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RESPONSE OF ORGANIC MANURES ON QUALITATIVE AND QUANTITATIVE PARAMETERS OF SOLANACEOUS CROPS: A REVIEW

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ABSTRACT

Excessive uses of chemical fertilizers in agriculture have disturbed the equilibrium of several environmental factors. This problem was recognized by the eminent ecologists, botanists and plant scientists who have changed people's behaviour to shift towards organic farming. Solanaceous being one of the major & fascinating groups in vegetables cultivated throughout the world. Cultivation practices in this group are highly intensive with using of many synthetic fertilizers that could lead to change in biotic and abiotic components. To overcome these issues organic farming could be a better alternative and implementation this system will surely help in improving the growth, yield & quality traits and reduction in the incidence of diseases & pests attack along with sustaining the soil health. Thus, adoption of such farming system would be helpful in improve production & for fulfilling the demand of consumers of solanaceous crops and sustaining the soil health as well. Considering the above fact, this review is intended to have a better understanding of organic manure response in terms of various quantitative as well as qualitative traits in solanaceous crops.

Keywords : Abiotic, Biotic, Chemical fertilizer, Ecologists, Organic farming, Solanaceous.

Introduction

The significant increase in agricultural production occurred in the period of 1960s to 1980s in India. During this period India got self-sufficiency in agriculture but excessive use of chemical fertilizers gave rise to many constraints including soil, water and air pollution which impaired human and animal health. Neutralization of such fatal inputs are desperately needed for the ecological sustainability. Organic agriculture is a type of ecological agricultural management that encourages biodiversity, biological cycles and environment stewardship through avoidance of using chemical fertilizer, growth regulators and pesticides to achieve long term environmental sustainability. It reduces the consumption of external resources by increasing soil biological activity, employs cultural practices that sustain ecological balance as inputs. Organic manures can be used instead for chemical fertilizer without decreasing the yield of crop if used in effective manner. It helps in improving the soil qualities in addition to yield (Greenspan, 2009). Organic matter is the resulted product of decomposition of various animal and plant-based products with aid of soil microorganism which provides different nutrients to plants. Organic manures improve the soil quality through enriching soil micro-flora and fauna activity in soil. Solanaceae is highly a diverse family that consists of perennial & annual species members of about 3000–4000 which is further classified into 90 genera (Knapp *et al.*, 2004). Some of the major solanaceous members including Potato, Tomato, Eggplant and Chilli are consumed all over the world but are threatened by various biotic and abiotic stresses (Colla *et al.*,

2008). Solanaceous crops have their significant role in balance diet as well as possess high marketing value. Therefore, scientific communities are continuously improving them through different breeding and other innovative practices (King *et al.*, 2010; Schwarz *et al.*, 2010). Responses of different organic manures with or without inorganic fertilizers on growth, yield, quality & other related traits of solanaceous vegetable crops stated in the Table 1.

Different responses of organic manures on different aspects in solanaceous crops

Response on soil fertility

Singh *et al.* (2007) conducted a study and revealed that application of organic manure improved the microbial activities in soil as compare to chemical fertilizers and also noticed progress in soil dehydrogenase and phosphatase enzyme activity. Raghav *et al.* (2008) reported that addition of organic manure like FYM, vermicompost, and poultry manure with the inorganic fertilizer improved the quality of soil as well as nitrogen availability in the soil. Kumar *et al.* (2009) reported that application of FYM improved the physical parameters and organic carbon content in the sub soil in potato field. Sarkar *et al.* (2013) observed that application of FYM at the rate 30 t/ha with bio-fertilizer increases the availability of NPK in the potato field soil. Kumar *et al.* (2012) performed an experiment and observed that organic manures had great effect on improvement of carbon pool in soil whether it will be used alone or in combination with inorganic fertilizer. Rees *et al.* (2014) reported that three annual applications of poultry manure

resulted into increased earthworm populations, soil CO₂ concentrations, infiltration and significantly increased level of P, B, Cu, K, Na, S & Zn in soil. However, soil organic carbon did not change.

Response on diseases & pests

Organic amendments help to control the incidence of diseases & pests as well as improves the crop growth and yield without affecting the environment (Pakeerathan *et al.*, 2009). Jadhav & Ambadkar (2007) reported highest seedling emergence in tomato, chilli & brinjal with *Trichoderma harzianum* Rifai, inoculation. They also observed highest seedling emergence in chilli with the inoculation of *Trichoderma viride* Pers, whereas lowest seedling mortality in chilli, brinjal and tomato was recorded with the applications of *T. harzianum*, *T. viride*. Kavitharaghavan *et al.* (2006) noticed that organic manures help in declining feeding rate of pest, oviposition durability and population buildup whereas these amendments prolonged the nymphal duration of eggplant pests as organic manures were found to release defensive chemical *viz.*, phenols and silicon dioxide, which revealed induced resistance in terms of antibiosis. Sureshi *et al.* (2007) conducted a field experiment with the applications of FYM, neem cakes, poultry manure & pungam cake in addition of parasitoids egg for e.g., *Trichogramma chilonis* and observed decreased incidence of shoot & fruit borer with enhanced yield in brinjal. Sathish *et al.* (2009) noticed that applications of neem with pungam & sweet-flag extract or in combination with HaNPV, Bt and spinosad helps in control of *Helicoverpa armigera*. Summers (2011) observed that application of organic manure helps to control the incidence of parasitic nematodes by promoting the multiplication of micro-organisms (fungi & bacteria) therefore improve the growth and yields of crop. Abolusoro *et al.* (2013) reported that application of poultry manure, domestic waste, cow dung and inorganic fertilizers helped to decrease the incidence of nematodes and enhance the growth of eggplant.

Response on growth parameters

Kumar & Sharma (2006) recorded highest shoot & root length, maximum fresh & dry shoot & root weight and maximum number of fruits per plant with the application of *Glomus fasciculatum* at nursery stage of tomato. Shukla *et al.* (2006) observed that with the application of chemical fertilizers with FYM & vermicompost early flowering was induced in tomato. However, the picking was done initially with the application of FYM and vermicompost alone. Ullah *et al.* (2008) to study the response of fertilizer and organic manure on the yield of brinjal. The combined application of organic manure and fertilizer had increase number of branches in this experiment. Prativa & Bhattari (2011) revealed that combined application of FYM along with vermicompost increased plant height, number of leaves per plant, number of fruit clusters, fruit weight and fruit yield. However, earliness in days to 50% of flowering was observed with the application of FYM at the rate 20 mt/ha.

Response on yield traits

Organic manure helps to increase yield of solanaceous crops without affecting soil quality in a sustainable way. The supplement of nitrogen through different organic sources affects the growth & yield of tomato where application of FYM was being used as substitute of 100% nitrogen

improved the plant height, number of branches and yield as compare to application of urea alone in tomato plant (Kannan *et al.*, 2006). Kumar *et al.* (2011) also observed increased yield and yield attributes through the application of the poultry manure with recommended dose of fertilizer in potato. Najm *et al.* (2012) recorded increased yield of potato tubers through combined application of cattle manure and nitrogen. Sepat *et al.* (2012) revealed that there was no difference with increase in dose of NPK on growth parameters & yield parameters whereas combined application of NPK with FYM and Azotobacter had considerably profound effect on growth and yield parameters over other treatments in tomato crop. Islam *et al.* (2013) observed increased weight of tuber, dry matter accumulation and yield with application of poultry manure and chemical fertilizer. Chatterjee *et al.* (2014) concluded that application of 75% RDF, vermicompost and biofertilizer was best suited for growth, fruit yield and other yield traits in tomato crop. Jamir *et al.* (2017) observed increased number of fruits, fruit weight and yield of sweet peeper through application of FYM, vermicompost and poultry manure along with chemical fertilizers. Hossain *et al.* (2022) observed that among 12 different treatments the best growth was obtained through Trichocompsot + N₂₃P₁₀K₂₅ kg ha⁻¹ in red capsicum.

Response on quality traits

Application of organic manure helps to improve quality parameters such as pH, total soluble solids, titratable acidity, reducing sugar, non-reducing sugar, crude protein and ascorbic acid content in solanaceous vegetables. Chassy *et al.* (2006) found that conventionally managed tomatoes do not show positive response towards quality traits whereas organically managed Burbank tomatoes exhibited higher soluble solids percentage, quercetin, kaempferol and ascorbic acid but only soluble solids percentage and kaempferol was higher in organic Ropreco tomato on fresh weight basis. Daood *et al.* (2006) observed that the levels of quality components were high in organically cultivated disease resistance hybrid varieties. Barrett *et al.* (2007) reported that the tomato juice of organically grown tomatoes contains high soluble solids, consistency and titratable acidity. Haase *et al.* (2007) observed that the tubers of potato obtained from the organic cultivation contains higher dry matter concentrations about 19% dry matter best suited for making French fries than conventionally grown potatoes. Hallmann & Rembialkowska (2007) observed that organic red pepper fruits contained more amount of vitamin C, carotenoids, flavonoids and dry matter with antioxidant properties as compare to conventional. Hallmann *et al.* (2008) observed that lycopene content was higher in conventional type but total and reducing sugars, organic acids, ascorbic acid, β-carotene, flavonoids and phenolic acids were higher in organic tomatoes. Hallmann *et al.* (2007) concluded that bioactive compounds like vitamin C and flavonoids, total and reducing sugars, were higher as well as acidity was high in organic fruits of paprika. Najm *et al.* (2012) concluded that chlorophyll a, b and total chlorophyll content significantly increased in response to organic manure and nitrogen fertilizer in Agria potato.

Response in nutrient uptake

Sharifi *et al.* (2009) noticed improved nutrient uptake through the application of organic manures in potato crop. Jatav *et al.* (2011) observed that nutrient uptake with

application of organic and chemical fertilizer in same amount was better than of chemical fertilizer alone in potato. Prativa & Bhattari (2011) revealed that organic matter percentage was recorded maximum with the application of 10 MT/ha vermicompost. Similarly, the combined application of half dose of NPK with 15 MT/ha vermicompost rises the accessibility of nitrogen, phosphorus and potassium in tomato crop. Similarly, Shambhavi & Sharma (2011) observed rise in macro and micro nutrient uptake through combined application of organic manure along with fertilizer in potato crop but the highest nutrient uptake was observed with full dose of NPK and vermicompost. Verma *et al.* (2011) recorded highest nutrient uptake as well as increased tuber size in potato crop through combined application of organic manure with bio-fertilizers including Azotobacter, phosphor-bacteria & other biodynamic approach as well as via microbial culture. Islam & Nahar (2012) reported maximum nutrient content in potato tuber & haulm in cow dung treatment whereas, nutrient uptake by plant was maximum in poultry manure.

Conclusion

This review show that, implementation of the organic manure has superior response than of chemical fertilizer on

solanaceous crop. Chemical fertilizer affects the soil health but organic manure result in improvement of physical, biological and chemical properties of soil but nutrient release is slow. Organic manure helps in enriching the soil fertility by enhancing soil microbes, carbon content and reducing pathogens. Among different organic manure, concentrated organic manure was more effective in controlling the incidence of the disease and pests. Organic manure like FYM, compost, vermicompost etc. has a positive response in growth, yield and quality parameters of solanaceous crops. It helps to increase yield, quality traits of crops and nutrient uptake by plants. Thus, application of organic fertilizer promotes in growth and development of crops with maintaining the soil health and also reduce the impact of inorganic fertilizer. Average farmer in developing countries could not meet the expense of chemical fertilizer as per the requirement of the crop so, it can be alternative method for them to sustain soil fertility and productivity. Government should priorities organic manure use in the cultivation of solanaceous crops instead of chemical fertilizers for the production of good quality vegetable and improve human health.

Table 1: Response of different organic manures with or without inorganic fertilizers on growth, yield, quality & other related traits of solanaceous vegetable crops

Organic manures with or without inorganic fertilizers	Response/s	Reference
Vermicompost + RDF	Observed that vermicompost @ 5 t/ha along with 125% RDF showed maximum level of N, P, K, Fe and crude protein contents in brinjal.	Choudhary <i>et al.</i> (2007)
FYM + RDF	Reported earliest flower initiation with 50% vermicompost + 50% RDF (27.12 days) Whereas, the number of days to 50% flowering was noticed at earliest with 100% FYM + 50% RDF (32.20 days). Treatments including 100% FYM + 50% RDF & 50% FYM + 100% RDF measured highest number of fruits/plant (41.86) & fruit weight (29.549 g) respectively in tomato.	Manolikar <i>et al.</i> (2007)
NPK fertilizer & poultry manure	Noticed that NPK fertilizer, poultry manure & poultry manure + NPK fertilizer increased tuber weight by 53, 86 and 131%, respectively. Poultry manure tended to improve soil pH, soil organic carbon, N, K, Ca and Mg concentrations compared with NPK fertilizer.	Agbede <i>et al.</i> (2010)
Organic fertilizers (FYM, Poultry manure & Vermicompost) + Inorganic fertilizers	Revealed that integrated application of 50% of NPK through inorganic sources and 50% RDN through poultry manure recorded highest tuber yield (22.73 t/ha). Maximum dry matter content (20.29%) & specific gravity (1.084) were found in treatment with 100% RDN through organic manures.	Kumar <i>et al.</i> (2011)
FYM + Rhizobium + PSB + Panchagavya spray	Observed significant increment in plant height, number of primary branches/plant, leaf area index at 90 DAS and 50% flowering and yield attributes of groundnut as compared to other treatments.	Kumar <i>et al.</i> (2012)
Cattle manure + Nitrogenous fertilizer	Noticed that maximum content of total chlorophyll (1.448 mg/g of fresh weight) was obtained by using 150 kg N + 20 t of manure/ha. Maximum tuber yield (36.8 t/ha) was obtained by the utilization of 20 t cattle manure + 150 kg N per/ha. The Chlorophyll a, b and total content were also significantly increased.	Najm <i>et al.</i> (2012)
Poultry manure + RDF	Observed highest yield (25.2 t ha ⁻¹) was achieved in T ₇ treatment, where Poultry manure 3 t ha ⁻¹ along with reduced rate of recommended dose of chemical fertilizers.	Islam <i>et al.</i> (2013)

Vermicompost	Noticed that vermicompost when applied at full dose increased beta carotene, ascorbic acid, total soluble solids and color value in tomato.	Murmu <i>et al.</i> (2013)
Neem cake + RDF	Revealed that with using 75% Neem cake + 25% RDF quality parameters including total soluble solids (T.S.S) (7 ⁰ Brix), total sugars (2.627 g), reducing sugar (0.47 g) and ascorbic acid (22.77 mg/100g) were recorded at maximum.	Kashyap <i>et al.</i> (2014)
Vermicompost + Poultry manure	Reported that among the organic treatments, fruit yield per hectare (2097 kg) and higher seed yield of 196.1 kg/ha were recorded maximum in 100% vermicompost followed by 100% poultry manure (2011 kg).	Marthandan & Sundarlingam (2016)
Neem seed cake + NPK fertilizers	Found that neem seed cake alone & in combination with reduced rates of NPK fertilizer, improved water & nutrient holding capacities and significantly increased the growth & yield components of sesame.	Eifediyi <i>et al.</i> (2017)
Vermicompost with RDN	Concluded that 50% RDN and 50% vermicompost /hectare resulted the most appropriate for better growth and yield (103.10 q ha ⁻¹) of sweet pepper.	Jamir <i>et al.</i> (2017)
Vermicompost	Observed that vermicompost shown promising results in betterment of growth and yields of chilli.	Reddy <i>et al.</i> (2017)

Declaration

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