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Response of Mango Trees to Organic and Biofertilizers to Enhance Crop Production and Quality in Egypt as A Step Towards Sustainable Agriculture. *Review Article*

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Abstract: The development of sustainable agricultural innovations is critically needed given the twin challenges of climate change and population growth, which jeopardise global food security. These developments have to be able to boost crop yields, preserve the health of the soil, lessen our dependency on artificial agrochemical inputs, and preserve the nutritional value of our food crops. The purpose of this study was to look into how using organic fertilisers and biofertilizers in Egypt affected mango fruit yield and quality. Mango (*Mangifera Indica*, L.) is Egypt's third largest fruit crop. Mango is the king of fruits; it is highly nutritious, has a distinct flavour and aroma, and accounts for roughly half of all tropical fruits produced globally due to the use of various fertilisers. The response of mango trees to organic and biofertilizers can significantly improve crop production and fruit quality. Fruit plant growth is also improved because they are environmentally safe and inexpensive, reducing the need for chemical fertilisers. Mango trees require nutrients for long-term growth, yield, and quality; however, using organic manure alone has some drawbacks, such as unbalanced nutrition, inefficient fertiliser use, a lack of cost-effectiveness, and low production. Mango yield can be increased by using biofertilizers that carry microbial inoculants while preserving soil fertility. Integrative nutrient management, which preserves soil health, can be critical for mango growth, yield, and quality in the long run. Combining organic and bio fertilisers in mango cultivation can result in higher growth and yield. The practices not only promote increased fruit production, but also improve mango quality, making it more appealing to consumers. Adopting these approaches encourages sustainable agricultural practices, which benefit both the environment and farmers' economic outcomes. Thus, organic and biofertilizers help plants meet their nutrient requirements while also restoring soil fertility. Furthermore, improving productivity and fruit quality for sustainable agricultural systems is a step towards sustainable agriculture.

Key words: Mango, Organic fertilizers, Biofertilization, Yield and fruit quality.

1. Introduction

With rising demand for high-quality food and a growing global population, food supply and environmental sustainability are critical. There is a pressing need for effective methods to increase crop yields, maintain soil fertility, and reduce reliance on chemical fertilizers and pesticides (**Garg *et al.*, 2018 and Shahzad *et al.*, 2021)**. Mango (*Mangifera indica* L. Anacardiaceae) is regarded as one of the most important tropical fruits in the world. In Egypt, mango is one of the most important fruits. The mango is a fruit with high nutritional content, distinct flavour, and aroma, making up around half of all tropical fruits produced worldwide due to the use of various fertilisers (**Anees, 2011 and Tan, 2015**). According to (**M.A.L.R, 2021**), the acreage of mango reached 321040 fed. which produced around 766128 tons annually. Mango is a seasonal fruit, with approximately 20% of production processed into products such as nectar, puree, and canned slices, all of which are popular around the world. It contains a high concentration of sugar, protein, fat, salt, and vitamins. Mango fruit is a great source of antioxidants like ascorbic acid, carotenoids, and phenolic compounds. Mangoes are highly valued for their delicious and distinct flavour. Also, a good source of provitamin A, vitamin C, and fibre. A fruit with a wide range of adaptable characteristics has naturally found use in the production of various goods (**Haseeb *et al.*, 2020**). The main growing regions for mangoes are Northeast India and Myanmar (**Sahu *et al.*, 2016**). China comes in second place in the world for mango production, behind India, while the two largest mango-producing nations in Africa are Nigeria and Egypt (**Patil *et al.*, 2018**). One of the most important fruit crops in the nation, it was recently referred to as a major item within the National Food Basket (**Ploetz, 2002**). In both fresh and refined forms, it is widely consumed by consumers and produced in large quantities. Mango comes in third place, behind grapes and citrus. Approximately 50 million tonnes of mangoes were produced worldwide (**FAOSTAT, 2020**). Regarding the export of Egyptian fruit to most Arab and European nations. Because mango fruits can be industrially processed and sold in markets both domestically and internationally, the crop of mango fruits is also very important (**Aga and Gagabo, 2024**). Chemical fertilisers are still widely used in mango cultivation, which lowers the fruit's nutritional value while promoting healthy tree growth. Everyone knows that nutrition has the biggest impact on fruit quality, health, and tree growth. However, the primary problem with mineral fertilisation is its high expense. For this reason, some researchers have previously developed novel composting techniques to produce organic fertilisers (**Chen *et al.*, 2021 and Supian *et al.*, 2024**). Indiscriminate use of chemical fertilisers resulted in chemical residues in the field and crop products, posing a variety of environmental and health risks, as well as socioeconomic issues. Furthermore, the rising cost of fertiliser and global concerns about ground water pollution caused by leaching from the soil are discouraging the use of fertilisers. Globally, biofertilizer development and use have increased in response to the universal problem of environmental degradation caused by the overuse of chemical fertilisers (**Aga and Gagabo, 2024**). So, it is necessary to maintain soil fertility and plant nutrient supply at an optimum level in order to sustain desired crop productivity by optimising the benefits from all possible plant nutrient sources in an integrated manner (**Srivastava *et al.*, 2021**). Numerous factors influence the growth, yield, maturity, and quality of fruits. One of the most important factors that can influence the characteristics of grown cultivars is growing area and balanced fertiliser. Organic fertiliser enhances the physical, chemical, and biological properties of almost all soil types by adjusting soil pH and increasing plant solubility production (**Hamid *et al.*, 2019**). According to (**Youssef *et al.*, 2001**), adding organic fertiliser (compost) to the soil stimulated the proliferation of soil microorganisms, increased microbial population and enzyme activity. Thus, in addition to helping plants meet their nutrient needs, organic and biofertilizers also help restore soil fertility. A further step towards sustainable agriculture is raising fruit quality and productivity for sustainable agricultural systems. Therefore, this study was to look into how using organic fertilisers and biofertilizers in Egypt affected mango fruit yield and quality. Also, study how organic farming affects the chemical and physical properties of mango.

2. The significance of Egyptian mango trees

Mango grows successfully in Egypt, from the cool Mediterranean coast (lat. 31° 30' N) to the scorching heat of Aswan Governorate (lat. 22° N). The governorates of Sharkeya, Ismailia, Fayoum, Qena, and Beheira are the principal locations for mango cultivation. Hindi, Taymour, Ewais, Zebda, Langara, Alphonse, and Keitt are the most significant varieties (**Riad, 1997**). All irrigated semiarid regions can successfully grow it, including Egypt, which is thought to be the Middle East's largest mango producer and has grown a wide variety of mango cultivars with success (**Elkhishen, 2015**). In Egypt, mango trees are very important for a number of reasons: **1.** Economic Value: In Egypt, mangoes are a significant cash crop. They support local markets and give farmers income, which boosts the agricultural economy. Mango exports bring in foreign exchange for the nation. **2.** Cultural Significance: In Egyptian cuisine and culture, mangos are a popular fruit. They are a staple of the local diet and are consumed raw, in juices, and in a variety of dishes. **3.** Mangoes are high in dietary fibre, vitamins A and C, and other nutrients. They are a vital fruit for the populace since they support nutrition and overall health. **4.** Environmental Benefits: Mango trees can prevent soil erosion and offer shade. They support a variety of wildlife species, which adds to biodiversity. **5.** Agricultural Diversity: Mango tree cultivation promotes agricultural diversity, which is critical for resilient farming methods and climate change adaptation.3. The response of mango trees to organic and biofertilizers: The response of mango trees to organic and bio fertilizers can significantly enhance both crop production and fruit quality. Here are some key points on how these fertilizers affect mango trees.

Organic fertilisers

1. Nutrient Availability: Compost and manure are examples of organic fertilisers that strengthen soil structure, improve water retention, and increase nutrient availability. Better root development and general tree health result from this.

2. Soil Microbiology: Adding organic fertilisers increases soil microbial activity, which in turn encourages nutrient cycling and builds a more robust soil ecosystem. This may improve the availability of micronutrients that are necessary for the growth of mangos.

3. Sustainable Growth: By minimising soil degradation and lowering reliance on chemical fertilisers, organic fertilisers support sustainable agriculture.

Biofertilizers

1. Microbial Inoculation: Beneficial bacteria are injected into the soil by biofertilizers like Rhizobium and Azospirillum, which can fix atmospheric nitrogen and make it available to plants. This is especially helpful for low-nitrogen soils. **2.** Enhanced Resistance: By boosting the general vigour of the trees and fortifying their stress tolerance mechanisms, bio fertilisers can increase the plants' resistance to pests and diseases. **3.** Quality Improvement: Using biofertilizers can result in larger, more flavourful, and more nutritious fruits, which will raise the standard of the mangoes produced as a whole. For this reason, growing mangos with a combination of organic and biofertilizers can result in better growth and yield. In addition to encouraging greater fruit production, these methods enhance mango quality and increase consumer appeal. Using these strategies encourages sustainable farming methods, which eventually improve the financial results for farmers as well as the environment.

3. The Impact of Organic Manure on the Quality and Yield of Mangos

An important field of research in agriculture is the impact of organic nutrients on plant growth, yield, and quality, especially when it comes to sustainable farming methods. Here are some important things to think about:1. Growth: - Nutrient Availability: Compared to synthetic fertilisers, organic nutrients—such as compost, manure, and cover crops—release vital nutrients more gradually. When plants gradually get access to nutrients, this gradual release can promote steady growth. - Soil Structure: Organic matter can promote better root development and general plant growth by strengthening the soil's structure, increasing aeration, and increasing its capacity to hold water.2. Yield: - Crop Performance: Research has indicated that using organic nutrients can yield yields that are on par with or occasionally higher than those obtained using conventional methods, particularly for some crops. A healthy supply of nutrients helps avoid deficiencies, which can restrict the growth of plants. - Sustainability: Increasing soil organism biodiversity through organic farming practices can produce healthier crops and longer-lasting yields over time, even in less fertile environments.3. Quality: - Nutritional Value: According to reports, crops cultivated with organic nutrients have higher concentrations of specific vitamins, minerals, and antioxidants, which results in superior nutritional quality.

Table (1). Mango governorates, production and fruit area and total area

Governorates	Mango			
	Production	Yield	F Area	Total Area
Alexandria	666	6.000	111	111
Behera	38050	5.171	7358	16048
Gharbia	465	2.360	197	223
Kafr-El Sheikh	213	5.605	38	43
Dakahlia	106	3.313	32	57
Damietta	14809	5.528	2679	3574
Sharkia	145913	4.737	30800	39752
Ismailia	313357	2.920	107332	116205
Port Said	161	2.300	70	88
Suez	56034	3.366	16646	17702
Menoufia	9205	3.757	2450	2465
Qalyoubia	4143	5.987	692	765
Cairo	23034	3.989	5775	5775
Lower Egypt	**606156**	**3.480**	**174180**	**202808**
Giza	15033	1.701	8836	9830
Beni Suef	2049	3.767	544	552
Fayoum	8917	1.148	7767	11171
Menia	6741	4.636	1454	2120
Middle Egypt	**32740**	**1.760**	**18601**	**23673**
Assuit	10361	5.547	1868	3138
Suhag	1443	4.610	313	423
Qena	3449	4.544	759	853
Luxor	7430	2.902	2560	2725
Aswan	67076	4.942	13573	15061
Upper Egypt	**89759**	**4.706**	**19073**	**22200**
Inside the valley	**728655**	**3.439**	**211854**	**248681**
New Valley	31528	6.356	4960	5053
Matruh	95	2.879	33	58
North Sinai	1311	3.099	423	433
South Sinai	2605	1.765	1476	3130
Noubaria	327341	7.000	46763	46763
Outside the valley	**362880**	**6.763**	**53655**	**55437**
Total	**1091535**	**4.111**	**265509**	**304118**

Source: Economic Affairs Sector.

Flavour and Aroma: According to some research, using organic farming methods improves the flavour and aroma of fruits and vegetables, which increases consumer appeal. The presence of helpful microbes and the slower growth rates can be attributed to this. - Pesticide Residue: Since organic farming typically uses less chemical inputs, the final product has fewer levels of pesticide residue, which can enhance consumer perception and marketability. 4. Challenges: - Nutrient Management: High-demand crops may not always receive enough nitrogen from organic nutrients, which, if improperly handled, could result in lower yields. - Soil Composition: The current soil composition, pH, and microbial activity all influence how effective organic nutrients are; however, these factors can differ significantly depending on the site. Thus, there is a complex and frequently interconnected relationship between organic nutrients and plant growth, yield, and quality. Although they have many advantages, efficient management techniques are essential to maximising their effects while resolving the particular difficulties related to organic farming. As this field of study develops, more knowledge about the most efficient ways to use organic nutrients becomes available.

According to (**Han *et al.*, 2015**), soil fertility is aided by a balanced supply of nutrients, including micronutrients; additionally, organic manure increases soil microbial activity and improves nutrient availability.

4. The Impact of Organic Nutrients on Mango Growth, Yield, and Quality:

Organic fertilisation improves microflora activity, water retention, grain aggregation, organic matter content, and nutrient availability. **El-Gioushy *et al.* (2018**) found that partially replacing mineral fertilisers with organic and bio-fertilizers improved Fagri Kalan Mango yield and quality. **Miller *et al.*** (**1990**) found that energising plant nutrient uptake improves organic food biosynthesis and cell division. **Silva (1998**) conducted experiments using organic manure on the Tommy Atkins mango variety with combinations of three sources (earthworm hums, cattle manure, and a combination of these) and five doses (0, 20, 40, 60, and 80 liters/plant) of organic matter. The results showed that using cattle manure improved fruit quality.

5. Impact of Farm Yard Manure (FYM) on Mango Quality, Yield, and Growth

The most widely used bulky organic manure, FYM improves soil physico-chemical characteristics and releases macro- and micronutrients, thereby increasing fruit yield (**Lakkineni and Abrol, 1994**). According to **Kumar *et al.* (2013),** applying 80 kg of pig manure or FYM per tree assisted in replenishing depleted nutrients. The highest tree height, annual shoot growth, fruit set, fruit yield, fruit weight, fruit size, fruit volume, and fruit quality characteristics like TSS, reducing sugar, total sugar, and non-reducing sugar were obtained with the application of 60% nitrogen of RDF + 40% organic manure (FYM). **Haokip *et al.* (2021)** discovered that 60% N from RDF + 40% N from FYM produced the highest yield attributing characteristics, viz., plant height increment (15.04%), highest percentage in canopy spread increment, North-South (22.17%) and East-West (20.35%), maximum fruit set percentage (37.78%), highest number of fruits (40.22) per plant, and maximum yield (8.52 kg) per tree. Chemical fertilisers are still widely used in mango cultivation today, which promotes healthy tree growth and has an impact on the nutritional value of the fruit. There is widespread agreement that nutrition is the most important factor influencing tree growth, health, and fruit quality. However, the high cost of mineral fertilisation is a major issue, and as a result, previous researchers have developed new methods of composting to produce organic fertilisers. Organic fertiliser improves the physical, chemical, and biological properties of nearly all soil types by adjusting soil pH and increasing plant solubility (Hamid et al., 2019). According to **Youssef *et al.* (2001),** adding organic fertiliser (compost) to the soil promoted the proliferation of soil microorganisms, increased microbial population, and enzyme activity. In this context, biofertilizers and liquid organic fertilisers of biological origin provide an alternative for producing residue-free organic mango trees (**Abou Hussein, 2002**). In this study, a mixture of green grass, salt, water, and composted leaf mould derived from dried leaves was chosen and added to determine its effectiveness in promoting mango tree growth and health. Using appropriate fertiliser combinations from these materials can improve soil quality in terms of physical, chemical, and biological properties (**Hasan *et al.*, 2013**). Furthermore, mango trees can tolerate alkaline conditions, so the ideal pH range for their soil is 5.5 to 8.7 (**Bally, 2006 and Zulkepeli, 2022**). According to **Zulkepeli** (**2022**), previous research indicated that the soil at UTHM is primarily composed of silty clay and is acidic, with a pH of 6. Furthermore, according to **Liu *et al.* (2020**), soil pH is critical for mango tree growth because it affects microbial activities, which are associated with nutrient availability. Recently, the possibility of using biodegraded wastes as liquid fertilisers to stimulate plant growth has been demonstrated (**Reyes, 2018 and Ryabtseva *et al.*, 2005**). Thus, raw materials from plant composting can be used as a fertiliser source. The positive influence of and LM on soil functionality has shown adequate potential and could act as an alternative to chemical fertiliser, with some of the stimulation on plant growth discussed by (**Ryabtseva *et al.*, 2005**). The primary goals of this research were to determine the effectiveness of organic fertiliser using two types of decomposing mediums (leaf mould and organic fertiliser) and to assess the growth and health of the Mango Tree.

6.Effect of Compost on Growth, Yield and Quality of Mango

Good fertilizer management improves soil quality, while poor fertilizer management degrades soil's physical, chemical, and biological properties (**Gathala, 2007**). Composting can improve soil fertility by adding nutrients to the soil, improve its physical, chemical, and biological properties, increase soil organic matter, and aid in the growth and yield of many plants (**Adugna, 2016 and Sarwar *et al.*, 2008**). **Abo-Ogiala and Khalafallah (2019)** conducted an experiment to investigate the effect of gypsum and compost on the growth and yield of Washington Navel orange in saline-sodic soils and discovered that the application of gypsum 10 tons/fed + compost 15 tons/fed is the best ameliorating material, resulting in increased growth, yield, and orange quality. The use of liquid organic fertilisers (both animal and plant-based) in drip irrigated citrus could replace traditional mineral fertilisers **(Martinez-Alcantara *et al.*, 2016).**

7. The Effect of Vermicompost on Mango Growth, Yield and Quality

Vermicompost is a rich source of nutrients, plant growth hormones, and plant growth regulators. It is the decomposed result of organic wastes that earthworms and microorganisms have broken down (**Devi *et al.*, 2015; Kumar et al., 2018**). Vermicompost and vermiwash promote growth, protect plants, and increase crop production. **Makode (2015)** reported that applying 10 kg of vermicompost per plant in June significantly increased fruit number, fruit weight, and fruit yield of oranges, as well as improving soil physical and nutrient status. In kinnow mandarin, combining nitrogen at 350 g/plant with vermicompost at 20 kg/plant resulted in the best plant growth parameters (**Pareek *et al.*, 2017**).

8. Biofertilizer's Effect on Mango Growth, Yield, and Quality

Currently, biofertilizers are regarded as a component of cutting-edge biotechnology, which is necessary for the advancement of environmentally friendly, sustainable, and clean agriculture. According to **Nath and Das (2018**), biofertilizers are inexpensive, eco-friendly, and productive inputs that have major agricultural advantages. As such, the farming community should support them more extensively. Microbial inoculants known as "biofertilizers" are effective tools for maintaining soil fertility, promoting plant tolerance to pests, and producing crops in a sustainable manner (**Abobatta, 2020**). Biofertilizers play a positive role in plant growth, productivity, and stress resistance, making them an important and powerful eco-friendly nutrient supplement for plants. They have the potential for widespread impact. Soils are typically inhabited by a variety of microbial species. Biofertilizers have been shown to improve seed germination and plant growth while also increasing tolerance to high salt conditions. Biofertilizers are live microorganism formulations that improve soil and plant quality by increasing nutrient availability to the soil, seeds, and roots. Some species, such as Azotobacter, can thrive even in alkaline soils. The impact of biofertilizers on the growth of mango rootstocks was examined by (**Bhadauria and Tripathi, 2023)**. Treatments included: (i) 400 g of Azospirillum; (ii) 400 g of phosphobacteria; (iii) 400 g of Azospirillum + 400 g of phosphobacteria; and (iv) 400 g of uninoculated as control. The treatment containing Azospirillum + phosphobacteria showed the highest values for 19 plant height, root length, number of leaves stem width, and root volume, but he clarified that all treatments were more effective than the control. According to (**Abd-Rabou, 2006**), the various biofertilizers thickened the stems of the avocado and mango seedlings, and the thickness of the stems increased gradually as the fertiliser rate increased. The type of biofertilizer used determined this effect; microbien, phosporein, and effective microorganisms (EM) were the most effective fertilisers. Using sandy soil from Tahrir province, Egypt, (**Haggag and Azzazy, 1996**) conducted a pot experiment to assess the impact of biofertilizer Microbien (50, 100, or 150 g/plot) and/or super phosphate (50, 100, or 150 kg/fed) on the growth of six-month-old mango seedlings. Additionally, pots 18 all received a basal dose of P and N. They discovered that Microbin greatly accelerated seedling growth. Additionally, the treatments that combined Microbien with superphosphate proved to be the most successful in stimulating growth. In the end, they came to the conclusion that, from an economic perspective, applying Microbien at 150 g + super phosphate at 50 kg/fed was the best course of action.

9. The Combined Impact of Biofertilizer and Organic Manure on Mango Quality, Yield, and Growth

Recent studies highlight the beneficial effects of The Combined Impact of Biofertilizer and Organic Manure on Mango Quality, Yield, and Growth. **Rana *et al.* (2020),** investigated the effect of organic manure and biofertilizers on growth, yield, and quality, and discovered that the application of FYM (40 kg/plant) + VAM (100g/plant) + Azotobacter (10 g/plant) resulted in the greatest increase in growth and yield parameters, while the application of FYM (40 kg/plant) + Azotobacter (10 g/plant) resulted in the greatest value in quality parameters. The use of the biofertilizer *Bacillus circulans* with various nitrogen levels in combination with 120 units of potassium has been shown to increase vegetative growth, yield, and quality (**El-Khawaga and Maklad, 2013**). Half the recommended dose of chemical fertiliser, half the amount of compost, and 150 or 200 ml of biofertilizer (*Bacillus circulance*, *Bacillus polymyxa*, *Candida spp.*, *Trichoderma spp.,* and *Bacillus megatherium*) (**El-Aidy *et al.*, 2018**). **Dutta *et al.*** (**2016**) investigated the effects of organic, inorganic, and biofertilizers on mango growth, fruit quality, and soil characteristics. The following eight treatments were used: vermicompost at 5 kg/plant/year, FYM at 10 kg/plant/year, inorganic fertiliser (NPK at 1000:500:1000 g/plant/year), 50% vermicompost + 50% inorganic fertiliser, 50% FYM + 50% inorganic fertiliser, biofertilizer (Azotobacter at 150 g/plant) + PSM at 100 g/plant), biofertilizer + 50% inorganic fertiliser, and control (no treatment). and reported that using biofertilizer in mango improves growth, fruit quality, and soil health. **El-Rahman and Amira (2021**) investigated the response of mango trees to mineral, bio-organic fertilisers, and growth stimulants and found that mineral (NPK) soil application, either alone or in combination with organic (compost), some soil bio-stimulants (Phosphorein, Nitrobein, and Potasein), and foliar spray with potassium silicate (5 ml/liter) and entocide (10 g/liter) as growth stimulants were investigated by studying their effect on fruiting aspects and fruit characterise showed that all investigated NPK soil application in mineral form, organic (compost) fertilisers, bio-fertilizers, and some foliar nutrients) had a significant effect.

10. The Impact of Integrated Nutrient Management on Mango Yield, Growth, and Quality

Increased production will help meet the growing global population's food demands. Substituting bioinoculants for synthetic chemicals can promote sustainable farming practices while protecting the environment. This aligns with efforts to promote healthy, nutritious diets and safe food production. To address nutritional deficiencies and soil conditions in specific contexts, microorganisms should be selected and applied accordingly. This targeted approach improves the mineral and micronutrient composition of crops in low-nutrient areas **(Makar *et al.*, 2023).** According to **Huang *et al.* (2021**), integrated nutrient management in acidic soil aided in pomelo root development and nutrient uptake, maximising crop productivity. **Lalrinfela and Varte (2021**) reported that in addition to chemical fertilizers, the integrated application of organic manure and biofertilizers enhances the physicochemical characteristics of the soil, increasing its available nitrogen, available phosphorus content, and producing more citrus fruits, such as mango trees. A study comparing the effects of FYM and biofertilizers with NPK fertilisers on soil fertility, growth, yield, and fruit quality produced the best results. **Kumar *et al.* (2019)** discovered that combining inorganic fertilisers with organic manure and biofertilizer significantly improved biochemical properties, and that using FYM + vermicompost + biofertilizers resulted in the highest TSS and fruit quality. **Musmade *et al.* (2009)** discovered that applying 600:300:300 gm NPK + 15 kg FYM + 15 kg neem cake per plant (10-year-old acid lime plant) each year resulted in a significantly higher yield (147.65 kg/plant), higher quality fruits, and improved soil fertility. **Khehra and Bal (2014)** found that combining FYM (75 kg/tree) with inorganic nitrogen and Azotobacter reduces fruit cracking and increases fruit quality in lemons. **Bakshi *et al.* (2018)** conducted an experiment to investigate the effect of integrated nutrient management on kinnow growth, yield, and quality and discovered that when 50% nitrogen was applied as poultry manure and 50% nitrogen as urea, along with Azotobacter, the maximum fruit length, fruit width, fruit weight, fruit volume, number of fruits per plant, and maximum yield per plant were achieved. The combination also had the highest leaf and fruit phosphorus concentrations **(Bakshi *et al.*, 2017).**

Conclusions

The mango is the king of fruits; it is highly nutritious, has a distinct flavour and aroma, and accounts for roughly half of all tropical fruits produced globally due to various fertilisers. Mango, one of the world's most important fruit crops, requires careful nutrient management to produce higher-quality fruit. Achieving higher mango yields requires effective nutrient management. The long-term, negligent application of chemical fertilisers can have a negative impact on both soil health and crop yield. Although applying organic manures alone has drawbacks such as unbalanced nutrition, inefficient fertiliser use, low cost-effectiveness, and low output, they can still be a source of nutrients. Biofertilizers have the potential to significantly increase mango yield by keeping the soil fertile. Mango growth, yield, and quality can all be maintained while soil fertility is preserved using an integrated nutrient management strategy.

Recommendations

Organic and biofertilizers are used to promote fruit plant growth because they are inexpensive and environmentally friendly. They can also be used to reduce the amount of chemical fertilizer used, lowering production costs and reducing environmental pollution.

Future Prospects

Agroecological practices are gaining popularity as a means of mitigating the negative consequences of traditional practices. Adoption of agroecological technologies, such as biofertilizers, is increasing at varying rates, with government agencies advocating for investments in their development, distribution, and application. Biofertilizers are low-cost inputs with significant environmental benefits. They have the potential to increase crop productivity and serve as a viable alternative to high-chemical inputs. Beneficial microbes incorporated into biofertilizers have been extensively researched for their ability to provide critical crop nutrients while also improving plant health and growth. Biofertilizers have now emerged as an essential component of agroecology, and their successful implementation has been documented all over the world; therefore, it is reasonable to expect similar success stories in Egypt. Biofertilizers are also much less expensive than chemical fertilisers and more environmentally friendly. Biofertilizers are now regarded as an essential component of advanced biotechnology for the development of clean, green, and sustainable agriculture.

References

Abd-Rabou, F.A. (2006). Effect of microbien, phosphorene and effective micro-organisms (EM) as bio-stimulants on growth of avocado and mango seedlings. Egyptian Journal of Applied Sciences, 21: 673-693.

Abobatta, W.F. and El-Azay, A.M. (2020). Role of organic and biofertilizers in citrus orchards. Aswan University Journal of Environmental Studies, 1(1), 13-27.

Abo-Ogiala, A. and Khalafallah, N. (2019). Effect of gypsum and compost on growth and yield of Washington Navel Orange under saline-sodic soils. Egyptian Journal of Horticulture, 46(1), 83-93.

Abou Hussein, S.D., L. EL-Oksha, T. EL-Shorbagy and A.M. Gomaa (2002). Effect of cattle manure, biofertilizers and reducing mineral fertilizer on nutrient content and yield of potato plant. Egyptian Journal of Horticulture, 29 (1): 99-115.

Adugna, G. (2016). A review on impact of compost on soil properties, water use and crop productivity. Journal of Agricultural Science and Research, 4(3), 93-104.

Aga, G. W. and Gagabo, S. Y. (2024). Review Status of Mango Production and Research in Ethiopia. Journal of Plant Sciences, 12(1), 21–29.

Anees, M., Tahir, F. M., Shahzad, J., and Mahmood, N. (2011). Effect of foliar application of micronutrients on the quality of mango (*Mangifera indica* L.) cv. Dusehri fruit. Mycopathologia, 9(1), 25-28.

Bakshi, M., Wali, V.K., and Sharma, D. (2018). Growth, yield and quality of kinnow mandarin as affected by integrated nutrient management. Annals of Biology 34 (2): 202-206.

Bakshi, M., Wali, V.K., Bakshi, P., Sharma, A., Sharma, D., and Shah, R.A. (2017). Integrated nutrient management induced changes in nutrient uptake, fruit yield and quality of kinnow mandarin. Indian Journal of Agricultural Science, 87(3):414- 418.

Bally, I. S. (2006). Mangifera indica (mango). Species profiles for pacific island agroforestry, 1-25.

Bhadauria, A. S., and Tripathi, V. K. (2023). Effect of Bio-enhancers and Bio-Fertilizers on Growth and Quality of Mango cv. Amrapali under Sub-tropical Plains of Central Uttar Pradesh, India. International Journal of Plant & Soil Science, 35(19); 1260-1267.

Chen, Y., Li, X., Li, S., and Xu, Y. (2021). Novel-integrated process for production of bio-organic fertilizer via swine manure composting. Environmental Engineering Research, 26(2).

Devi, J., and Prakash, M. (2015). Microbial population dynamics during vermicomposting of three different substances amended with cowdung. Int. J. Curr. Microbiol. Appl. Sci.,4(2):1086-1092

Dutta, P., Das, K., and Patel, A. (2016). Influence of organics, inorganic and biofertilizers on growth, fruit quality, and soil characters of Himsagar mango grown in new alluvial zone of West Bengal, India. Advances in Horticultural Science, 30(2), 81–85.

El-Aidy, A., Esa, W., and Alam-Eldein, S. (2018). Effect of organic and bio-fertilization on vegetative growth, yield, and fruit quality of 'Valencia' orange trees. Journal of Productivity and Development, 23(1), 111-134.

El-Gioushy, S. F., Abedelkhalek, A., and Abdelaziz, A. M. R. A. (2018). Partial replacement of mineral NPK by organic and bio-fertilizers of fagri kalan mango trees. Journal of Horticultural Science & Ornamental Plants, 10(3), 110-117.

El-khawaga, A.S., Maklad, M.F. (2013). Effect of combination between Bio and chemical fertilization on vegetative growth, yield and quality of Valencia orange fruits. Hortscience Journal of Suez Canal University. 1:269-279.

Elkhishen, M. A. (2015). Enhancing flowering and fruiting attributes of mango (Mangifera indica) cv. zebda in the off-year by binary application of KNO3, ethrel and paclobutrazol. J. Hortic. Sci. Ornam. Plants, 7(3), 87-93.

El-Rahman, A., and Amira, S. A. (2021). Response of Mango Trees to Mineral, Bio-Organic Fertilizers and Growth Stimulants. Journal of Plant Production, 12(9), 981-986.

FAOSTAT, (2020). http://www.fao.org/faostat/en/#home.

Garg, M., Sharma, N., Sharma, S., Kapoor, P., Kumar, A., Chunduri, V., and Arora, P. (2018). Biofortified crops generated by breeding, agronomy, and transgenic approaches are improving lives of millions of people around the world. Frontiers in Nutrition, 5, 12.

Gathala, M.K., Kanthaliya, P.C., Verma, A., and Chahar, M.S. (2007). Effect of integrated nutrient management on soil properties and humus fractions in the long-term fertilizer experiments. Journal of the Indian Society of Soil Science, 55:360-363.

Haggag, L. F. and Azzazy, M. A. (1996). Evaluation of Microbien as a multistrains biofertilizer for producing of improved mango seedlings with appropriate vigour for grafting in shorter time. Annals of Agricultural Science, Cairo, 41(1): 321-331.

Hamid, H. A., Qi, L. P., Harun, H., Sunar, N. M., Ahmad, F. H., Muhamad, M. S., and Hamidon, N. (2019). Development of organic fertilizer from food waste by composting in UTHM campus Pagoh. Journal of Applied Chemistry and Natural Resources, 1(1).

Haokip, S. W., Singh, B., Sheikh, K. H., Shankar, K., Debbarma, R., Lalrinngheta, J., and Nengparmoi, T. (2021). Growth and yield response to application of organic and inorganic nutrient sources in lemon [*Citrus limon* (L.) Burm.] cv. Assam lemon. International Journal of Plant & Soil Science, 46-52.

Haokip, S. W., Singh, B., Sheikh, K. H., Shankar, K., Debbarma, R., Lalrinngheta, J., and Nengparmoi, T. (2021). Growth and yield response to application of organic and inorganic nutrient sources in lemon [*Citrus limon* (L.) Burm.] cv. Assam lemon. International Journal of Plant & Soil Science, 46-52.

Hasan, M. A., Manna, M., Dutta, P., Bhattacharya, K., Mandal, S., Banerjee, H., and Jha, S. (2013). Foliar nutrient content in mango as influenced by organic and inorganic nutrients and their correlative relationship with yield and quality.

Haseeb, G. M., Ghounim, I. E. S., Hmmam, I., and Mustafa, M. R. (2020). Evaluation of four newly introduced mango (*Mangifera indica* L.) cultivars grown under El-Giza conditions. Plant Archives, 20(2), 9405-9410.

Huang, X., Muneer, M. A., Li, J., Hou, W., Ma, C., Jiao, J., and Zheng, C. (2021). Integrated nutrient management significantly improves pomelo (*Citrus grandis*) root growth and nutrients uptake under acidic soil of southern China. Agronomy, 11(6), 1231.

Khehra, S., and Bal, J.S. (2014). Influence of organic and inorganic nutrient sources on growth of lemon (*Citrus limon* L.) Journal of Experimental Biology and Agricultural Science, 2(15):126-129.

Kumar, P. S., Choudhary, V. K., Kanwat, M., and Sangeetha, A. (2013). Influence of different sources of nutrients on growth, yield and quality of Khasi mandarin grown under mid hills of Arunachal Pradesh (India). Journal of Applied Horticulture, 15(3), 220-223.

Kumar, T. B., Kumar, G. P., Nathan, R. S., Kumar, R. S., Kumar, M. R., Nandan, C. M., and Mullaimaran, S. (2019). Influence of nutrient management through bio-organic manures on biochemical attributes of acid lime (*Citrus aurantifolia* Swingle). Plant Archives, 19(2):3763-3766.

Kumar, V., Malik, S., Dev, P., Kumar, M., Manendra, S., and Braj, M. (2018). Effect of integrated nutrient management in relation to vegetative parameters of lemon (*Citrus limon* burm) cv. pant Lemon-1 in sandy loam soil under western Uttar Pradesh conditions. Progressive Agriculture, 18(2):236-239.

Lakkineni, K.C., and Abrol, Y.P. (1994). Sulfur requirement in crop plants: Physiological Analysis. Fertil News, 39:11- 18.

Lalrinfela, T., and Varte, Z. (2021). Effect of integrated nutrient management on soil nutrient status, fruit quality and yield of mandarin orange (*Citrus reticulata*) in Darzo, Mizoram. Int. J. Curr. Microbiol. Appl. Sci., 10(05):709-714.

Liu, G., Mylavarapu, R., Hanlon, E. and Lee, W. C (2020). Soil pH Management for Optimum Commercial Fruit Production in Florida, UF/IFAS Extension, (4):1–6.

M.A.L.R. (2021). Ministry of Agriculture and Land Reclamation (Bulletin of Agricultural Statistics. Part (2). Summer and Nili crop.

Makar, O., Kavulych, Y., Terek, O., and Romanyuk, N. (2023). Plant-Microbe Interaction: Mechanisms and Applications for Improving Crop Yield and Quality. Biologicni Studii, 17(3), 225–242.

Makode, P.M. (2015). Effect of vermicompost on the growth of Indian orange, *Citrus reticulatus* with reference to its quality and quantity. Biosci Biotechnol Res Commun, 8(2):217-220.

Martinez-Alcantara, B., Martinez-Cuenca, M., Bermejo, A., Legaz, F., and Quinones, A. (2016). Liquid organic fertilizers for sustainable agriculture: nutrient uptake of organic versus mineral fertilizers in Citrus trees. Plos One,.11(10).

Miller, E.W., Donahue, D.L. and Miller, J.U. (1990). Soils "An Introduction to soils and plant Growth" (5th ed.). Prentice Hall, International Inc. Engleword Cliffs, New Jersy: 303- 339.

Musmade, A.M., Jagtap, D.D., Pujari, C.V., and Hiray S.A. (2009). Integrated nutrient management in acid lime. Asian Journal of Horticulture, 4(2):305-308.

Nath, B. S. and Das, A. (2018). Biofertilizers: A Sustainable Approach for Pulse Production. In R. S. Meena, A. Das, G. S. Yadav & R. Lal (Eds.), Legumes for Soil Health and Sustainable Management. (pp. 445-485). Singapore: Springer.

Pareek, P. K., Bhatnagar, P., and Chander, S. (2017). Effect of nitrogen and vermicompost interaction on growth and development of Kinnow Mandarin in vertisols of Jhalawar district. Chem. Sci. Rev. Lett, 6(23), 1555-1560.

Patil, R. S., Deshmukh, R. G., Bhaskar, K. R., and Jahagirdar, S. W. (2018). Growth and export performance of mango in India. International Journal of Current Microbiology and Applied Sciences, 6, 2667-267.

Ploetz, R., Zheng, Q. I., Vazquez, A., and Sattar, M. A. (2002). Current status and impact of mango malformation in Egypt. International Journal of Pest Management, 48(4), 279-285.

Rana, H., Sharma, K., and Negi, M. (2020). Effect of organic manure and biofertilizers on plant growth, yield and quality of Sweet orange (*Citrus sinensis* L.). International Journal of Current Microbiology and Applied Sciences, 9(4), 2064-70.

Reyes-Torres, M., Oviedo-Ocaña, E. R., Dominguez, I., Komilis, D., and Sánchez, A. (2018). A systematic review on the composting of green waste: Feedstock quality and optimization strategies. Waste management, 77, 486-499.

Riad, M. (1997). Mango production in Egypt Acta Horticulturae, 455 1026 1037

Ryabtseva, T. V., Kapichnikova, N. G., and Mikhailovskaya, N. A. (2005). Influence of soil application of biological and mineral fertilizers on the growth, yield, and fruit biochemical components of'Charavnitsa'apple, and on some agrochemical soil characteristics. Acta Scientiarum Polonorum. Hortorum Cultus, 4(1), 59-67.

Sahu, S. C., Suresh, H. S., And Ravindranath, N. H. (2016). Forest structure, composition and above ground biomass of tree community in tropical dry forests of Eastern Ghats, India. Notulae Scientia Biologicae, 8(1), 125-133.

Sarwar, G., Schmeisky, H., Hussain, N., Muhammad, S., Ibrahim, M., and Safdar, E. (2008). Improvement of soil physical and chemical properties with compost application in rice-wheat cropping system. Pakistan Journal of Botany, 40(1), 275-282.

Shahzad, R., Jamil, S., Ahmad, S., Nisar, A., Khan, S., Amina, Z., Kanwal, S., Aslam, H. M. U., Gill, R. A., and Zhou, W. (2021). Biofortification of cereals and pulses using new breeding techniques: current and future perspectives. Frontiers in Nutrition, 8, 721728

Silva, D. J. (1998). Organic fertilizer in irrigated mango in the region of Sao Francisco Pesquisa em Andamento Centro de pesquisa Agropecuaria do Tropico Semi Arido, (92): 5.

Srivastava, A. K., Wu, Q. S., Mousavi, S. M., and Hota, D. (2021). Integrated soil fertility management in fruit crops: An overview. International Journal of Fruit Science, 21(1), 413-439.

Supian, N. S., Kadir, A. A., Mohd Zin, N. S., Nabila Hissham, N. F., and Supian, N. S. (2024). The efficacy of organic fertilizer and leaf mold toconserve the health and growth of mango tree (*Mangifera indica*). International Journal of Conservation Science, 15(1).

Tan, L. M. (2015). Production of Fertilizer using Food Wastes of Vegetables and Fruits (Bachelor of Science with Honours, Plant Res. Science and Manag.

Youssef, A. M., El-Fouly, A. H. M., Youssef, M. S., and Mohamedien, S. A. (2001). Effect of using organic and chemical fertilizers in fertigation system on yield and fruit quality of tomato. Egyptian Journal of Horticulture, 28 (1): 59-77.

Zulkepeli, Z. A., & Talib, Z. A. (2022). A GIS-Based Approach for Data Management in University Tun Hussein Onn Malaysia (UTHM), Batu Pahat, Johor, Malaysia. Recent Trends in Civil Engineering and Built Environment, 3 (1), 281-289.

استجابة أشجار المانجو للزراعة العضوية والأسمدة الحيوية لتحسين إنتاج المحصول وجودة الثمار كخطوة نحو التنمية المستدامة في مصر. مقالة مرجعية

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الملخص العربي

في ضوء التحديات التي يفرضها تغير المناخ والنمو السكاني العالمي المتزايد، والتي تعرض الأمن الغذائي للخطر، هناك حاجة ملحة لتطوير ابتكارات زراعية مستدامة. يجب أن تكون هذه الابتكارات قادرة على زيادة إنتاجية المحاصيل والحفاظ على صحة التربة، والحد من اعتمادنا على المدخلات الكيماوية الزراعية الاصطناعية، والحفاظ على الجودة الغذائية لمحاصيلنا الغذائية.هدفت هذه الدراسة إلى تأثير استخدام الأسمدة العضوية والأسمدة الحيوية في مصر على تحسين خصائص المحصول وجودة ثمار المانجو. تعتبرالمانجو ثالث محصول فاكهة رئيسي في مصر كما تعتبرملك الفاكهة، مغذيه للغاية، ولها نكهة ورائحة مميزة، وتمثل المانجو حوالي نصف جميع الفواكه الاستوائية المنتجة في جميع أنحاء العالم. بسبب الأسمدة المختلفة. يمكن أن تعمل استجابة أشجار المانجو للأسمدة العضوية والحيوية على تعزيز إنتاج المحاصيل وجودة الثمار بشكل كبير. كما تعمل على تحسين نمو نباتات الفاكهة لأنها آمنة بيئيًا وغير مكلفة وتقلل من كمية الأسمدة الكيماوية المستخدمة. تتطلب أشجار المانجو العناصر الغذائية للنمو المستدام والإنتاج والجودة؛ ومع ذلك، فإن استخدام السماد العضوي وحده له بعض العيوب، بما في ذلك التغذية غير المتوازنة، والاستخدام غير الفعال للأسمدة، ونقص الفعالية من حيث التكلفة، والإنتاج المنخفض نسبيًا. من خلال الحفاظ على خصوبة التربة، يمكن استخدام الأسمدة الحيوية التي تحمل الملقحات الميكروبية لزيادة محصول المانجو. من خلال الحفاظ على خصوبة التربة، يمكن أن تكون الإدارة المتكاملة للمغذيات فعالة لنمو المانجو على المدى الطويل، والإنتاج، وجودة المانجو. يمكن أن يؤدي الجمع بين الأسمدة العضوية والحيوية في زراعة المانجو إلى نمو وإنتاجية متفوقة. لا تدعم الممارسات زيادة إنتاج الفاكهة فحسب، بل تعمل أيضًا على تحسين جودة المانجو، مما يجعلها أكثر جاذبية للمستهلكين. إن تبني هذه الأساليب يعزز الممارسات الزراعية المستدامة، مما يعود بالنفع في نهاية المطاف على البيئة والنتائج الاقتصادية للمزارعين. وبالتالي، تساعد الأسمدة العضوية والحيوية النباتات على تلبية متطلباتها الغذائية واستعادة خصوبة التربة. بالإضافة إلى ذلك، فإن تعزيز الإنتاجية وجودة الفاكهة للأنظمة الزراعية المستدامة وكخطوة نحو الزراعة المستدامة.

الكلمات الدالة: المانجو، التسميد العضوي، التسميدالحيوي، المحصول، جودة الثمار.