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Anjugramam - Kanyakumari Main Road, Palkulam, Varivoor P.O. - 629 401, Kanyakumari District.

AI3019

SUSTAINABLE AGRICULTURE AND FOOD SECURITY

UNIT 3
ORGANIC FARMING

Perionix excavatus have been recommended for vermiculture technology. Vermicompost is the compost which is prepared by earthworms. It is a mixture of worm casting (faecal excretions) organic materials including humus, live earthworms, their cocoons and other micro organisms.

Vermiculture : It is the process of rearing and breeding of earthworms in controlled condition and presently it is known as earthworm biotechnology. It is estimated that 1800 worms which is an ideal population for one sq. meter can feed on 80 tonnes of humus per year. Faecal matter or excretions of earthworms is known as vermin cast. Vermi wash is a liquid fertilizer collected after the passage of water through a column of worm activation, which is useful for foliar spray. It may be diluted with water before use. It can also be diluted with 10% urine of cow. The average nutrient content of vermicompost is about 0.5 to 0.9- 0.1 to 0.2- 0.67 % N,P,K respectively.

VERMIWASH – A liquid manure: It is a transparent pale yellow coloured fluid collected after the passage of water through a column of worm action or it a collection of excretory products and mucus secretions of earthworm along with nutrients from the soil organic molecules. It is very useful as a foliar spray to enhance the plant growth and yield and to check development of diseases.

BENEFITS OF VERMICOMPOST

1. When added to clay soil, loosens the soil and provides the passage for the entry of air.

2. The mucus associated with it being hygroscopic, absorbs water and prevents water logging and improves water holding capacity.

3. In the vermicompost, some of the secretions of worms and the associated microbes act as growth promoter along with other nutrients.

4. It improves physical, chemecal and biological properties of soil in the long run on repeated application

5. The organic carbon in vermicompost releases the nutrients slowly and steadily into the system and enables the plant to absorb these nutrients.

6. The multifarious effects of vermicompost influence the growth and yield of crops.

APPLICATION OF VERMICOMPOST

In orchards the dose depends on the age of the tree. It can be used @ 500 g in small fruit plants and 3 – 4 kg/tree whereas for vegetable crops @ 3 kg/10 m2 area. For general use in agriculture, vermicompost should be applied @ 5 t/ha. Vermicompost is mixed with equal quantity of dried cow dung and used as broadcast when seedlings are 12-15 cm height and water should be sprinkled.

GREEN MANURING

Definition :Crops grown for the purpose of restoring or increasing the organic matter content in the soil are called green manure crops while there green undecomposed plant material used as manure is called green manure. Their use in cropping system is generally referred as green manuring. It is obtained in two ways-either by grown in situ or brought from out site. In both ways, the organic material should be worked into the soil while they are fairly young for easy and rapid decomposition.

i) In situ green manuring: Growing of green manure crops in the field and incorporating it in its green stage in the same field (i.e. in situ) is termed as green manuring.

ii) Green leaf manuring: is the application of green leaves and twigs of trees, shrubs and herbs

collected from nearby location and adding to the soil. Forest tree leaves are the main source of green leaf manuring. Legumes are usually utilized as green manure crops as they fix atmospheric nitrogen in the root/stem nodules through symbiotic association.

ADVANTAGES OF GREEN MANURING

1. It adds organic matter to the soil. This stimulates the activity of soil micro organisms

2. Green manuring concentrates plant nutrient in the surface layer of the soil

3. It improve the structure of soil by deep rooting system

4. It facilitates the penetration of rain water, thus decreasing run off & soil erosion.

5. It holds plant nutrients that would other wise be lost by leaching (eg.N)

6. It increases the availability of certain plant nutrients like P,Ca,K,Mg & Fe.

7. It checks weed growth by quick initial growth

8. It aid in reclamation of sodic soils by release of organic acids.

BIO-FERTILIZERS (Microbial inoculants)

The atmosphere over an hectare of land consists of 80,000 tones of N. Though atmospheric N is present in sufficient quantity (80%), it is not available to plants since it exists in inert form. Biological nitrogen fixation is the conversion of atmospheric N by living organisms into forms that plants can use. This process is carried out by a group of bacteria and algae which fix atmospheric Nitrogen (N2) in to assimilable forms of nitrogen (NH3)

It can be defined as bio-fertilizers or microbial inoculants are preparations containing live or latent cell of efficient strain of N-fixing or P-solubilizing micro organisms used for seed or soil application with the objectives of increasing the numbers of such micro organisms in the soil or rhizosphere and consequently improve the extent of microbiologically fixed N for plant growth.

Use of bio-fertilizers

Azospirilum is applied as seed treatment or soil application in crop like rice, sugarcane, pulses,

soybean and vegetables. It increase in root length, top dry weight, root dry weight, total leaf area and yield were reported. The inoculants like nitroplus (legume inoculants) and VAM (Vesicular Arbuscular Micorrhizae) are also effective for crop yield improvement. The Bacillus sp. and pseudomonas sp. are help full in synthesizing the insoluble form of phosphorus. The combined application of phosphobacteria, rock phosphate and FYM to commercial crops have greatly unhanced biomass production, uptake of nutrients and yield

Benefits of bio- fertilizers in organic farming

- Bio-fertilizers are eco-friendly and do not have any ill effect on soil health and environment.
- They reduce the pressure on non-renewable nutrient sources/fertilizer.
- Their formulations are cheap and have easy application methods.
- They also stimulate plant growth due to excretion of various growth hormones.
- They reduce the incidence of certain disease, pathogen and increase disease resistance.

- The economic benefits to cost ratio of bio-fertilizers is always higher.
- They improve the productivity of waste land and low land by enriching the soil.

DISEASE AND PEST MANAGEMENT IN ORGANIC FARMING

Crop	Tolerant / Resistant variety	Pest/Disease
Cotton	L.K.861, Kanchana	White fly
	L-603, L-604,	Jassids
	Narsimha	Helicoverpa
Groundnut	Vemana, Tirupathi, ICGS-11	Bud rot
	Kadiri, ICGS-10	Leaf spot
	ICGV-86325	Multiple resistant to pests & diseases
Red gram	ICPL-332 (Abhaya)	Pod borer
Castor	JI-144	Capsule borer

5. Trap cropping

Some crops are more preferred by the pests for feeding and egg laying are grown as trap crops on the bunds of the main crop or 1 row after 10 rows. Removal and destruction of egg masses and small larvae from trap crop reduce the pest population ***i.e.***

Crop	Pest	Trap crop
Cotton, Groundnut	Spodoptera	Castor, sunflower
Cotton, chickpea, pigeonpea	Helicoverpa	Merigold
Sesamum	Red hairy cater pillar	Cowpea
Green gram	Red hairy cater pillar	Sunn hemp

Organic farming-regulation and sustainability

What are organic foods?

Organic foods are products of holistic agricultural practices focusing on bio-diversity, soil health, chemical free inputs etc. with an environmentally and socially responsible approach that have been produced in accordance with organic production standards.

Need for standards for organic foods?

People are wary to purchase organic food due to lack of confidence about its genuineness. The problem of fraud and mis-labelling occurs when a Food Business Operator (FBO) marks a product as organic while it contains non-organic ingredients or where the organic production standards are not adhered to in the production process. Therefore, it becomes important to check if the food labelled as "organic" is genuinely organic.

Standards for Organic Foods in India?

Food Safety and Standards Authority of India (FSSAI) has the mandate to regulate manufacture, distribute, sell or import “organic foods” as per the provisions laid under Section 22 of the Food Safety Standards Act, 2006. Organic foods are regulated by Food Safety and Standards (Organic Foods) Regulations, 2017 .

The Regulations aim to benefit farmers by way of increasing their income. These Regulations recognizes two systems of certification i.e. Participatory Guarantee System (PGS) implemented by Ministry of Agriculture and Farmers Welfare and National Programme for Organic Production (NPOP) implemented by Ministry of Commerce and Industry. These regulations ensure integrity of the Organic Food products, and help in controlling unscrupulous practices in the market.

These regulations came into force from the date of their publication in Gazette, however the enforcement against these standards started from 01.07.2018.

The Offences and Penalties for the Food Business Operators who are not complying with the FSS Act, Rules and Regulations are liable for offences and penalties provided under Section 48 and 49 of the FSS Act.

Exemption from the need of verification of compliance?

Organic food which is marketed through direct sales to the end consumer by the small original producer or producer organisation is exempted from the provisions of the certification. Small

original producer or producer organisation is the one whose annual turnover is not exceeding Rs 12 Lakhs per annum.

Small aggregators upto turn over of Rs. 50 lakhs can aggregate and sell organic products from exempted farmers.

Who is responsible for certifying Organic Food?

The Accredited Certification Bodies in case of NPOP and Local Group in case of PGS-India are responsible for certifying the Organic Food.

Certified Organic Foods?

The Jaivik Bharat logo for Organic Food is an identity mark to distinguish organic products from non-organic ones. The logo is supported with the tagline "Jaivik Bharat", at the bottom, which signifies Organic Food from India.

To search the Organic Food products by name of the food and by the name of the company,

Consumer should look for the following labels on Certified Organic Food Products

Jaivik Bharat

fssai

NPOP Certified Organic Food Products

- FSSAI Logo & License No.
- India Organic Logo
- Single Ingredient products to be labelled as “Organic”.

- Multi-Ingredient products to be labelled as “Certified Organic” (minimum 95% of ingredients are of certified organic origin).
- Name and logo of the Accredited Certification Body & Accreditation Number

PGS-India Certified Organic Food Products

- FSSAI Logo & License No.
- India Organic Logo
- Single Ingredient Products to be labelled as ‘PGS-Organic’.
- Mixed/Processed Products to be labelled as ‘PGS-Organic’ (minimum 95% ingredients are PGS-Organic).
- The description of the PGS group & unique ID code.

The scale and productivity of organic sustainable systems:

In the realm of modern agriculture, the debate between organic and conventional farming methods has become increasingly prominent. As the world grapples with environmental challenges and the quest for sustainable food production, organic farming has emerged as a potential solution, acclaimed for its eco-friendly practices. However, one of the most pressing questions in this debate concerns the real productivity of organic farming systems.

Productivity Analysis of Organic Farming Systems

A key metric for assessing the productivity of any farming system is the land area required to produce a certain amount of food. Studies have shown that organic farming generally requires more land—about 2–3 times the area used by conventional farms—to produce the same quantity of food. This finding raises questions about the efficiency of organic farming, especially in a world grappling with limited land resources and increasing food demands. When assessing the productivity of organic farming, several key factors need to be considered, including land use efficiency, crop yields, and the challenges inherent in organic agricultural practices.

Land Use Efficiency

A critical aspect of productivity in agriculture is land use efficiency. Studies have shown that organic farming often requires more land compared to conventional farming to produce the same amount of food. The need for larger land areas in organic farming can be attributed to the absence of synthetic fertilizers and pesticides, which conventionally boost crop yields. The organic approach, which relies on natural fertilizers and pest control methods, typically results in lower crop densities and longer growth periods. However, this increased land requirement must be weighed against the environmental benefits of organic farming, such as reduced chemical runoff and better soil health.

Yield Gaps

The yield gap between organic and conventional farming is a significant point of discussion. On average, organic farming yields tend to be lower by about 20-25% compared to conventional methods. This gap can vary widely depending on the type of crop, climatic conditions, and the specific organic farming techniques used. While advancements in organic farming practices are helping to narrow this yield gap, achieving parity with conventional yields remains a challenge. Factors like pest and disease management, soil fertility, and the efficiency of organic fertilizers play a crucial role in determining these yields.

Challenges in Organic Farming

Organic farming faces unique challenges that impact its productivity. Pest and disease control in organic systems often requires more labor-intensive methods and a deeper understanding of ecological relationships. Additionally, maintaining soil fertility without synthetic fertilizers requires careful management of organic matter, green manures, and crop rotations. These practices, while beneficial for long-term soil health and environmental sustainability, can initially be less efficient in terms of immediate crop production, while organic farming faces challenges in terms of land use efficiency and yield gaps compared to conventional farming, it offers significant environmental benefits. The lower yields in organic farming are counterbalanced by its positive impacts on soil health, biodiversity, and overall ecosystem sustainability. As the agricultural sector continues to evolve, the role of organic farming in feeding a growing global population sustainably becomes increasingly pertinent. Future advancements in organic farming techniques and a better understanding of its ecological benefits will be crucial in maximizing its productivity and potential. Moreover, the crop rotation practices integral to organic farming often result in a reduction of the number of crops harvested per year. When this factor is combined with the inherent yield gaps—estimated at 29 to 44% depending on the crop types—the overall productivity of organic farming systems appears to lag behind that of conventional systems.

Yield Gaps and Challenges

The yield gap between organic and conventional farming is influenced by various factors. Organic farms, by eschewing synthetic fertilizers and pesticides, often face greater challenges in pest control and nutrient management. However, it’s important to note that this gap varies significantly depending on the type of crop, local environmental conditions, and the specific organic farming practices employed.

Yield Gaps and Challenges in Organic Farming

One of the critical aspects of assessing the productivity of organic farming systems lies in understanding the yield gaps between organic and conventional farming and the inherent challenges that organic agriculture faces.

Yield Gaps between Organic and Conventional Farming

Organic farming typically yields less compared to conventional farming. This yield gap is primarily attributed to the non-use of synthetic fertilizers and pesticides, which are potent in boosting crop production in conventional systems. Organic methods, relying on natural processes and inputs, often result in lower crop densities and slower growth rates. The extent of this yield gap varies significantly based on crop types, environmental conditions, and the specific organic farming techniques employed. On average, organic yields are estimated to be about 20-25% lower than those from conventional farming, although this can be much higher or lower depending on the specific circumstances.

Challenges Leading to Lower Yields in Organic Farming

1. Nutrient Management: Without synthetic fertilizers, organic farmers must rely on natural sources of nutrients, which can be less concentrated and slower to release. Managing soil fertility through compost, animal manures, and green manures requires careful planning and can be labor-intensive.

2. Pest and Disease Control: Organic farming prohibits the use of synthetic pesticides, leading farmers to depend on biological pest control, crop rotations, and other natural methods. These practices, while environmentally sustainable, may not always be as immediately effective as synthetic pesticides in controlling pests and diseases.

3. Weed Management: Controlling weeds without chemical herbicides is a significant challenge in organic farming. Mechanical and manual methods used in organic systems are often more labor-intensive and less efficient.

4. Varietal Selection: Many crop varieties have been bred for optimal performance with synthetic fertilizers and pesticides and may not perform as well under organic conditions. The development and selection of crop varieties better suited for organic systems is an ongoing challenge.

Mitigating Yield Gaps

To mitigate these yield gaps, continued research and development in organic farming methods are essential. This includes developing more efficient organic fertilizers, improving biological pest control methods, breeding crop varieties suitable for organic cultivation, and innovating weed management techniques. Moreover, understanding the ecological and environmental benefits of organic farming is crucial. While organic farming may produce lower yields, its positive impacts on soil health, biodiversity, and ecosystem sustainability are significant. These benefits must be factored into any assessment of the overall productivity and viability of organic farming systems, while the yield gap between organic and conventional farming presents a significant challenge, organic farming remains a vital part of the solution to sustainable agriculture. The challenges inherent in organic farming are balanced by its environmental and ecological benefits. Future advancements in organic farming practices and technologies will be critical in addressing these challenges and enhancing the overall productivity and sustainability of organic agriculture.

Environmental Considerations and Sustainability

Despite the challenges in productivity, the environmental benefits of organic farming are substantial. Organic methods lead to reduced pollution, enhanced biodiversity, and improved soil health. These practices are more in harmony with natural ecosystems, promoting a balanced environment. Furthermore, organic farming can contribute to mitigating climate change through carbon sequestration in soil. To enhance the productivity of organic farming, innovations in organic agricultural practices are crucial. Research in organic pest control, soil fertility management, and crop varieties suited for organic cultivation could help narrow the

yield gap. Furthermore, understanding the socio-economic aspects of organic farming, including market demands and consumer preferences, is vital for its growth and sustainability.

Future Directions in Organic Farming

As organic farming continues to evolve, addressing the challenges of yield gaps and environmental sustainability, future directions in this field must be geared towards innovation, research, and policy development. These efforts will be crucial in enhancing the productivity and sustainability of organic farming systems.

1. Advancements in Agricultural Technology: The integration of new technologies in organic farming can significantly improve efficiency and productivity. Precision agriculture, using tools such as GPS and data analytics, can optimize resource use and management in organic farms. Additionally, advancements in biotechnology, including the development of organic-compatible pest-resistant and drought-tolerant crop varieties, could substantially reduce yield gaps.

2. Enhanced Research and Development: There is a need for increased research focusing on organic farming methods, particularly in areas such as soil fertility, pest and disease management, and crop genetics. Collaborations between agricultural scientists, organic farmers, and environmentalists can lead to more effective and sustainable organic farming practices.

3. Policy and Incentive Support: Governments and international bodies can play a crucial role in promoting organic farming through supportive policies and incentives. This includes subsidies for organic farmers, funding for organic farming research, and assistance in obtaining organic certifications. Policies that encourage sustainable agricultural practices can make organic farming more viable and attractive to farmers.

4. Educational and Training Programs: Educating and training the next generation of farmers in organic practices is essential. This involves not just the transfer of knowledge but also the fostering of an understanding of the ecological and environmental principles underlying organic agriculture.

5. Consumer Awareness and Market Development: Building consumer awareness about the benefits of organic products can drive market demand, providing an incentive for more farmers to adopt organic practices. Developing robust markets for organic products, both locally and globally, can ensure economic viability for organic farmers.

6. Addressing Global Food Security: Research and dialogue on how organic farming can contribute to global food security are necessary. This includes understanding the role of organic farming in diverse agricultural contexts and developing models that integrate organic practices with broader food production systems.

7. Sustainability Assessments: Continuous assessments of the environmental, economic, and social sustainability of organic farming will be important. These assessments should consider the long-term impacts of organic farming on soil health, biodiversity, and climate change mitigation. Organic farming, with its emphasis on sustainability and ecological balance, presents a compelling alternative to conventional agriculture. However, the challenges in productivity, particularly in terms of land efficiency and yield gaps, cannot be overlooked. Balancing these challenges with the environmental benefits is key to advancing organic farming practices. As the global community continues to seek sustainable agricultural solutions, organic farming remains an important piece of the puzzle, one that requires ongoing innovation and support to realize its full potential.