IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Review on Organic Management Practices of Brinjal (*Solanum melongena* L.)

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Abstract.

Conventional agricultural practices can contribute to soil degradation and pollution, as well as pose health risks to humans. Organic farming practices can offer a more sustainable and environmentally friendly alternative to conventional methods. Organic farming focuses on building soil health through the use of natural processes and inputs, such as compost, cover crops, and crop rotation. By avoiding synthetic fertilizers and pesticides, organic farming can help reduce the negative impacts of conventional agriculture on human health and the environment.

Brinjal, also known as eggplant, is an important crop in India and other parts of the world. There is growing interest in using organic amendments to improve the quality and yield of brinjal, while also reducing the use of synthetic pesticides and fertilizers. Research has shown that organic amendments, such as compost and vermicompost, can improve soil health and increase the availability of nutrients to plants. They can also help suppress pests and diseases, reducing the need for synthetic pesticides. In addition, studies have shown that organic farming practices can increase the antioxidant content of brinjal, making it a more nutritious crop.

Overall, organic farming practices have the potential to promote sustainable agriculture cultivation, protect the environment, and improve human health. More research and investment in organic farming practices are needed to ensure that they can be implemented on a larger scale and provide a viable alternative to conventional agriculture.

Keywords: Brinjal, bio amendments, and enduring viability.

Introduction.

Solanum melongana, commonly referred to as brinjal, eggplant, or aubergine, is a widely cultivated tropical vegetable in India. Its immature fruits are utilized in the preparation of various dishes and curries and contain moderate levels of essential vitamins and minerals, including phosphorus, calcium, and iron. India ranks as the world's second-largest producer of brinjal after China, generating 12.80 million metric tons from an area of 0.73 million hectares in 2018. The cultivation of brinjal is most prominent in the states of Madhya Pradesh, Gujarat, Chhattisgarh, and Bihar, but it is distributed across nearly all states.

The use of intensive cultivation practices that indiscriminately apply agrochemicals has resulted in soil, water, and environmental pollution, leading to degradation and negative impacts on human health. Growing awareness about the importance of conserving natural resources, protecting the environment, and promoting healthy food has sparked an interest in alternative agricultural systems. The negative effects of excessive agrochemical use and consumer demand for safe and chemical-free food are driving the increasing interest in organic agriculture. However, the rising cost of fertilizers, the global energy crisis, the depletion of non-renewable energy sources, and the low purchasing power of farmers limit the use of fertilizers alone to increase crop production.

Therefore, it is crucial to use alternative sources of plant nutrients judiciously to minimize chemical fertilizer use while sustaining soil fertility and crop productivity continuously. Effective soil fertility management requires a balanced and adequate supply of nutrients, and soil quality depends on the efficient use of plant nutrients through the integrated use of all possible organic resources alongside minimal chemical fertilizers. Long-term experiments have shown that even the recommended dose of NPK alone fails to sustain soil quality and crop productivity. For instance, in 1950-51, only 0.5 kg of chemical fertilizer nutrients per hectare per year produced 51 million metric tons of food grains, but this has increased to 117 kg per hectare per year with a productivity of 230 million metric tons in 2008-09 (Tiwari, 2008)

Organic farming encourages crop diversity, which can help maintain species and increase production and productivity while improving soil and human and livestock health. Utilizing indigenous sources of nutrients through organic materials that would otherwise go to waste can reduce cultivation costs and enhance productivity. Recognized organic manures include green manures, compost, farmyard manure, vermicompost, and liquid organic manures. Organic farming is an agricultural practice that emerged in response to changing farming practices in the early 20th century. It relies on non-synthetic fertilizers of organic origin such as compost, green manure, and bone meal. Synthetic fertilizers and pesticides are prohibited, while naturally occurring substances like pyrethrin and rotenone are allowed. Organic production combines scientific knowledge of ecology with traditional farming practices based on naturally occurring biological processes. Key methods of organic farming include crop rotation, green manures and compost, biological pest control, and mechanical cultivation. These methods promote natural environmental approaches to enhance productivity, such as nitrogen fixation in the soil through legume growth, insect predator encouragement, crop rotation to confuse pests and renew soil, and non-synthetic mulches for disease and weed control

Organic farming emphasizes the importance of cultivating multiple vegetable crop species to support a diverse range of beneficial insects, soil microorganisms, and other factors that contribute to overall farm health. To maintain soil health, organic farmers utilize green manure and composting to break down organic matter and replenish nutrients in the soil that were removed by previously grown crops. Additionally, reducing tillage helps to preserve soil carbon content by limiting carbon loss through exposure to air. Weed management in organic farming focuses on suppression rather than elimination, using methods such as crop competition, phytotoxic effects, crop rotation, and selection of competitive crop varieties. Livestock raising is also incorporated into organic farming, with a focus on providing natural living conditions and feed for the animals.

Principles of organic farming

These are the guiding doctrines for producing quality food, fiber and other goods in an environment friendly and sustained manner. They convey the contribution that organic farming would make to the world.

The four principles of organic farming are:

1. **Principle of health:** organic farming focuses on maintaining and improving the well-being of the entire ecosystem, including soil, plants, animals, and humans. The interconnectedness of all living beings highlights the importance of promoting physical, mental, social, and ecological health. Organic farming aims to sustain and improve the health of ecosystems from production to consumption, benefiting all organisms, from the smallest in the soil to human beings. This principle emphasizes the exclusion of synthetic fertilizers, pesticides, animal drugs, and food additives.
2. **Principle of ecology:** organic farming requires that it should be aligned with and emulate living ecological systems and cycles while promoting sustainability. The goal is to harmonize with the natural ecosystem instead of attempting to dominate it, while also adapting to local conditions, culture, and scale. Organic farming practices should be geared towards minimizing input use through the efficient management of materials and energy, as well as reusing and recycling resources, to maintain and enhance environmental quality, and conserve resources. A suitable system of farm design, habitat establishment, and biodiversity conservation should be employed to maintain the ecosystem.
3. **Principle of fairness:** organic farming requires that all individuals and living beings should be treated with equity, respect, and justice regarding the shared environment and life opportunities. This involves ensuring that animals are provided with living conditions that allow them to express their natural behavior and that natural and environmental resources are managed in a way that considers their use by future generations. Fairness also extends to the relations between people and other living beings, to maintain a harmonious coexistence within the ecosystem.
4. **Principle of care:** organic farming emphasizes the need for responsible and precautionary management to safeguard the health and well-being of present and future generations as well as the environment. The pursuit of higher agricultural productivity should not come at the expense of human and environmental health. It is essential to exercise caution and take responsibility in the choices of management practices, technological developments, and innovations. Organic farming integrates scientific advancements with practical experience, traditional wisdom, and indigenous knowledge to

find sustainable solutions. This principle discourages the use of untested and potentially harmful technologies, such as genetically modified (GM) crops.

The characteristics of organic farming systems, by the principles of organic farming, include:

1. Promoting and enhancing biological cycles within the farming system.
2. Preserving or improving long-term soil fertility.
3. Utilizing organic matter and nutrients within closed systems, preferably from renewable resources.
4. Avoiding any type of pollution.
5. Preserving biodiversity at both regional and local levels.
6. Allowing livestock to behave naturally.

Producing food that is socially and economically acceptable, as well as high-quality and in adequate quantities.

1. The main goal of organic farming is to enhance soil fertility by improving the biological processes that support nutrient uptake in crops.
2. Effective management in organic farming relies on traditional crop techniques, the use of bio-pesticides, and careful monitoring of pest, weed, and disease levels to maintain a balanced ecosystem.
3. Farm waste and manure recycling are key to maximizing the uptake of necessary nutrients.
4. The sustainability of nitrogen in the soil can be improved by growing leguminous crops and promoting natural biological nitrogen fixation.
5. Natural soil micro-organisms and chemical reactions are important contributors to the natural supplementation of vital crop nutrients.

Organic Farming Options:

Organic farming provides alternative options to conventional agricultural practices and can be broadly categorized into three types:

1. Pure Organic Farming: This prohibits the use of synthetic fertilizers and pesticides.
2. Integrated Green Revolution Farming: this uses high-yielding hybrid varieties and employs Integrated Nutrient and Pest Management practices.
3. Integrated Farming System: which relies on locally available resources and the recycling of agricultural waste.

Organic Farming in India:

Organic farming holds great potential in India because 70% of cultivable land is rain-fed and farmers have traditionally relied on locally available resources instead of synthetic fertilizers. This presents an opportunity for the country to lead in organic farming. The North-Eastern region is particularly promising, with 18 million hectares of arable land suitable for the organic production of crops. In India, there are three types of farmers engaged in organic farming:

1. Those who follow traditional Indigenous Technical Knowledge (ITKs) that have been passed down for generations.
2. Farmers who own small to medium-sized landholdings.
3. Private companies that have converted to organic production practices on a large scale in response to market demand and pressure

Despite being a major exporter of agricultural products, India does not export organic produce. The country generates approximately 700 metric tonnes of agricultural waste, but less than 20% of it is utilized effectively. Proper utilization of this waste could lead to a surplus of organic matter and essential nutrients for the soil. However, only a small fraction of this waste is currently being utilized in the open field. To address this issue, various technologies have been developed to produce large quantities of nutrient-rich organic manure/compost, such as vermicompost and bio-fertilizers, which can serve as alternative sources of soil nutrients

Importance of Organic Brinjal in India:

Brinjal is considered the fourth most important vegetable crop in India, after potato, onion, and tomato, and is planted thrice a year during the kharif season (June-Sept), rabi season (Nov-Feb), and in March. This crop is predominantly grown by small and marginal farmers who rely on it as a major source of income. However, brinjal production is associated with several challenges that lead to significant yield losses, with the most destructive pest being the fruit and shoot borer, responsible for 60-70% of yield losses. To control this pest, farmers heavily rely on synthetic pesticides, which have negative impacts on the environment and farmers' health.

Alternative methods such as mechanical control and integrated pest management are not widely adopted due to a lack of collaboration and labor requirements.

The use of chemicals to control the problems in brinjal production is leading to a slow decline in soil health and poses a risk to public health as the product is heavily exposed to harmful chemicals. To prevent this, it is crucial to adopt a sense of responsibility towards each other and the land, which is the source of our food. Organic farming is a beneficial practice that can eliminate the use of dangerous field chemicals and improve the quality of brinjal produce. This can lead to increased demand and income in the brinjal market.

Chakravarty and Kalita (2006) conducted both a field and lab experiment to explore the potentiality of various organic formulations of *Pseudomonas fluorescens* and to manage bacterial wilt disease of brinjal under local conditions and found that, CVPf formulation and seed + root + soil method of application performed better in comparison to others with 83.33% of bacterial wilt control.

Zadda et al., (2007) reported that, the application of organic sources of nutrients and amendments such as FYM, poultry manure, neem cake, mahua cake, pungam cake and biofertilizers i.e. *Azospirillum*, phosphobacteria and silica solubilizing bacteria significantly enhanced the production of defensive chemicals viz., silica and phenols in plants and thus exhibiting induced resistance to pests. Brinjal plants, applied with organics, registered less quantity of reducing sugars, proteins and leaf chlorophyll making the plants less prone to insect attack.

Badoni and Chauhan (2009) experimented to analyze the seed germination and growth behavior of brinjal with synthetic fertilizer (NPK) and organic manure (Cow Dung) by sowing seeds of *Solanum melonagana* L. cv. BR 112 in poly bags (1 seed/bag) at a depth of 2.5 cm with different treatments *viz*. S1 (Control – only soil), S2 (Soil + NPK) and S3 (Soil + Cow dung) and their results revealed that cow dung showed maximum germination percentage *i.e.* 49 plantlets from 50 seeds than control (29 plantlets) and NPK (35 plantlets).

Shahid *et al.*, (2009) conducted two greenhouse experiments to study the potential of bio-pesticides, chemical pesticides, organic amendments and bio-control in controlling the root-knot nematode *Meloidogyne incognita* on brinjal 'cv' Dilnasheen. In the first trial, bio-pesticides (Abamectin and Azadirachtin) and a synthetic pesticide (Lorsban) individually and together along with the combination of a bio-control agent *Pasteuria penetrans* were used and in another, bio-pesticides (Abamectin and Emamectin) and organic amendments (sawdust and Conair leaves) and a chemical pesticide (Furadan) were used. Both experiments revealed that the use of bio-pesticides and organic amendments resulted in the best control of the root-knot nematode. Later, **Ashadul *et al.*, (2011)** studied the effect of plant extracts on the management of fruit and shoot borer (*Leucinodes orbonalis* Guenee) in brinjal (cv. Singhnath), the experiment consisted of eight treatments *viz.* T1: Tamarind fruit extract, T2: Bon kolmi leaf extract, T3: Ata leaf extract, T4: Neem leaf extract, T5: Tobacco leaf extract, T6: Mahogany seed extract, T7: Aktara 25 WG and T8: Control. Among all the treatments, T4 treatment resulted in a higher number of total shoots (16.0 per plant), healthy shoots (15.7 per plant), total fruits (25.3 per plant), healthy fruits (23.0 per plant), fruits weight (2.7 kg per plant), healthy fruits weight (2.7 kg per plant) and fruit yield (36.2 t/ha).

Rahman *et al.* studied the effect of spent mushroom substrate (SMS) and cow dung on the growth, yield and composition of brinjal (BARI Begun-6 and BARI Begun- 8). The result revealed the highest plant height, branch per plant, earliest days to first flowering, the highest number of fruit per plant, the weight of individual fruit, yield per plant and yield per ha, highest crude fiber, protein, K, and Mg in T3 treatment for both cultivars. However, T1 recorded the highest dry matter, carbohydrate, lipid, Zn and Na content. Whereas the highest ash content, P, Ca and fe content was found in T2 treatment.

Waseem *et al.*, (2011) conducted a pot experiment to evaluate the effect of different growing media *viz.* river soil, FYM, poultry manure, river soil + poultry manure, river soil + FYM, FYM + poultry manure and river soil + FYM + poultry manure. It was found that FYM + poultry manure application proved to produce better vegetative growth in the crop and a combination of all, river soil + FYM + poultry manure gave rise to much better reproductive growth.

Munshi (2012) experimented to assess the effectiveness of organic waste compost made from household and cafeteria refuse on insect-pest suppression and yield of brinjal. The experiment comprised four treatments *viz.* T1: 16 kg compost per plot, T2: 32 kg compost per plot, T3: 50% NPK + 32kg compost per plot and T4: 100% NPK. T1 and T2 plots demonstrated lower insect and disease infestation and T3 plots gave significantly greater yield.

Kumar (2013) conducted a field experiment to study the effects of Integrated Nutrient Management (INM) practices on soil fertility and crop yield of the hybrid cultivar of Brinjal (cv. F1 hybrid purple long). Ten treatments were applied during the investigation viz. without nutrient (control) (T1), the recommended dose of fertilizer (RDF) (T2), vermicompost @ 5 t/ha (T3), sugarcane press mud compost @ 5 t/ha (SPC) (T4), FYM @ 12.5 t/ha (T5), sewage sludge @ 2 t/ha (SS) (T6), 50% RDF + vermicompost @ 5t/ha (T7),

50% RDF + SPC @ 5 t/ha (T8), 50% RDF + FYM @ 12.5 t/ha (T9) and 50% RDF + SS @ 2 t/ha (T10). The agronomical results were remarked in the descending order of T7 > T10 > T9 > T8 > T3 > T6 > T5 > T4 > T2> T1.

Roy et al., (2013) conducted a trial on the application of rural slaughterhouse waste as an organic fertilizer for pot cultivation of solanaceous vegetables. In their experiment, Waste blood and rumen digesta were mixed in 1:1, 2:1, and 3:1 ratios and dried to obtain a 'bovine-blood-rumen-digesta-mixture' (BBRDM). The efficacy of this combination was compared with diammonium phosphate (DAP) in pot cultivation of tomato, chili, and brinjal. The application of 5 g of BBRDM (N/P/K = 30.36:1:5.75)/kg of soil at the 2nd and 6th weeks produced earlier fruiting by 2 weeks and produced a higher yield by 273% for brinjal in BBRDM (3:1) as compared to DAP. Although high N concentration caused toxicity when applied at the time of planting to young plants, BBRDM enhanced the yield and productivity when applied to mature plants after 15 days of the plantation. Higher numbers of *Azotobacter*, phosphate-solubilizing bacteria, fungi, and amount of chlorophyll were also isolated from soils treated with BBRDM than with DAP.

Sundararasu and Jeyasankar (2014) experimented to investigate the effects of vermiwash on the growth and productivity of brinjal and reported that vermiwash spray amplified the growth parameters *viz.*, plant height and a number of leaves, and yield parameters *viz., the* number of flowers and fruits per plant at the same time flowering and fruiting ratio was significantly increased as well. It could also be seen that the extracts from earthworms offer a valuable resource that could be effectively exploited for increasing the production of brinjal.

Samadhiya *et al.*, (2014) also studied the effect of vermiwash and vermicompost on the growth and development of leaf and shoot length in brinjal and revealed a significant result with vermiwash and vermicompost as compared to soil and dung only.

Doifode and Nandkar (2014) tested the influence of biofertilizer inoculation viz. *Azotobacter* and Phosphate Solubilizing Bacteria (PSB) alone and in different combinations with recommended doses of NPK. Growth characteristics such as plant height, stem diameter, length of root, etc. were found to have significant improvement in inoculated crops along with high yield of fruits and prevention of infestation of fruit and shoot borer.

Ravindra *et al.*, (2014) conducted a field experiment in a plot of brinjal which was infested by root-knot nematode to evaluate the efficacy of acacia compost individually and in integration with bioagents such as *Pochonia chlamydosporia* and *Paecilomyces lilacinus* and revealed the lowest root-knot nematode indices in treatments with the combination of acacia compost and *P. lilacinus*.

Thingujam *et al.*, (2015) experimented to study the effects of INM on the nutrient accumulation and plant nutrient status of the post-harvest soil of Brinjal. Results showed that the treatment which comprised 75% RDF (NPK 125:100:50) + *Azospirillum* + PSB + Borax @ 10 kg/ha recorded the highest oxidizable organic carbon (8.049 g/kg), total nitrogen (1.05 g/kg), available nitrogen (212.67 g/kg), available phosphorus (76.20 g/kg) and available potassium (177.59 g/kg) in the post-harvest soils of brinjal.

Hossen *et al.*, (2017) experimented to investigate the effects of different organic and inorganic mulches such as black polythene, transparent polythene, rice straw, sawdust and control on soil properties and brinjal growth and yield. Regarding soil properties, black polythene reduced soil acidity while saw dust mulch was better in respect of total nitrogen and organic matter contents. Concerning yield, rice straw proved to be far more effective in producing higher yields as compared to other types of mulches. Mishra (2018) conducted a trial on the effect of organic manures and bio-fertilizers on brinjal cv. Kashi Taru concluded that the use of FYM, Vermicompost, neem cake, PSB and Azospyrillum at a specific concentration can considerably increase the fruit weight and total yield of brinjal.

Conclusion and Prospects:

From the cited experiments and case studies above, it is perceptible to know that the use of the organics and its amendments in the production of brinjal has an ample scope and added benefit in the country. A significant change in fruit quality and yield parameters not only satisfies the needs of the consumers but also pleases the income capacity of various local markets and large-scale outputs. Therefore, through this review, one can adapt the need to inculcate organic practices for the year-round cultivation of brinjal and through self-experience, impart the knowledge to local farmers, spreading awareness which slowly takes the initial steps towards the expulsion of the need for top reliance on synthetic fertilizers in the field of agriculture.

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