number of biological and natural disease management products coming onto the market that are approved for use on organic farms, but it must be noted that the efficacy of these biocontrol products may vary among sites, crops, and diseases, reflecting the the complexities and particulars of interactions amongst the host, pathogen and environment. Therefore, planting pathogen-free seed, when possible, is always preferable to trying to eradicate a pathogen from seed.

When growing seed crops, the following steps will minimize the risk of disease:

1. Learn to diagnose and manage the diseases of each crop grown.
2. Know what seed borne pathogens are important to your crop and prevalent in your region, and ensure, through communication with your seed supplier or contractor, that the seed you are planting has been tested to be pathogen-free or has been treated preventatively.
3. Design and manage the cropping system to minimize the likelihood of disease development. See the related article Keys to Disease Management in Organic Seed Crops.
4. Scout fields regularly for early symptoms of disease development.
5. If you must apply materials to your crops to control disease, communicate with your certifier to make sure the materials are permitted for use on organic farms and labeled for that crop and disease. See the related article Can I Use this Product for Disease Management on my Organic Farm?
6. Screen seed lots for seed borne pathogens before sale. This is the responsibility of the seed company, and all diagnostic laboratory results should be communicated to the seed grower. Be aware that there may not be commercial seed health tests available for the particular crop of interest, particularly specialty crops grown on a small scale and for which there has been limited research on seed borne pathogens.

Review on organic farming in India with special reference to vegetables

1.Organic sources of plant nutrients

At present, most optimistic estimates showed that about 25 - 30 percent of nutrient needs of Indian agriculture can be met by various organic sources. Supplementation of entire N through FYM sustains crop productivity at more than use of conventional N fertilizers. Since the estimates of NPK availability from organic sources are based on total nutrient content, efficiency of these sources to meet the nutrient requirement of crops is not as assured as mineral fertilizers, but the joint use of chemical fertilizers along with various organic sources is capable of sustaining higher crop productivity, improving soil quality, and productivity on long-term basis (Chhonkar, 2002). These organic sources besides supplying N, P, and K also make unavailable sources of elemental nitrogen, bound phosphates, micronutrients, and decomposed plant residues into an available form to facilitate the plants to absorb the nutrients. Application of organic sources encouraged the growth and activity of *mycorrhizae* and other beneficial organisms in the soil and is also helpful in alleviating the increasing incidence or deficiency of secondary and micronutrients and is capable of sustaining high crop productivity and soil health (Nambiar *et al.*, 1992). The farmers can in turn, get good remuneration from organically produced crops and if included in high value crop rotations, that is, table pea (*Pisum sativum* L.) and onion (*Allium cepa* L.) due to their heavy demands in domestic, national, and international markets (Kalyan, 2005).

Nutrient concentrations in FYM are usually small and vary greatly depending upon source, conditions, and duration of storage. Tandon (1992) reported that on an average, well rotted FYM contains 0.5 per cent N, 0.2 per cent P_2O_5, and 0.5 per cent K_2O. Gaur (1992) stated that an application of 25 t/ha of well rotted FYM can add 112 kg N, 56 kg P_2O_5, and 112 kg K_2O /ha.

2.Effect of organic nutrition on crop productivity

Addition of organic matter in the soil is a well known practice to increase crop yields. Vegetables are highly responsive to organic sources of nutrients and profitable to farmers. Gurubatham *et al.* (1989) reported that *Azospirillum* increased bulb yield of onion from 19.1 to 20.5 t/ha and slightly better yields were obtained when *Azospirillum* inoculum in a sticky paste was used to pellet the seeds (100 g/kg seeds). Kalembasa (1996) reported that vermicompost application of 15 kg per square meter gave the highest yield in tomato crop. Patil *et al.* (1997) reported that total potato (*Solanum tuberosum* L.) tubers yield was significantly higher with the application of vermicompost at 4 t/ha and FYM at 25 t/ha. Singh *et al.* (1997) studied the response of chilli (*Capsicum annuum* L.) to vermicompost and reported that vermicompost has a positive effect on the performance of crops due to a higher number of branches and fruits. Thanunathan *et al.* (1997) reported that soil + mine spoil + coir pith vermicompost (1:1:1) significantly increased plant height, number of leaf, and root length in onion (*Allium cepa* L.). Kalembasa and Deska (1998) obtained significantly higher yield of sweet pepper (*Capsicum annum* L. var. grossum) with vermicompost. Reddy *et al.* (1998) recorded maximum plant height at harvest, days to first flowering and branches plant per plant in pea with the application of vermicompost (10 t/ha). Renuka and Ravishankar (1998) reported that in tomato crop, the application of biogas slurry + FYM, vermicompost + FYM, vermicompost alone have recorded maximum fruit size, more number of fruit per plant, while inorganic fertilizers (NPK) recorded the minimum fruit size. It is inferred that tomato crop would respond well to the application of organic manures either in combination with FYM or alone. The effect of fertilizer application on yield of onion cv. Blonska was studied by Rumpel (1998) and he reported that FYM alone gave better results than NPK fertilizer only at low soil moisture. Tomar *et al*. (1998) recorded the highest yield (97 g/plant) through vermicompost in brinjal (*Solanum melongena* L.). They also reported that the application of vermicompost significantly increased leaf area in carrot (*Daucus carota* L.) plants. Gupta *et al.* (1999) studied the effect of organic manure and inorganic fertilizers on growth, yield and quality of kharif onion cv. Agrifound Dark Red and reported that FYM @ 72 q/ha alone with ammonium sulphate @ 565 k/ha were effective in increasing the growth and yield and gave the highest net return.

Shreenivas *et al.* (2000) conducted a field experiment on ridge gourd (*Luffa acutangula* L. Roxb.) and observed that the increasing levels of vermicompost (0, 5, 10, and 15 t/ha) increased the fruit weight and fruit volume. Singh (2000) observed that the application of vermicompost at 13 - 20 q/ha increased yield of pea (23.62 q/ha). Rao and Sankar (2001) observed that the effect of organic manure on leaf number, leaf area index, dry matter production, and other growth characters was significantly better than those of inorganic fertilizer in brinjal. Renuka and Sankar (2001) reported in tomato that the yield increased two and half times with the application of organic manures in comparison with inorganic fertilizer (18.44 tonnes). Samawat *et al.* (2001) reported that vermicompost had a significant effect on root and fruit weight of tomatoes. In 100 per cent vermicompost treatment, fruit, shoot and root weights were three, five and nine times, respectively, more than control. Alkaff *et al.* (2002) obtained the highest rate of increase in bulb weight (44%) as absorbed with the mineral fertilizer, followed by the biofertilizer and FYM. The highest rate of increase in total yield (21.76%) was recorded with FYM, followed by the mineral fertilizer and biofertilizer. Sule *et al.* (2002) studied the impact of biofertilizers (*Azospirillum*, *Azotobacter*, *Rhizobium* and phosphate solubilizing bacteria) on the productivity of onion. The results showed that, the average areas under biofertilizers users and non-users were 0.47 kg/ha and 0.50 kg/ha, respectively. An average productivity of biofertilizer users and non users was 20.05 and 18.13 t/ha, respectively. The productivity increased by 10.59 per cent due to use of biofertilizer. Application of vermicompost at 5 t/ha or at 10 t/ha, increased shoot weight and leaf area of pepper plants (*Capsicum annuum* L.) compared to inorganic fertilizers (Arancon *et al.*, 2003). Choudhary *et al.* (2003) obtained the highest yield and available N of tomato cv. S-22 and cabbage (*Brassica oleracea* L. var. capitata) cv. Golden Acre with vermicompost at 200 g/plant + FYM at 250 g/plant, while maximum K and soil organic carbon was obtained with vermicompost at the rate of 100 g /plant + FYM at 500 g/ plant. Sharma *et al.* (2003) reported that application of FYM @ 10 and 20 tonnes per ha increased bulb yield of onion by 9 and 19 per cent over 100 per cent NPK alone, respectively. Yadav and Vijayakumari (2003) conducted an experiment to evaluate the effect of vermicompost and inorganic fertilizers on the yield parameters of chilli and reported that higher number of fruits per plant, fruit weight, fruit length and fruit diameter were obtained by applying vermicompost alone. Studies were conducted by Patil *et al.* (2005) to investigate the effect of fly ash and farmyard manure (FYM) on nutrient uptake and yield of onion. Results indicated that with the increasing level of fly ash and FYM, there was a corresponding increase in uptake of nitrogen, phosphorus and potassium. Onion yield was also increased by increasing levels of fly ash and FYM, later having more influence on yield of onion bulbs. Fly ash can also be used at 30 t/ha with affecting the crop yield. Reddy and Reddy (2005) reported that yield of onion increased significantly with increasing levels of vermicompost (from 10 – 30 t/ha). Studies were conducted by Shashidhar *et al*. (2005) to determine the effects of different organic manures (farmyard manure, vermicompost, poultry manure, pressmud, sheep manure, *Gliricidia* and sunn hemp) on the nutrient uptake and yield of garlic cv. BLG-1. Results revealed that application of sunnhemp at 20 t/ha resulted in the highest uptake of nitrogen, phosphorus and potassium during *kharif* (103.44, 23.04 and 74.29 kg/ha, respectively), *rabi* (108.12, 25.10 and 76.25 kg/ha, respectively) and over two seasons (105.78, 24.07 and 75.89 kg/ha, respectively) by BLG-1. The yield per hectare (73.48, 68.15 and 70.82 q/ha, respectively, during *kharif*, *rabi* and over two seasons) was also highest with the application of sunnhemp at 20 t/ha. It was at par with the application of poultry manure (2.5 t/ha) and vermicompost (5.0 t/ha). Baswana and Rana (2007) reported that the highest pod yield (93.96 q/ha) of pea was recorded when farm yard manure (1 t/ha) + poultry manure (1 t/ha) along with mulch treatment was applied followed by farm yard manure (2 t/ha) + biofertilizers with mulch treatment. Similar trend was also observed for biological yield and harvest index. Mourao *et al.* (2008) found that organically grown potato cv. Virgo yielded 66 per cent of the conventional crop, whereas Raja yielded 46.6 per cent.

Khang *et al.* (2011) studied the effect of integrated nutrient management on onion yield and soil properties in soybean – onion cropping sequence. They reported that the application of 100 per cent organic nutrient source through FYM, vermicompost, neem seed cake, *Azotobacter*, PSB and trap crop gave the maximum yield of onion. Suchitra and Manivannan (2012) noticed that among the various organic manures and inorganic fertilizers tested in okra, application of vermicompost at 5 t/ha and humic acid 0.2 per cent at regular intervals recorded the longest fruit length (17.85 cm), maximum fruit girth (5.86 cm), maximum fruit yield per plant (378.56 g) and maximum fruit yield per plot (13.26 kg). The highest yield and quantity attributes may be due to the supplementation of micronutrients by nitrogen, phosphorus and potassium in inorganic form besides the growth effect of vermicompost. Naik *et al* (2013) reported that vermicompost application resulted in highest bulb weight and bulb yield. Rohit Kumar (2014) reported that vermicompost alone and vermicompost with PSB and *Azotobactor* was found to be superior over all the other treatments in respect of number of umbels per plant, seed weight per umbel, seed weight per plant, and seed yield per plot.

3.Effect of organic nutrition on quality parameters

Thanunathan *et al.* (1997) in pot experiments, onions (*Allium cepa*var. aggregatum) were grown in

12 different combinations of soil, mine spoil, vermicompost made from coir or water hyacinth and farmyard manure. Results revealed that organic manure application significantly increased the plant height, numbers of leaves, root length and bulb circumference. Among the various amendments with minespoil, coirpithvermicompost + minespoil + soil in 1:1:1 ratio recorded maximum plant height (27.24 cm) followed by water hyacinth vermicompost + mine spoil + soil in 1: 1: 1. Similarly, Soil mine spoil and coirpithvermicompost combination in equal proportion recorded more number of leaves (33.3), highest root length (20.07 cm) and maximum bulb circumference of 6.23 cm. Gupta *et al.* (1999) studied the effect of organic manure and inorganic fertilizers on growth, yield and quality of *kharif* onion cv. Agrifound Dark Red and reported that FYM @ 72 q/ha alone with ammonium sulphate @ 565 k/ha were effective in increasing the quality contributing characters such as bulb colour, compactness, TSS and dry matter and gave the highest net return. Maheswari *et al.* (2004) studied the effect of foliar organic fertilizers on the quality and economics of chilli and observed the highest ascorbic acid content (175.23 mg/100g) with vermiwash: water at 1:5 ratio. Yadav and Vijayakumari (2004) carried out an experiment to assess the effect of vermicomposted vegetable waste on the biochemical characters of chilli and found that the protein was higher at 60 (113 mg/g) and 90 DAS (79 mg/g). The carbohydrate content was higher in vermicomposted treatment at 60 DAS (15.34 mg/g). Chlorophyll (2.61 mg/g) and total chlorophyll (3.62 mg/g) contents were observed at 60 DAS, while chlorophyll a (1.01 mg/g) was higher at 90 DAS as compared to inorganic fertilizers. Reddy and Reddy (2005) reported that plant height, number of leaves per plant, leaf area, bulb length, diameter and weight of onion increased significantly with increasing levels of vermicompost (from 10 – 30 t/ha). Haase *et al*. (2007) suggested that tubers from organic potato cropping may be expected to have sufficiently high tuber dry matter concentrations (19 %) for processing into French fries without impairing the texture of the fries when concentrations exceed 23 per cent. Naik *et al.* (2013) reported that vermicompost application resulted in highest bulb weight and bulb diameter. Rohit Kumar (2014) reported that vermicompost alone and vermicompost with PSB and *Azotobacter* was found to be superior over all the other treatments in respect of quality parameters viz., shoot length, root length, shoot dry weight, root dry weight and vigour index length, etc.

4. Effect of organic nutrition on soil fertility

Organic farming was capable of sustaining higher crop productivity and improving soil quality and productivity by manipulating the soil properties on long term basis. Minhas and Sood (1994) reported that the organic matter after decomposition release macro and micronutrients to the soil solution, which becomes available to the plants, resulting in higher uptake. Clark *et al.* (1998) reported that organic and low-input farming practices after 4 years led to an increase in the organic carbon, soluble phosphorus, exchangeable potassium, and pH and also the reserve pool of stored nutrients and maintained relativity stable EC level. Renuka and Ravishankar (1998) reported that in tomato crop, organic manures application helps to maintain good soil health. Urkurkar *et al.* (2010) reported that supply of 100 per cent nitrogen, that is, 120 kg/ha for rice and 150 kg/ha for potato in a rice-potato cropping system, 1/3 each from cow dung manure, neem cake and composed crop residue appreciably increased the organic carbon (6.3 g/kg) over initial value (5.8 g/kg) as compared to supply from inorganic fertilizers alone. However, availability of phosphorus and potassium did not show any perceptible change after completion of five cropping cycles under organic as well as integrated nutrient approaches. Khang *et al.* (2011) studied the effect of integrated nutrient management on onion yield and soil properties in soybean – onion cropping sequence. They reported that application of 100 per cent organic nutrient source through FYM, vermicompost, neem seed cake, *Azotobacter*, PSB and trap crop improved the fertility status of soil more than control and 100 per cent NPK recommended dose.

5.Effect of organic nutrition on soil biological properties

Compost played an important role in control of plant nematodes and in mitigating the effect of pesticides through sorption. Sorption is the most important interaction between soil/organic matter and pesticides and limits degradation as well as transport in soil. Pesticides bound to soil organic matter or clay particles are less mobile, bio available, but also less accessible to microbial degradation and thus, more persistent (Gaur and Prasad, 1970). Compost contains bacterial, actinomycetes, and fungi; hence, a fresh supply of humic material not only added microorganisms, but also stimulated them (Balasubramanian *et al.*, 1972). Singh *et al.* (1997) studied the response of chilli (*Capsicum annuum* L.) to vermicompost and observed that the application of vermicompost increased the microbial activities. Bulluck *et al.* (2002) reported that organic fertility amendments enhanced beneficial soil microorganisms, reduced pathogen population, total carbon, and cation exchange capacity, and lowered down bulk densities, thus, improved soil quality. Composting material added plenty of carbon and thus increased heterotrophic bacteria and fungi in soil and further increased the activity of soil enzymes responsible for the conversion of unavailable to available form of nutrients. Agricultural practices have had an impact on soil bio-physio-chemical properties. Densities of bacteria, protozoa, nematodes, and arthropods in soils under organic farming were higher than under conventional farming (Wu *et al.*, 2002). The National Academy of Agricultural Sciences (NAAS) recommended a holistic approach involving integrated nutrient management (INM), integrated pest management (IPM) for enhanced input use efficiency, and adoption of region specific promising cropping systems as an alternative organic farming strategy for India and to begin with the practice of organic farming in vegetables (Bhattacharya and Chakraborty, 2005).

CONCLUSION

Organic Farming has the twin objective of the system sustainable and environmentally sensitive. To achieve these goals, there is need to develop some rules and standards, which must be strictly adhere to. There is very little scope for change and flexibility. Thus, the organic farming does not require best use of options available rather the best use of options that have been approved. With ever increasing population having huge requirements of vegetables and meager availability of organic resources, pure organic farming in India, requires some specific area and vegetable crops having high potential in national markets that can be diverted to organic farming for high quality produce. Nobel Laureate Dr. Norman Borlaug (2002) said that," Switching on food production to organic would lower crop yields. We can use all the organic that are available but we are not going to feed six billion people with organic fertilizers." For Indian Agriculture, use of chemical fertilizers cannot be totally eliminated, rather can be reduced, or minimized. It has also been proved by various experiments that by conjoint application of inorganic fertilizers along with various organic sources are capable of sustaining higher crop productivity, improving soil quality and soil productivity.

REFERENCES

Alkaff, H. A.; Saeed, O. S. and Salim, A. Z. (2002). Effect of biofertilizer, inorganic, organic and foliar application of Power 4 on the productivity of onion. *Univ. Aden. J. Natural Appl. Sci.*, **6(1)**: 1-14.

Arancon, N. Q.; Edwards, C. A.; Bierman, P.; Metzger, J. D.; Lee, S. and Welch, C. (2003). Effects of vermicomposts on growth and marketable fruits of field-grown tomatoes, peppers and strawberries. The 7th international symposium on earthworm ecology, Cardiff, Wales. *Pedobiologia*, **47**(5-6): 731–73.

Balasubramanian, A., Siddaramappa, R. and Rangaswami, G. (1972). Effect of organic manuring on the activities of the enzymes hydrolysing sucrose and urea and on soil aggregation. *Plant Soil*, **37**(2): 319 – 328.

Baswana, K. S. and Rana, M. K. (2007). Effect of organic sources and biofertilizers on growth and yield of garden pea (*Pisum sativum* L). *Haryana J. Hort. Res.*, **36**(3-4): 326-330.

Bhattacharya, P. and Chakraborty, G. (2005). Current status of organic farming in India and other countries. *Indian J. Ferti.* **1**(9): 111-123.

Bulluck III, L. R.; Brosius, M.; Evanylo, G. K. and Ristaino, J. B. (2002). Organic and synthetic fertility amendments influence soil microbial, physical and chemical properties on organic and conventional farms. *Appl. Soil Ecol.*, **19**(2): 147-160.

Chandramohan, S. (2002). Organic farming in cotton + blackgram intercropping system. M. Sc. (Agri.) Thesis (Unpublished), Tamil Nadu Agricultural University, Coimbatore (India).

Chhonkar, P. K. (2002). Organic Farming Myth and Reality. In: *Proceedings of the FAI Seminar on Fertilizer and Agriculture Meeting the Challenges*, New Delhi, India, December 2002.

Choudhary, R. S.; Das, A. and Patnaik, U. S. (2003). Organic farming for vegetable production using vermicompost and FYM in Kokriguda watershed of Orissa. *Indian J. Soil Cons.* **31**(2): 203–206.

Clark, M. S.; Horwath, W. R.; Shennan, C. and Scow, K. M. (1998). Changes in soil chemical properties resulting from organic and low-input farming practices. *Agron. J.*, **90**(5): 662-671.

Gaur, A. C. (1992). Bulky Organic Manures and Crop Residues," in Fertilizer Organic Manures Recyclable Wastes and Bio-Fertilizers, H. L. S. Tandon, Ed., Fertiliser Development and

Consultation Organisation, New Delhi, India.

Gaur, A. C. and Prasad, S. K. (1970). Effect of organic matter and inorganic fertilizers on plant parasitic nematodes. *Indian J. Entomol.,* **32**: 186-188.

Giraddi, R. A. (1993). Vermiculture and role in agriculture. In: *Proc. Course on the Officers of the State Department of Agriculture*, Karnataka. Department of Agricultural Microbiology, Univ. Agric. Sci. Dharwad, Pp. 50-54.

Gupta, R. P.; Sharma, V. P.; Singh, D. K. and Srivastava, K. J. (1999). Effect of organic manures and inorganic fertilizers on growth, yield and quality of onion variety Agrifound Dark Red. News Letter 19, 2/3thedn. Pp. 7-11. National Hortic. Res. and Dev. Found.

Gurubatham, J. R. J.; Thamburaj, S. and Kandasamy, D. (1989). Studies on the effect of biofertilizers on the bulb yield in Bellary onion (*Allium cepa* L.). *South Indian Horti.,* **37(3)**: 150-153.

Haase, T.; Schüler, C.; Haase, N. U. and Heß, J. (2007). Suitability of organic potatoes for industrial processing: effect of agronomical measures on selected quality parameters at harvest and after storage. *Potato Res.,* **50**(2); 115 – 141.

Kalyan, S. (2005). Development of sustainable farming system model for the Irrigated agro-ecosystem of Eastern UP, ICAR, Ad-hoc project," Final Annual Report, Department of Agronomy, Institute of Agricultural Science, Banaras Hindu University, Varanasi, India.

Kalembasa, D. (1996). The effects of vermicompost on the yield and chemical composition of tomato. *Zeszyty Problemowe Postępów Nauk Rolniczych*, **437**: 249–252.

Kalembasa, S. and Deska, J. (1998). The possibility of utilizing vermicompost in the cultivation of radish and paprika. *Annals of Agricultural University of Poznan*, **27**: 131–136.

Khang, V. T.; Patil, H. M. and Gudedhe, N. N. (2011). Effect of integrated nutrient management on onion yield and soil properties in soybean – onion cropping sequence. *Omonrice*. **18**: 112-120.

Lammerts van Bueren, E. (2002) Organic plant breeding and propagation: concept andstrategies. Ph.D. Thesis Wagening University. Louis Bolk Institute, Driebergen, P. 210.

Maheswari, T. U.; Haripriya, K.; Poonkodi, P. and Kamala Kannan, S. (2004). Effect of foliar application of organic nutrients on some quality indices and economics of chilli (*Capsicum annum* L.). *Adv. Pl. Sci.*, **17**(1): 259 – 262.

Minhas, R. S. and Sood, A. (1994). Effect of inorganic and organic on yield and nutrients uptake by three crops in rotation in aid alfisol. *J. Indian Soc. Soil Sci.,* **42**: 257-260.

Mourao, I.; Brito, L. M. and Coutinho, J. (2008). Cultivating the-future based-on science, volume-1: organic crop-production. In: *Proceedings of the 2nd Scientific Conference of the International Society of Organic Agriculture Research ISOFAR*, held at the 16th

IFOAM Organic World Conference in Cooperation with the International Federation of Organic Agriculture-Movements IFOAM and the Consorzio Modena Bio, pp. 596–599. International Society of Organic Agricultural Research (ISOFAR), Bonn, Germany, June 2008.

Naik, M. H.; Srihari, G. and Rao, B. G. (2013). Organic production of onion. *Crop Res.*, **45(1/3)**: 218-220.

Nambiar, K. K. M.; Soni, P. N.; Vats, M. R.; Sehgal, D. K. and Mehta, D. K. (1992). AICRP on long term fertilizer experiments. Annual Reports 1987-88 and 1988-89, IARI, New Delhi, India.

Patil, M. P.; Hulamani, N. C.; Athani, S. I. and Patil, M. G. (1997). Response of potato (*Solanum tuberosum*) cv. Kufri Chandramukhi to integrated nutrient management. *Adv. Agril. Res. India*, **8**: 135 -139.

Patil, P. V.; Chalwade, P. B.; Solanke, A. S. and Kulkarni, V. K. (2005). Effect of fly ash and FYM on nutrient uptake and yield of onion. *J. Soils and Crops*. **15(1)**: 187-192.

Rao, T. S. S. and Sankar, C. R. (2001). Effect of organic manures on growth and yield of brinjal. *South Indian Hort.*, **49**: 288–291.

Reddy, K. C. and Reddy, K. M. (2005). Differential levels of vermicompost and nitrogen on growth and yield in onion (*Allium cepa*L.) – radish (*Paphanus sativus* L.) cropping system. *J. Res.* ANGRAU, **33(1)**: 11-17.

Reddy, R.; Reddy, M. A. N.; Reddy, Y. T. N.; Reddy, N. S. and Anjanappa, M. (1998). Effect of organic and inorganic sources of NPK on growth and yield of pea. *Legume Res.*, **21**(1): 57–60.

Renuka, B. and Ravishankar, C. (1998). Effect of organic manures on growth and yield of tomato. In: *Proc. Nation. Sem. Changing Scenario in the Production System of Horticultural Crops*, held at Tamil Nadu Agric. Univ. Coimbatore, August 28-30, pp. 215-218.

Renuka, B. and Sankar, C. R. (2001). Effect of organic manures on growth and yield of tomato. *South Indian Hort*., **49**: 216 – 219.

Rohit Kumar (2014). Effect of organic and inorganic fertilizers on yield and quality of onion (*Allium cepa* L.) seed. M. Sc. (Agri.) Thesis (Unpublished) submitted to Junagadh Agricultural University, Junagadh, Gujarat.

Rumpel, J. (1998). Effect of long term organic, mineral, and combined organic mineral fertilization on yield of onions (*Allium cepa* L.) grown from seeds. *Biuletyn Warzywniczy*. **48:** 5-15.

Saha, P. (2013). Concept on Organic Vegetable Production. *Odisha Review*, August, 2013. http:// *orissa.gov.in/e-magazine/Orissareview/2013/aug-sept/.../76-85.pdf*

Samawat, S.; Lakzian, A. and Zamirpour, A. (2001). The effect of vermicompost on growth characteristics of tomato. *Agril. Sci. Technol.*, **15**(2): 83–89.

Sharma, A. R. and Mitra, B. N. (1989). Direct and residual effect of organic materials and phosphorus fertilizers in rice-based cropping system. *Indian J. Agric.*, **36**: 299-303.

Sharma, R. P.; Datt, N. and Sharma, P. K. (2003). Combined application of nitrogen, phosphorus, potassium and farmyard manure in onion (*Allium cepa*) under high hills, dry temperate conditions of north western Himalayas. *Indian J. Agric. Sci.*, **73(4)**: 225-227.

Shashidhar, T. R.; Dharmatti, P. R.; Chavan, M. L. and Mannikeri, I. M. (2005). Nutrent uptake and yield of garlic with different organic manures. *Karnataka J. Horti.*, **1(4)**: 98-101.

Shreenivas, C.; Muralidhar, S., Rao, M. S. and Singa Rao, M. (2000). Yield and quality of ridge gourd fruits as influenced by different levels of inorganic fertilizers and vermicompost. *Ann. Agril. Res.*, **21**(2): 262–266.

Singh, J.; Bhat, S. S.; Sudharshan, M. R.; Singh, Jasvir and Sreekrishna-Bhat, S. (1997). Performance of Scotch Bonnet chilli in Karnataka and its response to vermicompost, *Indian Cocoa, Arecanut Spices J.*, **21**: 9–10.

Singh, R. A. (2000). Feasibility of vermi-farming in peanut (*Arachis hypogaea*) - vegetable pea (*Pisum sativum*) cropping system. *Indian J. Agron.*, **45**(2): 257 – 262.

Sriramachandrasekharan, M. V.; Ramanathan, G. and Ravichandran, M. (1996). Effect of organic manures on the availability of nutrients in rice rhizosphere soil. *Oryza*, **33**: 126-131.

Suchitra, S. and Manivannan, K. (2012). Studies on the influence of organic inputs on the growth and yield of bhendi, vegetable cowpea in various seasons. *Indian J. Pl. Sci.*, **1(2-3)**: 124-132.

Sule, S. R.; Rahane, R. K. and Shinde, V. A. (2002). Impact of biofertilizers on productivity of field crops. *J. Maharashtra Agric. Univ.*, **27(2)**: 180-181.

Tandon, H. L. S. (1992). Fertilizers and Their Integration and Organics and Bio-fertilizers. In: Fertilizers, Organic Manures, Recyclable Wastes and Bio-Fertilizers, H. L. S. Tandon, Ed., pp. 32–36, FDCO, New Delhi, India.

Thanunathan, K.; Natarajan, S.; Sentikumar, R. and Asulmurogan, K. (1997). Effect of different sources of organic amendments on growth and yield of onion in mine spoil. *Madras Agril. J.*, **84**(7): 382–384.

Tomar, V. K.; Bhatnagar, R. K. and Palta, R. K. (1998). Effect of vermicompost on production of brinjal and carrot. *Bhartiya Krishi Anusandhan Patrika*, **13**(3-4):153–156.

Urkurkar, J. S.; Chitale, S. and Tiwari, A. (2010). Effect of organic v/s chemical nutrient packages on productivity, economics and physical status of soil in rice (*Oryza sativa*) - Potato (*Solanum tuberosum*) cropping system in Chhattisgarh. *Indian J. Agron.*, **55**(1): 6-10.

Yadav, A. K. Training Manual Certification and Inspection Systemsin Organic Farming in

India, National Centre of Organic Farming, Department of Agriculture and Cooperation,Ministry of Agriculture, Government of India, CGO-II, Kamla Nehru Nagar, Ghaziabad, UP – 201 002. Pp: 1-67, http://ncof.dacnet.nic.in/Training_manuals/Training_manuals_in_English/Cert_and_Inspection_manual.pdf

Yadav, R. H. and Vijayakumari, B. (2003). Influence of vermicompost with organic and inorganic manures on biometric and yield parameters of chilli (*Capsicum annuum* L.). *Crop Res.*, **25(2**): 236-243.

Yadav, R. H. and Vijayakumari, B. (2004). Impact of vermicompost on biochemical characters of Chilli (*Capsicum annum*). *J. Ecotoxicol. Environl. Monitoring*, **14**(1): 51 – 56.

Wu, S.; Ingham, E. R. and Hu, D. (2002). Soil microfloral and faunal populations in an organic ecosystem in Oregon, USA. In: *Proceedings of the 17th World Congress of Soil Science*, 5: p. 1756. Queen Sirkit National Convention Centre, Bangkok, Thailand, August 2002.

READING SUGGESTED

Coleman, E. (1995). The New Organic Grower. Chelsea Green Publishing Co., P.O. Box 428, White River Junction, VT 05001 (802) 295-6300, www.chelseagreen.com.

Grubinger, V. P. (1999). Sustainable Vegetable Production from Start-Up to Market. Plant and Life Sciences Publishing (formerly NRAES), PO Box 4557, Ithaca NY 14853. 607-255-7654, palspublishing.cals.cornell.edu.

Malty, T. K. and Tripathy, P. (2004). Organic farming of vegetables in India: Problems and Prospects. www.share4dev.info/kb/documents/2997.pdf

The International Seed Testing Association (ISTA) and Organic Seed Production, www.seedtest.org/upload/cms/user/OrganicsPamphletforwebsite.pdf

Zhu, Z. I.;Liu, C. Q. and Jiang, B. F. (1984). Mineralization of Organic Nitrogen, Phosphorus and Sulphur in Some Paddy Soils in China. In: Organic Matter and Rice, pp. 259–272, IRRI, Los Banos, Philippines.

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