A Review on Organic Production of Brinjal (*Solanum melongena*)

Mishael R. Marak, T. Chamroy and Asha Rajkumari

Department of Horticulture, School of Agriculture
Lovely Professional University
Phagwara, Punjab-144411

Abstract.

Our present day scenario of conventional agricultural practices can be considered as an alternative source of pollution and degradation to the soil. Not only this, exploitation and overdose of chemical fertilizers also proves to be detrimental to human health, augmenting the chance of cancer and other life threatening diseases. For this, we need to begin our advancement in organic farming practices so as to keep a check on not only human health, but also environmental health, thus ensuring a sustainable agriculture cultivation scenario around the globe and particularly in India. Thus, many investigations had been done to make use of a number of organic amendments in enhancing the quality and yield, keeping a check on pests and diseases and improving the nutritive value of different cultivars of brinjal (*Solanum melongana* L.) mainly White, Green and Purple types of brinjal.

Keywords: Brinjal, organic amendments, sustainability.

Introduction.

Brinjal (*Solanum melongana*) is one of the most common tropical vegetable grown in India and is known by a wide range of nomenclatures such as aubergine (French), egg plant, baingan (Hindi), etc. Immature brinjal fruits are used to prepare a variety of curries and dishes. Fruits are moderate sources of vitamins and minerals like phosphorous, calcium and iron and nutritive value varies from variety to variety. India is the second largest producer of brinjal in the world next to China and produces 12.80 mt from an area of 0.73 mha (Anonymous, 2018). Cultivation of brinjal is highest in Madhya Pradesh, Gujarat, Chatisgarh and Bihar and is also distributed in almost all the states.

Intensive cultivation practices with indiscriminate use of agro-chemicals has polluted the soil, water and environment causing their degradation and also affected human beings. Increasing consciousness about conservation of natural resources, protection of environment as well as healthy food is creating interest among the people on alternative agricultural systems. Adverse effect with excessive use of agro-chemicals in agriculture and consumer preference to safe and hazard free food are the driving forces for growing interest in organic agriculture. Increase in the cost of fertilizers, worldwide energy crisis, and rapid exhaustion of non-renewable energy sources and low purchasing power of farmers restricts the use of fertilizers alone as an input

for increasing crop production. Under these conditions, it has become imperative to use alternate sources of plant nutrient in a judicious way to minimize chemical fertilizer use and at the same time to sustain soil fertility and crop productivity on a continuous basis. Sustaining crop productivity depends mainly on the soil fertility management which involves adequate and balanced supply of nutrient. Therefore, soil quality depends on the efficient use of plant nutrients through judicious and integrated use of all possible organic resources in conjunction with minimum chemical fertilizers. In long term experiments even application of recommended dose of NPK alone fails to sustain the soil quality and crop productivity. In 1950-51 only 0.5 kg chemical fertilizer nutrients per ha per year were used to produce 51 million MT of food grains, which has increased to 117 kg per hectare per year with a productivity of 230 million MT in 2008-09 (Tiwari, 2008).

The organics are the indigenous source of nutrients which can help in increasing production and productivity along with improvement in soil physical conditions. Use of such organic materials, which are being wasted in large amounts without proper use otherwise, can help in reducing cost of cultivation, increasing productivity and improving soil as well as human and livestock health. Various organic manures so far recognised in this group are green manures, rural/urban compost, farmyard manure, vermicompost and liquid organic manures etc. Organic Farming therefore, is an optional system of agricultural practice which is believed to have originated early in the 20th century in response to the hotfooted change in farming practices. It is defined by the use of non-synthetic fertilizers, having organic origin, *viz*., compost manure, green manure, bone meal, etc. The use of crop rotation, companion planting, biological pest control, mixed cropping is designed to allow the use of naturally prevailing substances while meticulously restricting the use man-made, synthetic substances. For instance, natural substances such as pyrethrin and rotenone are allowed while synthetic fertilizers and pesticides are illicit. This practice of organic production combines the scientific comprehension of the ecology and some latest interventions with traditional farming habits based on naturally occurring biological processes. The predominant methods of organic farming include crop rotation, green manures and compost, biological pest control, and mechanical cultivation. These pave way for the natural environmental approaches to amplify productivity: legumes are grown to fix nitrogen in the soil, encouragement of insect predators, crop rotation to confuse pests and renew the soil, use of non-synthetic mulches for disease and weed control.

Crop diversity is highly encouraged in organic farming. It helps in keeping species extant and maintaining the environmental burgeons. Growing a number of vegetable crop species support a broader range of advantageous insects, soil microorganisms, and other factors that add up to overall farm health. Use of green manure and composting not only maintains soil health, but also break down the organic matter which replace nutrients taken by from the soil by formerly grown crops. Reducing tillage is also a factor followed in organic farming which reduces the exposure of soil to air; this reduces the carbon loss resulting in more organic carbon content in the soil.

Organic weed management promotes weed suppression instead of weed elimination. This is executed by intensifying crop competition and phytotoxic effects of weeds. Crop rotation induces dissimilar crop cycles which inhibit weed growth in association to a particular crop. Selection of competitive crop varieties, high density planting, tight row spacing and late planting help suppress weeds in addition to rapid crop germination. Raising of livestock is another method which complements organic growth. In this, the farms provide the animals with natural living conditions and feed.

Basic Concepts of Organic Farming:

i) In order for the crop to be able to attain maximum nutrients from the soil, organic farming focuses on enhancing the biological fertility of the soil.

ii) A balance in the ecosystem keeps a check on the volume of pests, weeds and diseases, thus ensuring their proper management, along with the use of traditional cropping patterns and bio-pesticides.

iii) An optimal consumption of essential nutrients is maintained by the recycling of manures and all wastes within the farm.

iv) Growing leguminous crops and allowing natural biological nitrogen fixation increases the sustainability of available nitrogen in the soil.

v) Through the action of soil micro-organisms and the chemical reactions in the soil, the natural supplementation of necessary crop nutrients is provided.

Organic Farming Options:

In order to nullify the short-comings or difficulties faced by the conventional agricultural practices, organic farming is grouped into three different categories:

1. **Pure Organic Farming** (Strict prohibition of any sort of synthetic fertilizers, pesticides, etc.)
2. **Integrated Green Revolution Farming** (Use of high yielding, hybrid varieties with the use of Integrated Nutrient and Pest Management.)
3. **Integrated Farming System** (Use locally available resources and recycling of agricultural wastes.)

Organic Farming in India:

India has a high potential of taking the front line the field of organic farming since 70% of the cultivable land is pre-dominantly rain-fed and the farmers hardly make use of the synthetic fertilizers. Having already the plentiful amount of available resources in their own lands, farmers solely depend on them, thus negating the need to acquire synthetic resources. The North-Eastern Region, in this regard, is known to have significantly high potential and considerably opportunity for organic farming in the country. About 18 million ha of arable land is available in the N-E which can be used for organic production of agronomical and horticultural crops. In India, there are three types of farmers who are engaged in organic farming;

1. Farmers who follow the century old ITKs.
2. Farmers who have small to medium sized holdings.
3. Private companies who under the pressure and demand of the markets, make large scale conversions to organic production practices.

In spite of being a large exporting nation, our country still does not export an organic produce. It had been found that India produces about 700 metric tonnes of agricultural wastes, out of which not even 20% is used properly. Proper utilization of such wastes could result in the surplus availability of the required organic matter and essential nutrients for the soil. However, in reality, only a fragment of this is available for utilization in the open field. For this purpose, various technologies have been developed in order to produce immense quantities of nutrient-rich organic manure/compost (vermicompost, bio-fertilizers, etc.) which act as an alternative source of soil nutrients.

Importance of Organic Brinjal in India:

Following potato, onion and tomato, brinjal is considered as the fourth most important vegetable crop in India. It is planted three times in a year in the country; during the kharif season (June-Sept), rabi season (Nov-Feb) and in the month of March. The crop is mainly grown by small and marginal farmers, playing the role of an important income source. These come with an array of problems in production, which cause a large number of yield losses. About 60-70% of yield losses were caused by the most devastating pest i.e., fruit and shoot borer. In order to manage this, farmers rely on a large amount of synthetic pesticides which in turn cause different side effects that not only cause harm to the ecology, but also the health of the farmers. Other methods such as mechanical control and integrated pest management are not well known among the farmers due to lack of collaborative action and labour requirements.

The continuous non-judicious use of chemicals in order to curb the pre-existing problems in the production of brinjal is proving to be a gradual degradation in the soil health of the country. Apart from this, produce provided to the daily customers are those which have been heavily exposed to such chemicals which can in the long run deteriorate the health of the population as a whole. Thus, in order to prevent the practice of such perilous cultivation of brinjal, it is imperative that we develop a sense of need to care for one another and the land, which is the birth-place of all edibles that we consume. For this, we can inherit the beneficial practice of organic farming, which keeps a check and totally restricts the use of these hazardous field chemicals. This can also be developed for the production of brinjal which can add a hearty benefit to not only the quality of produce, but also increase its demand, thus amplifying the income generated by the brinjal market.

Som *et al*., (1992) conducted an experiment on aubergine cv. Garia with 4 oilcakes viz., karanj [*Pongamia pinnata*], mahua [*Madhuca longifolia*], mustard [*Brassica juncea*] or neem [*Azadirachta indica*] cake, applied

@ 12.5, 25.0 or 50.0 q/ha along with a constant NPK fertilizer dose and obtained the highest growth and yields with application of 50 q neem cake/ha.

Ullah *et al*., (2004) tested the effects of organic manures and chemical fertilizers on the yield of brinjal and found that the application of mustard oil cake/poultry manure alone gave better performance compared to any chemical fertiliser. attack. **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, 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)** performed an experiment to analyse the seed germination and growth behavior of brinjal with synthetic fertiliser (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 (saw dust and kanair 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 for the management of fruit and shoot borer (*Leucinodes orbonalis* Guenee) in brinjal (cv. Singhnath), the experiment consisted of eight treatments *viz.* T_1: Tamarind fruit extract, T_2: Bon kolmi leaf extract, T_3: Ata leaf extract, T_4: Neem leaf extract, T_5: Tobacco leaf extract, T_6: Mahogany seed extract, T_7: Aktara 25 WG and T_8: Control. Among all the treatments, T_4 treatment resulted with 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). During the same year **Rahman *et al.,*** studied the effect of spent mushroom substrate (SMS) and cow dung on growth, yield and composition of brinjal (BARI Begun-6 and BARI Begun-8). The result revealed highest plant height, branch per plant, earliest days to first flowering, highest number of fruit per plant, weight of individual fruit, yield per plant and yield per ha, highest crude fiber, protein, K and Mg in T_3 treatment for both cultivars. However, T_1 recorded the highest dry matter, carbohydrate, lipid, Zn and Na content.

Whereas the highest ash content, P, Ca and fe content was found in T_2 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) carried** out an experiment 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 of four treatments *viz.* T_1: 16 kg compost per plot, T_2: 32 kg compost per plot, T_3: 50% NPK + 32kg compost per plot and T_4: 100% NPK. T_1 and T_2 plots demonstrated lower insect and disease infestation and T_3 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 hybrid cultivar of brinjal (cv. F_1 hybrid purple long). Ten treatments were applied during the investigation viz. without nutrient (control) (T_1), recommended dose of fertiliser (RDF) (T_2), vermicompost @ 5 t/ha (T_3), sugarcane pressmud compost @ 5 t/ha (SPC) (T_4), FYM @ 12.5 t/ha (T_5), sewage sludge @ 2 t/ha (SS) (T_6), 50% RDF + vermicompost @ 5t/ha (T_7), 50% RDF + SPC @ 5 t/ha (T_8), 50% RDF + FYM @ 12.5 t/ha (T_9) and 50% RDF + SS @ 2 t/ha (T_{10}). The agronomical results was remarked in the descending order of $T_7 > T_{10} > T_9 > T_8 > T_3 > T_6 > T_5 > T_4 > T_2 > T_1$.

Roy et al., (2013) conducted a trial on 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 'bovine-blood-rumen-digesta-mixture' (BBRDM). The efficacy of this combination was compared with diammonium phosphate (DAP) in a 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 2^{nd} and 6^{th} weeks produced earlier fruiting by 2 weeks and produced 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 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)** conducted an experiment to investigate the effects of vermiwash on growth and productivity on brinjal and reported that vermiwash spray amplified the growth parameters *viz.*, plant height and number of leaves, and yield parameters *viz.*, 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 which 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 biofertiliser inoculation viz. *Azotobacter*

and Phosphate Solubilizing Bacteria (PSB) alone and in different combinations with recommended dose of NPK. Growth characters 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 thelowest root-knot nematode indices in treatments with the combination of acacia compost and *P. lilacinus*. **Thingujam *et al.*, (2015)** carried out an experiment 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 of 75% RDF (NPK 125:100:50) + *Azospirillum* + PSB + Borax @ 10 kg/ha recorded the highest oxidisable 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)** conducted an experiment to investigate the effects of different organic and inorganic mulches such as black polythene, transparent polythene, rice straw, saw dust and control on soil properties and brinjal growth and yield. In relation to soil properties, black polythene reduced soil acidity while saw dust mulch was better in respect of total nitrogen and organic matter contents. With respect to yield, rice straw proved to be far more effective in producing higher yield 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 and concluded that use of FYM, Vermi-compost, neem cake, PSB and Azospyrillum at a specific concentration can considerably increase the fruit weight and total yield of brinjal.

Conclusion and future 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 in 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 of top reliance on synthetic fertilizers in the field of agriculture.

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