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Response of organic and inorganic fertilizer on growth and yield of bitter gourd: A review

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Abstract

Bitter gourd (*Momordica charantia*) is a significant vegetable crop and is grown for its immature fruit products which have a kind of bitter taste. One of the commercially important cucurbitaceous vegetable crops extensively grown throughout the country for its nutritive worth and restorative properties. Its fruits are considered as a rich source of vitamins and minerals. It is grown in rainy season and as well in spring summer season widely. Fruits are of various in shapes, size, colour and bitterness. It is widely utilized in cooking styles of East Asia, South Asia, and Southeast Asia. It tends to grow in both warm or cold climate. organic bitter gourd cultivation involves organic manures like Panchagavya, Jeevamrit, Vermicompost and humic acid, etc. which has important nutrients that are required for crop growth and productivity. Inorganic fertilizers are good for quick growth of plants because the nutrients are already water soluble. Therefore, the effect is usually immediately and quick, contains all fundamental nutrients that are ready to be utilized. It can be grown in organic and inorganic fertilizers for better growth and yield. Thus, combined application of organic and inorganic fertilizers improves soil fertility, productivity and reduce the impact of inorganic fertilizer on environment. So, it can be alternate way for sustainable soil fertility and productivity.

Keywords: Bitter gourd, organic, inorganic, fertilizers, vermicompost, soil fertility

Introduction

Cucurbits are the famous name of the family Cucurbitaceae, generally known as gourd family. A family of about 117 genera and 825 (Jeffery 1967). Bitter gourd (*Momordica charantia* L.) is one of the most important and round the year cultivated popular vegetable crops. Bitter melon, papilla, bitter gourd, salsamino, corilla or Karela, Hanzal, assorossie, ampalaya, nigauri or goya, pare, khogua, sora, balsam apple, pear or balsamina, and several other common names of *M. charantia* (Taylor 2002) [39] uses for extensive review and technical data. The east Asian bitter gourd plant is one of the newly introduced vegetables crops in Egypt. It has been effectively grown in Mansoura region (Hamaiel 2004). The plant is adapted to wide variation of climates although production is best in hot areas (Binder *et al.* 1989) [8], So it has been successfully grown in Damietta area.

Bitter gourd is a significant vegetable in South Indian states, especially in Kerala and is developed for its juvenile tuberculate organic products which have an extraordinary bitter taste. Organic products are considered as a rich wellspring of nutrients and minerals and 88 mg L-ascorbic acid per 100 g. Fruits are utilized after cooking and delightful arrangements are made subsequent to stuffing and frying. During times of glut in market, fruits are cut, somewhat boiled with salt and dried under direct daylight and stored for months. This is used after frying. bitter gourd fruits have medicinal worth and are utilized for relieving diabetes, asthma, blood illnesses and ailment. Drinking fresh bitter gourd juice is suggested by naturopaths. Roots and stem of bitter harsh gourd are utilized in numerous ayurvedic drugs.

Bitter gourd grows under a very wide range of conditions throughout the subtropics and tropics. Its excessive growth and maturation allow it to grow in any area where there is sufficient short-term soil moisture, while it can also survive as a perennial in conditions of continuous soil moisture. It grows from sea level to over 1300 m (Tjitrosoedirdjo, 1990), and in regions with yearly precipitation as low as 480 mm. Minimum average annual temperature could be as low as 12.3 degree Celsius, though the plant can grow in such cold areas. pH of the soil should be ranging from 4.3 to 8.7 (Holm *et al.*, 1997) [17] for better growth of bitter gourd. Bitter gourd is a fast-growing vine and quickly covers the supporting vegetation or structure completely.

This species is likely to be found grown in coastal areas, along creeks and rivers, forest edges and disturbed sites. For optimum growth it needs strong support, should be 1-4 m tall, however it will also grow as matted ground cover.

Bitter melon is broadly distributed through tropical and subtropical areas on all continents. It is native to the African and Australian continents, but its actual origin has been obscured by its spread as a food crop. Currently it can be found cultivated and naturalized in North, Central and South America, the West Indies and on several islands in the Pacific Ocean. The wild forms of bitter melon are distributed in tropical and subtropical of Africa and southeast Asia. The original place of demonstration of bitter melon is unknown or unclear for want of credible archaeological evidences. The putative areas for domestication of bitter melon proposed by various workers include southern China, eastern India or eastern Asia (Walters and Decker-Walters 1998)^[11].

For a very long time ago, bitter melon has been widely utilized in traditional medicine for many treatments. Recently, many phytochemicals in the herb have been identified and clinically demonstrated, which exhibit many medicinal activities such as antibiotic, antimutagenic, antioxidant, antileukemic, antiviral, antidiabetic, antitumor, aperitive, aphrodisiac, (Hamaiel, *et al.* 2015)^[16] astringent, carminative, cytotoxic, depurative, hypotensive, hypoglycemic, immunomodulatory, insecticidal, lactagogue, laxative, purgative, refrigerant, stomachic, styptic, tonic and vermifuge. It is quite possibly the most nutritious gourds and has numerous therapeutic property A compound known as "Charantin" present in the bitter melon has a rich measure of vitamin A, L-ascorbic acid, iron, phosphorus and carbs, particularly that of high carotenoid pigments and minerals (Bose and Som 1986)^[9]. The plant also used in the treatment of diabetes to lower blood sugar levels.

Fertilizer response on bitter melon

Fertilizer is one of the most important crop inputs applied for the crop production which significantly increases its productivity and yield quantity with quality (Shamima, *et al.*, 2013)^[35]. Mainly, Bitter melon hybrids respond well to manure and fertilizer applications (Prasad *et al.*, 2009)^[16]. Organic manure is generally low on nutrients as they release nutrients very slow; in other hand inorganic fertilizer are rich in nutrients and release nutrients very quickly without letting nutrient deficiency (Benitez, 2013). For the best result of production of bitter melon the combination of both organic and inorganic fertilizers should be used (Sangetashree *et al.*, 2018). The best way of use of fertilizer on bitter melon crop is to reduce the quantity of organic manure by half and mix it with the required amount of inorganic fertilizer to make it balance (Prashanti, 2021)^[29]. Nutrients are more readily available for bitter melon crops with the mixed fertilizer than the individually used fertilizers (Akande *et al.* 2003). Fertilization like this can produce more yield and better plant growth in tropics. It seems N from gliricidia leaves was more readily available to the plants than poultry manure. Lower K content as a result of some treatment may be due to complexes formed with native soil K which causes the release of nitrogen in the NPK fertilizers. Organic materials increase soil pH (Akande, *et al.*, 2003). Organic fertilizers, poultry manure and inorganic fertilizers applications helps in development of plant growth as compared to controlled types. An optimum level of productivity can be obtained with a lowered level mixture of inorganic fertilizer combined with

manures. However, continuous use of the heavy doses of fertilizers damages the natural ecology and adversely affects the nutrient recycling and the biological communities in soil which otherwise support the crop production (Prasad *et al.*, 2009)^[16].

Response of organic Manure on vegetative growth of bitter melon

The effect of organic manure on plant height and vegetative growth can be determined by the contribution of manure to fertility of the soil as the soil has low carbon content. The vegetative growth of bitter melon can be determined genetically more than the environmental traits (Singh *et al.*, 2018)^[37]. Organic manure contains both macro and micro nutrients as well as enhances the physico-chemical properties of the soil which led to high vegetative growth. Mostly bitter melon grown in the poultry manure performs better in vegetative growth than other organic manures. These data shows that the poultry manure was readily available and is easy for crops to absorb compared to other organic manures (Mulani, *et al.*, 2007)^[24]. He also reported that among different organic manures, poultry manure could increase vegetative growth of the crops such as increase in number of leaves and increase in vine length (Mishra, *et al.*, 2019)^[23]. Increase in quantity of the organic manure may stress for the vegetative growth of the crops, all this can be occurred due to all the nutrients are diverted to the vegetative growth. This may occur due to bulk use or higher amount of nutrients are already present in the soil. The increase of fresh fruit of bitter melon is due to use of poultry manure application which could be easily soluble in the soil and has water holding capacity (Tripathi, 2009). Similar results were obtained in turmeric (Sanwal, *et al.*, 2007)^[34], in okra (Rajshree, *et al.*, 2009)^[31] and tomato (Premsekhar, 2009)^[30]; in which they reported the higher yield of crops due to organic manure application which improved physical and biological properties of the soil resulting better supply of the nutrients. Thus, among organic manures poultry manure is termed as good for bitter melon crop as it helps to increase productivity and growth of the crops.

Organic and inorganic fertilizer application for yield and related attributes in bitter melon

Nowadays organic manure has gained public attention and support as well as they are available abundantly, chemicals free as well as they can increase soil fertility in sustainable manner. The soil fertility can be improved by both organic and inorganic fertilizers application depends on several factors like soil type, nature of crops, cropping pattern and socio-economic conditions of that area. Organic manures improve soil fertility by activating soil microbial activity (Amiry, *et al.*, 2017) and also sustains cropping system through better nutrient recycling (Shankar *et al.*, 2008)^[36]. Organic manures provide all sources of micro and macro nutrients in available form, by improving physical and biological properties of the soil (Onwu, 2014)^[25]. Geethu *et al.*, (2015)^[13] observed that the treatment combination of (25% NPK+2 tonnes of vermicompost+5 tonnes of poultry manure) was found for plant growth and fruit yield of bitter melon (*Momordica charantia*) with maximum benefit cost ratio (2.80:1). The data acquired from the experiment is useful to plan nourishment program as indicated by plant development and natural product yield of bitter melon. The organic and inorganic nutrients to be thought

advantageous while growing, to help the plant development and better fruit yield. NPK + vermicompost combination is maximum value recorded 25% NPK+2tonnes of vermicompost +5 tonnes of poultry manure these combinations are applied to bitter gourd getting more yield under the agro climatic conditions.

Prashanti *et al.*, (2021) [29] concluded that the treatment 50% RDF of NPK + 50% Vermicompost + Poultry manure was found suitable for application in Rainy (kharif) season bitter gourd cultivation for better growth, yield and quality traits and Benefit cost ratio. In terms of cost benefits ratio maximum gross returns and net return was recorded in treatments 50% RDF of NPK + 50% Vermicompost + Poultry manure and cost benefit ratio was found in treatment whereas minimum Gross return and net return was recorded in Control Recommended dose of NPK120:60:60 kg/ha + FYM 20t/ha.

Sureshkumar *et al.*, (2008) [38] conducted an experiment on bitter gourd type mithipagal; the observations recorded were vine length, days taken for female flowering, number of female flowers, number of fruits, weight of fruits and yield per plant. Based on the performance, it was found that the treatment combination of 75% of NPK (60:30:20 kg/ha) +vermicompost at 5 t/ha + Azospirillum at 2 kg/ha was the

best in the rice fallow condition with the total yield of (1.33 kg/plant) followed by (75% NPK + Panchagavya at 3% foliar spray + *Azospirillum* at 2 kg), which was on a par with (NPK 100%+vermicompost at 5 t/ha).

Combined application of organic and inorganic fertilizers along with biofertilizers for quality improvement

Organic and inorganic manures play important role in chelation and absorption of micronutrients which helps in number of biochemical process and so formation of many minerals and salts. This kind of application improves the quality of fruits produced. The primary role of biofertilizers is to provide vitamins and bioactive substances. Furthermore, it helps against diseases and pests which is well established fact that prevents the qualitative deterioration of fruits. Das *et al.*, (2015) [10] reported that the quality character was increased by application of biofertilizers. Mahmoud *et al.*, (2017) recommended that the application of 75% RDF as N and P in comparison to biofertilizers significantly increase in vitamins contents and TSS content. Das *et al.*, (2015) [10] reported significant interaction between biofertilizers and manures to increase the concentration of plant chlorophyll.

Table 1: Response of NPK on vegetative growth of Bitter Gourd

NPK application	Response/ effects	References
Application of nitrogen	Increase in vine growth and branching in bitter gourd	Reddy (2005) [32]
Nitrogen levels	Earliness in flowering and initiation for first fruit set in bitter gourd	Umamaheshwarappa <i>et al.</i> , (2005) [41]
Application of N and P	Earliness in germination, earliness in flowering and no. of nodes to first pistillate flower	Vishwakarma <i>et al.</i> , (2007) [42]
Application of organic and phosphorus	Early seed germination, flowering and harvest in bitter gourd.	Bacha <i>et al.</i> , (2005) [6]
Application of NPK as fertigation	Early flowering, fruiting and harvesting with maximum number of fruits per plants.	Arshad <i>et al.</i> , (2014) [5]
Application of inorganic fertilizers	Induced earliness in flowering and fruiting in cucumber.	Jilani <i>et al.</i> , (2009) [20]
Increase in dose of phosphorus	Germination of seeds, flowering and harvesting was earlier in bitter gourd.	Eifediyi and Samaon (2010a) [12]
Level of potassium	No effects on flowering, fruits set of cucumber.	Umamaheshwarappa <i>et al.</i> , (2005) [41]
Application of organic fertilizer	Increased the growth characters, vine growth, branching and leaf area of cucumber.	Oga and Umekwa (2013)

Table 1: Response of organic manure on yield and attributing traits of Bitter gourd.

OM application	Response/ effect	References
Application of 75% mineral and 25% organic matter	Increase the growth of plant, yield and quality in bitter gourd	Prasad <i>et al.</i> , (2016)
Poultry manure + fertilizers	Significantly increased the number of leaves, fruit size and count, quality, weight and yield in bitter gourd.	Okoli and Nweke (2015) [27]
Poultry manure @20t/ha	Yield was higher	Khan (2017) [21]
Vermicompost application	Higher bitter gourd field and fruit weight	Ghasem <i>et al.</i> , (2014) [14]
Application of FYM and vermicompost	Increased yield in bitter gourd	Gajjela <i>et al.</i> , (2018) [15]
Application of bio fertilizers	Increase fruit count, length, fruit weight and yield in bitter gourd.	Jilani <i>et al.</i> , (2009) [20]
Application of cow manure along with NPK fertilizers	Increase fruit yield, length of fruits, diameter of fruits and branching in bitter gourd.	Prasad <i>et al.</i> , (2016)
Application of biological fertilizers	Increase yield and yield attributes in bitter gourd	Isfahani (2012) [18]
Seed treatment with phosphorus solubility bacteria	Higher yield in pumpkin	Alekar <i>et al.</i> , (2015) [11]

Conclusion

This review shows that, continuous use of organic and inorganic fertilizers on bitter gourd has their own benefits and disadvantages. Though inorganic fertilizers have productivity advantages but they are the main reason behind the declining of soil fertility. The soil loses organic matter resulting in reduction of soil physical, biological and chemical properties.

Organic fertilizers have more benefits in the long run as compared to inorganic fertilizers. Organic fertilizers improve physical, biological and chemical properties of soil but they are not readily available. The integrated soil fertility management system is an alternate approach for sustainable and cost-effective management of soil fertility. Thus, combined application of organic and inorganic fertilizers

improves soil fertility, productivity and reduce the impact of inorganic fertilizer on environment. So, it can be alternate way for sustainable soil fertility and productivity.

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