A Review on the Impact of Organic and Biofertilizer Amendments on Growth, Yield, and Quality of Strawberry

ABSTRACT

The effects of using organic additives and biofertilizers such as vermicompost, panchgavya, beejamruth, jeevamruth, and organic manure on the growth and production of strawberries were studied. High levels of inorganic compound use in agriculture can negatively impact crop sustainability, increase cultivation costs, and decrease productivity. Traditional farming practices, like conservation agriculture, are being adopted more due to the negative effects of chemical fertilizers on soil health. Biofertilizers, which are made from living organisms that can either produce nitrogen or create a beneficial environment for plants, are more organic, cost-effective, and do not harm the soil in the way chemical fertilizers do.

Keywords: Organic manure, growth, yield, Biofertilizers, Panchgavya, strawberry.

1. INTRODUCTION

Fragaria ananassa Duch., or cultivated strawberry, is an octoploid species (2n = 8x = 56) of the Rosaceae family and a member of the genus Fragaria. Strawberries evolved in Europe in the 18th century as a consequence of an unintentional hybridization of two native American species, F. virginiana and F. chiloensis. It is a prostrate-growing herbaceous plant, annual in subtropical climes and perennial in warmer climates. Strawberries are a popular temperate berry that can also be cultivated in tropical and subtropical climates. It may reach heights of 3,000 meters above sea level in both wet and dry places. It is a rapidly growing plant that thrives in grain and vegetable areas. Strawberries are not only popular as a dessert and have a special taste and smell due to presence of volatile esters, but are also in great demand by fruit processing companies for the production of jams, ice cream, syrups and other goods. . It is a prominent fruit all over the world. It has been a favored fruit crop among Indian producers near towns and cities due to its lucrative prices and increased profitability, leading to tremendous growth in its acreage and production in recent years (Sharma and Sharma, 2006)[1]. The strawberries were beautiful and had a distinct scent. Very tasty flavor. Strawberries are rich in anthocyanins, which are responsible for their color, and a serving of various berries can give up to 100 mg of anthocyanins. Berries, like other fruits and vegetables, are high in fiber, vitamins, and minerals. They also include considerable levels of phytochemicals that have not been identified as deficient but may have key biological activity in mammalian cells. Strawberries are particularly high in folate and vitamin C, which account for more than a

quarter of the fruit extract's overall antioxidant activity. Strawberry is a perishable fruit that sells quickly after harvest and is expensive, especially when hand-picked (fresh fruit are almost exclusively hand-picked). Offering high-quality berry fruit constantly would be a fantastic way to capture consumers' attention and exceed their expectations. Organic farmers rely on natural methods to provide plants with the necessary nutrients and to control pests and diseases. One of the most important components of organic farming is the use of organic manure. Organic manure is a natural fertilizing agent that is made from plant and animal waste and is considered one of the best ways to improve soil health and promote sustainable crop production (Okwuagwu et al., 2003)[2] . Strawberries are popular for their sweet taste and excellent nutritional value. However, the use of chemical fertilizers can have a significant impact on the growth, productivity and quality of strawberries.. Alternatively, organic manure is a natural and environmentally friendly fertilizers capable of releasing nutrients slowly which can improve soil health and promote sustainable crop production. The current demand for bio-fertilizer is 4, 26,000 MT, while the total supply The present demand for manures is 710 million tonnes, with a total supply of 105 million tonnes and a need of 4, 26,000 MT for bio-fertilizer. Organic manure promote soil fertility by increasing enzyme activity, accessible nitrates, the carbon-to-total organic carbon ratio, and metabolic quotients. Composting has also been shown to boost soil respiration and microbial biomass (Bhattacharyya et al., 2003)[2,3]. Compost fermentation boosts soil enzyme activity, which influences the health of soil microbes. organic fertilizers. Soil fertility may be enhanced by modifying the soil's structure, pH, biophysical conditions, and availability of important nutrients. (Crecchio et al.,2001)[4] Strawberry farming is primarily localized in India. Solan and Dehradun, Nainital (Uttaranchal), Kullu Valley Hills (HP), Srinagar (J&K), Darjeeling, and Gurgaon (Haryana) of West Bengal, an d Muzaffar Nagar (UP).. Strawberry is grown in Himachal Pradesh, Uttar Pradesh, Maharashtra, West Bengal, Delhi, Haryana, Punjab, and Rajasthan. The crop may also be cultivated under irrigated circumstances in Jammu's subtropical areas (Antoun H et al.,2007)[5].

Apart from organic manure, biofertilizers are also exploit the soil's nutrient content to enrich the soil. The introduction of beneficial microbes as biofertilizers stimulates plant development by boosting available nutrients and the production of growth-stimulating plant hormones, which is the key factor impacting strawberry crop yield. Because of the increased use of chemical fertilizers and the decrease in environmental contamination, biological fertilizers have garnered more attention for boosting soil fertility and crop quality. (Sindhu et al., 2010)[6]The intense practice of contemporary plant breeding, use of huge quantities of costly chemical fertilizers are polluting the soil, water, and air and hence, the process of investigating the feasibility of utilising organic and bio fertilizers is essential. This review paper aims to examine the impact of organic manure on growth characteristics of strawberries. Bio-fertilizers are microbial compounds that improve soil health and agricultural productivity. The efficacy of organic manure application in enhancing strawberry growth and yield. (Hassan, 2015)[7]. Bio-fertilizers contain plant growth regulators (Sood et al., 2018)[8]. They include vital macronutrients, micronutrients, vitamins, and amino acids, as well as growth factors like IAA and GA and helpful microbes.(Mangturamet al. 2017)[9]. Excessive use of chemical fertilizers and pesticides, particularly for fruits that may be eaten without peeling, such as strawberries, is hazardous to human health, the biological environment, and traditional agricultural practices, all of which can be avoided with bio-agriculture. But, the usage of various organic materials can fulfill the nutritional demands of fruit trees, boosting output and quality sustainably.

2. Impact of Organic Manure on growth characteristics of strawberries.

One of the main benefits of using organic matter in strawberry cultivation is the enhancement of soil microbial biomass, providing an environmentally friendly alternative to chemical fertilizers (Selvamani et al., 2011)[10]. Organic matter has been found to accelerate blooming in strawberry plants, while conventional treatments may delay it. However, conventional treatments have been found to provide the most fruit weight and overall production per tree (Abu-Zahra and Tahboub, 2008)[11]. Research by Nowsheen et al. (2006)[12] revealed that combination of poultry manure, Azotobacter, wood ash, PSB, and oil cake led to the highest plant height (23.39 cm), plant spread (24.21 cm), and runners (13.03) per plant. While, Rajbir et al. (2010)[13] found that vermicompost at 10 t ha-1 led to an increase in plant spread (16.1%) and leaf area (31.4%) compared to the control plants. The same observations were made by Arancon et al. (2004) [14] when food and paper waste vermicompost was used. Odongo et al. (2008) [15] noticed similar results with the use of farm yard manure, which is high in phosphorus, led to an increase in photosynthetic production, breaking bud dormancy and increasing flowering sites. The application of vermicompost, which provides essential nutrients such as nitrogen, phosphorus, and potassium, as well as hormones, plays a crucial role in increasing gibberellic acid in the roots, thereby breaking bud dormancy and increasing flower buds and fruiting sites, as reported by Tagliavini et al. (2005) [16]. In addition, Herencia et al. (2011) [17] found that the use of organic fertilizers in strawberry plants led to an earlier onset of the reproductive stage. Fertilizers containing favorable levels of macro and micronutrients have been found to improve fruit set and increase fruit size and weight by promoting carbohydrate formation more effectively than the use of inorganic triple phosphate fertilizer (Odongo et al. 2008) [15]. During the ripening process, fruits require large amounts of potassium and nitrogen, and composts are a rich source of these essential nutrients. A reduction in the number of fruits and flowers can be attributed to a lack of nitrogen and phosphorus during the flowering phase, leading to smaller flowers and the abortion of female flower parts, as reported by Tagliavini et al. (2005).[16]

Fig 1: Growing plants

3. Effect of Vermicompost on Plant Growth, Yield, and Quality of Strawberries.

One study, conducted by Kumar et al. (2015)[18], found that the most effective results were obtained by combining vermicompost at 2.5 tons/ha with half the required NPK ratio. This led to increased plant height**,** number of leaves per plant**,**, days to first blooming, number of flowers per plant, yields per plant harvest time, and number of berries per tree. This research investigated how different bio combinations affect strawberry yield and quality. According to Kumar et al. (2018)[19], the use of organic manure such as vermicompost, chicken manure, and PSB (phosphorus solubilizing bacteria) improved the vegetative development characteristics of strawberries and increased total dissolved solids. This research also revealed that the use of Azotobacter, vermicompost, chicken manure and PSB had the greatest impact on quality (TSS, acid) and shelf life (5.69 days), even though FYM (Farm Yard Manure) had the highest B: C ratio (**VALUE**) (ascorbic acid) and yield. The study conducted by Changotra et al. (2017)[20] surfaced that strawberry plants treated with 2.80 t/ha of vermicompost showed a significant increase**,** in plant height, leaf area, number of leaves per plant, number of flowers, number of fruits per plant, and fruit set percentage. Additionally, the study found that vermicompost application also had a significant impact on the physicochemical properties of the fruits. The fruits treated with vermicompost showed the highest fruit weight, fruit size, total soluble solids, total soluble solids to acid ratio, total sugars, reducing sugars, ascorbic acid content, organoleptic rating, and the lowest acidity. Based on these findings, it was concluded that vermicompost has a significant effect on the vegetative growth and quality of strawberries.

Vermicompost, a stabilized organic material produced by earthworms and microorganisms, has been shown to have a positive impact on seed germination, plant growth and yield in greenhouse condition. It has been found to favorably affect the growth and production of plants, promoting plant growth and production outside of greenhouses. In addition, vermicompost promotes soil respiration, activity of several enzymes and activation of soil microbes (Arancon et al., 2003) [21]

.4. Effect of Biofertilizers on Plant Growth, Yield, and Quality of Strawberry Crops

A study by (Rana and Chandal, 2003)[22], found that the use of a biofertilizer containing Azotobacter chroococcum and Azospirillum brasilense improved the growth of strawberries. The plants grown with the biofertilizer had a higher root weight, stem weight, and leaf area than those grown with chemical fertilizers. Additionally, the study found that the use of biofertilizer also improved the yield of strawberries. The plants grown with biofertilizers produced more fruit than those grown with chemical fertilizers.

Another study by [Rueda et al.,2016][23] found that the use of biofertilizers also improved the quality of strawberries. The fruits grown with biofertilizers had a higher Vitamin C content and a lower pH than those grown with chemical fertilizers. Additionally, the study found that the use of biofertilizers also increased the total soluble solids content of strawberries, which is an indicator of fruit sweetness. In addition to their positive effects on growth and yield, biofertilizers can also improve the overall health of the soil. Biofertilizers are rich in microorganisms that can improve soil structure, increase the population of beneficial microorganisms, and reduce the need for chemical pesticides.

Biofertilizers are being widely used in the agricultural and horticultural sectors to reduce costs and decrease environmental impact. Research by Nazir et al., (2006)[24] found that fertilizing strawberries with a combination of chicken manure, Azotobacter, wood ash, phosphorus-degrading bacteria, and the appropriate NPK fertilizer levels resulted in improved plant height, leaf growth, and apical diameter. Using biofertilizers in addition to inorganic and organic fertilizers has been shown to significantly enhance strawberry plant growth, as these microbial products assist in nitrogen fixation and organic nutrient mineralization, increasing the efficiency of fertilizer usage and nutrient uptake. Studies by Kumar et

al., (2018)[25] have also found that the use of biofertilizers can lead to an increase in plant height, canopy size, leaf count, and hydroponic strawberry dry weight. The shallow root system of strawberries requires specific feeding and management strategies. The majority of the plant's roots are located within the top six inches of soil, consisting of both large primary roots and small secondary roots. Germination occurs when the soil temperature is above 45°F and is affected when compared to no stool as per Sharma et al., (2013)[26].

Using biofertilizers, which are microbial compounds, can improve soil health and increase crop output. These biofertilizers, when combined with organic fertilizers and the right growth regulators, can improve plant growth, fruit quality, and strawberry yield. Studies have shown that using specific microorganisms and nitrogen fertilizers on strawberry plants can have positive effects on plant growth. Additionally, NPK fertilization of strawberry plants after microbiological inoculation can also improve plant growth.

A study by Kumar et al. (2015)[19] found that the use of a combination of PSB and Azotobacter greatly improved plant height, number of leaves, canopies, apexes, number of flowers, number of fruits per tree, and fruit quality, such as length, width, weight, volume, TSS, total sugar, ascorbic acid, and titrated acid. They also found that the strawberry cv had the largest fruit production and the finest fruit quality. Additionally, they discovered that excellent diversity was obtained after inoculating Azotobacter and Azospirillum at 2 kg/ha each, with 60 kg N/ha and 100 ppm GA3. According to a review of the application of biofertilizers and nitrogen on the Chandler strawberry variety, plants infected with Azotobacter produced the maximum plant growth, including increased height, more leaves per plant, larger leaf area, stolons, larger and longer fruits, heavier fruits, and wider fruit. A study by Tripathi et al. (2017)[27] found that larger yields were obtained using black polyethylene and azotobacter (7 kg/ha) and the maximum width and length of TSS, ascorbic acid berries, total sugar, and degree Brix. The use of Azotobacter and nitrogen treatments was found to be more effective for strawberry growth and development in hydroponic systems compared to Azospirillum species, according to a study by Rueda et al. (2016)[23]. Microorganisms from the kingdoms of bacteria, fungus, and potentially protozoa found in the soil and plant tissue can aid in plant development and can be used to create microbial fertilizers, known as biofertilizers. However, there are still issues hindering their widespread usage in agricultural practices. A study by Pesakovic et al. (2013)[28] found that the use of biofertilizers can greatly increase the growth, production, and fruit quality of replanted strawberries, with a significant increase in output and improvements in sugar/acid ratio, soluble solids, and VC content compared to control.

Organic fertilizers have been found to have a positive impact on strawberry plant growth, specifically in the areas of seed set and solubility. The combination of biofertilizers, Azotobacter, vermicompost, chicken manure, and PSB were found to improve the total soluble solids (TSS) and ascorbic acid content in strawberries. In addition, the use of FYM had the highest benefit-to-cost ratio. A study by Kumar et al. (2015)[19] found that post-treatment with 2.5 t/ha of organic matter and half the recommended dose of NPK fertilizer resulted in improved plant height, number of leaves, days to first bloom, number of flowers, yield, harvesting duration and number of fruits per plant. Other studies have also shown that the combination of compost, wood ash, Azotobacter, phosphate-soluble bacteria, and oil meal improves overall fruit quality. The use of vermicompost and Azotobacter at the same time has been found to enhance plant size, leaf number, number of plants, number of strawberry blooms, and fruit set. Additionally, the combination of vermicompost and the Chandler strawberry variety was found to improve plant height, leaf mass, and strawberry production and area.

5. Effect of Azotobacter on Plant Growth, Yield, and Quality of Horticultural crops

Azotobacter is a type of bacteria that can fix nitrogen in the soil and belongs to the Azotbacteriaceae family. There are different species of Azotobacter, such as A. beijrinckii, A. chroococcum, and A.vinelandii, which can be found in various soil types. Azotobacter can also produce compounds such as antibiotics, antifungals, hormones, and siderophore (Riffat et al., 2011)[29] when applied as a seed treatment, seedling root dip, or soil treatment, it can cling to the seed and grow

densely around roots, providing the plants with readily available nitrogen. When Azotobacter inoculants are applied to crops as a seed treatment, seedling root dip, or soil treatment, a large number of Azotobacter cells will attach to the seed. Azotobacter thrives near soil roots where food is readily available and they fix atmospheric nitrogen as a normal course of action, either from dead organic material in soils or root exudates exuded by developing roots. The population quickly stabilizes and fixed nitrogen is released into the environment for the plant to absorb.

According to Sukla et al. (2009)[30], Azotobacter cells are uncommon on the root surface (rhizoplane), even though they are abundant in the surrounding soil (rhizosphere) near the roots. Chandel and Ranna (2003)[22] found that when the strawberry cultivar 'Chandler' was given biofertilizer and nitrogen, plants infected with Azotobacter had the greatest height, the biggest number of leaves per plant, the largest leaf area, and the greatest number of leaves per plant, heavier fruit, and bigger fruit length and width, when compared to all other treatments. Umar et al. (2010)[31] found that a combination of Nitrogen supply of 25% through green leaves and sublabel (Leucaena leucocephala) manure + 75% nitrogen in the form of urea coupled with biofertilizer resulted in the greatest plant height, spread, and leaf area. According to Singh and Singh (2009)[32], when Azotobacter and Azospirillum were injected at a rate of 2kg ha-1, each, in addition to 60 kg nitrogen ha-1 and 100ppm GA3, sweet Charlie had the biggest fruit set production and the finest fruit quality when harvested.increase in the number of flowers. Additionally, the use of higher doses of Azotobacter and PSB also resulted in more flowers per plant. Azotobacter and PSB (7 kg/ha) increased the number of flowers/plants and also Kumar et al., (2015)[19].

6. The combined effect of organic manure and biofertilizer on the growth, yield, and quality of strawberries:

Treating strawberry plants with a combination of vermicompost, Jeevamruth, and Beejamruth seedling treatment can lead to increased flower and fruit production, as well as enhanced photosynthesis due to heightened vegetative growth. This is likely due to the positive impact of the media mixture and the availability of essential nutrients, such as nitrates, phosphates, and sulfates. Similar results have been found by other researchers, including Kirad et al. (2009)[33] and Arancon et al. (2004)[12]. Additionally, using a combination of vermicompost, Azotobacter, and PSB resulted in the quickest fruit production, with the highest number of fruiting plants and fruit trees observed in this treatment group. This is consistent with previous findings by Ghazvani et al. (2007)[34]that showed increased concentrations of Azotobacter and PSB lead to higher fruit sets in tomatoes. Azotobacter is believed to accelerate plant development.

Research has shown that using various organic combinations can significantly improve the production and quality of strawberries. For example, a study by Dadashpour and Jouki (2012)[35] found that using a combination of compost, azotobacter, wood ash, phosphorus-soluble bacteria, and oil meal resulted in larger fruit size, increased weight, higher sugar content, and a greater yield in Kurdistan. Similarly, Tripathi and Gupta (2017)[36] reported that using a combination of Azotobacter and Vermicompost improved plant height, leaf and stolon number, and the number of blooms and fruit set in strawberries. Another study by Singh et al. (2015)[37] found that using a combination of vermicompost, Azotobacter, PSB, and arbuscular mycorrhiza led to the highest plant height, leaf, and fruit yield. Another study found that combining earthworm compost, chicken manure, and Azotobacter resulted in the highest growth, yield, and fruit size in the

strawberry variety Sweet Charlie. Overall, using organic fertilizers and biofertilizers can have a positive impact on strawberry growth, yield, and quality.

Research has shown that using organic matter in combination with biofertilizers can improve vegetative development and fruit set in strawberries. Kumar et al. (2015)[19] found that using chicken manure, vermicompost, azotobacter, and PSB resulted in the highest yield and quality in terms of total soluble solids, ascorbic acid, and shelf life. Additionally, Jain et al. (2017)[38] found that using a combination of FYM, vermicompost, azotobacter, and PSB resulted in a higher benefit-cost ratio for strawberry crops. Furthermore, Kumar et al. (2015)[19] found that using a combination of 2.5 t/ha of vermicompost and a reduced amount of NPK fertilizer resulted in increased plant height, number of leaves, days to first blooming, and flowers per plant. Studies also found that using biofertilizers and vermicompost improved yield, fruit output, fruit size, weight, and shelf life. The highest yield (311.26 g) plant-1 was reported in the vermicompost + Azotobacter + PSB + AM treatment group and the second-highest (297.73 g) in vermicompost + PSB + AM fertilized plants. The lowest yield was noted in the control group (13.59 g). These results are in line with those obtained by other researchers for strawberries and tomatoes, who have also observed increased yield following the application of Azotobacter. Increased fruit set per plant, fruit length and breadth, and berry weight with nitrogen might all contribute to an increase in yield.

Organic fertilizers have been shown to enhance soil microbial biomass, making them a more environmentally friendly alternative to chemical fertilizers (Selvamani et al., 2011)[10].According to Herencia et al. (2011)[17], composting with high concentrations of nitrogen and phosphate can promote the formation of floral buds and vegetative growth. Using worm-based fertilizer, Senevirathne et al. (2009)]39] observed significant increases in strawberry yield and blooming. Bio-fertilizers, which are organic compounds that contain living microorganisms, are also an environmentally friendly option for plant growth. Azotobacter, PSB, and other biofertilizers that are derived from live microorganisms can fix atmospheric nitrogen and make insoluble phosphorus available to plants. Additionally, these biofertilizers can improve soil fertility by increasing the quantity and activity of soil microbes. They also play a role in boosting plant growth hormones and aiding in the fixation of atmospheric nitrogen and solubilization of phosphorus.

7. Effect of Panchagavya on Plant Growth, Yield, and Quality of Horticultural crops

Panchagavia is an organic food made from five cow byproducts: cow dung, urine, milk, fat, and curd. It contains essential nutrients such as nitrogen, phosphorus, and potassium, which are important for plant growth and development. Additionally, the insecticidal properties of Panchagavia are enhanced by the use of cow dung and urine, allowing farmers to reduce their use of toxic pesticides on their crops (Singh M et al. 2020)[40]. The term "Panchagavya" is derived from Sanskrit and refers to a mixture of five cow-derived products: milk, ghee, curd, dung, and urine. It is mentioned in both ancient Indian knowledge texts such as Vedas and Vrikshayurveda (Mangturam et al., 2017)[9]. In recent years, Panchagavya has gained popularity in the states of Tamil Nadu and Kerala. To prepare Panchagavya, the following five cow-derived products are used, in addition to other ingredients: 7 kg of fresh cow dung, 3 liters of milk, 2 liters of curd, 1 kg of cow ghee, 3 kg of sugarcane juice or 500 g of jaggery, 3 liters of tender coconut water, 12 ripe bananas, 100 g of yeast and 100 g of jaggery dissolved in 2 liters of warm water. Panchagavya is considered important in managing all aspects of agricultural production, including soil fertility, pest control, and disease management.

8. Effect of Jeevamruth and Beejamruth on Plant Growth, Yield, and Quality of Horticultural crops

The application of two batches of 500ml pots of Jeevamruth, a 100% RDN with vermicompost, was found to significantly enhance the number of crowns per plant, number of stolons per plant, and plant dry weight (36.87 g) in strawberries. In contrast, plants that were given the recommended amount of fertilizer alone showed only minimal signs of vegetative development. The enhancement of nutrient uptake may be due to the increased availability of nutrients and helpful enzyme activity from the vermicompost, an increase in beneficial microbes, or the presence of biologically active chemicals (Arancon et al., 2003)[21]. Fermented liquid organic fertilizers like Beejamruth also contain beneficial bacteria that generate plant growth-promoting hormones, such as IAA and GA, which result in longer seedlings (Gore et al., 2010)[41]. All studies came to the same conclusion that the use of vermicompost and Jeevamruth, in addition to 100% RDN and Beejamruth, resulted in maximal vegetative development, increased blooms, photosynthesis, and fruit set in strawberry plants. This may be due to the positive impact of the physicochemical state of the medium combination and the presence of available nutrients (Cantliffm et al., 2003)[42].

Table 1 : **List of reviewed articles in this study**

Sr.No	CROP	SOURCE	IMPACT	RESULT
1	**Strawberry (*Fragaria* x *ananassa* Duch.) Cv. Chandler**	Application of vermicompost + vermiculite + sand + soil + cocopeat (1:1:1:1:1) with the treatment of Azotobactor	Application of vermicompost + vermiculite + sand + soil + cocopeat (1:1:1:1:1) with the treatment of Azotobactor	(Yadav et al., 2012).
2	**strawberry (*Fragaria* x *ananassa* Duch.) Cv. Chandler**	Vermicompost + PSB and Vermicompost + *Azotobacter*	. From the maximum number of flowers/plant (59.91)	Kumar *et al*., (2015)
3	**Guava (Psidium guajava L.) cv. Allahabad safeda**	Vermicompost (30 kg/plant) + Azospirillum culture (250 g/tree) + PSB @ 250 g/tree. Vermicompost (30 kg/plant) + Azospirillum culture (250 g/tree) + PSB @ 250 g/tree + Vermi wash foliar spray (dilution with water @ 1:1).	Maximum average weight of fruits (400.00 g), yield of fruits (29.60 kg/tree and 11.84 t/ha) Maximum number of fruits produced per plant (85.00 fruit/ plant) was found from plant fertilized with FYM (30 kg/plant	Crespo, P.V.A.S. (2010).
4	**Strawberry (*Fragaria* x *ananassa* Duch.) Cv. Chandler**	FYM + Vermicompost + Poultry manure + *Azotobacter* + PSB,) With treatment FYM + Vermicompost + Poultry manure + *Azotobacter*+ PSB	Minimum days to produce first flower. (50.99 days number of flowers/plant (59.91) and number of fruit set/plant, and number of fruit set/plant (49.60) were recorded highest	El-Araby; S.M., I.M. Ghoneim, A.I. Shehata and R.A. Mohamed (2003). Effect of Nitrogen, organic manure and Biofertilizer application on strawberry plants. J. Agric. & Envi. SCI., Alex. Univ. Egypt., 2: 36-62.
5	**Sweet Orange (Citrus sinensis)**	(FYM@46Kg/plant + Neemcake@22Kg /Plant + Azospirillum@200g/Plant+PSB@200g/ Plant)	recorded highest yield of 3.39 t/ha(0.41 B:c ratio). Advent of high density planting, and increased productivity per unit area ,	M M Naidu

6	**Strawberry (Fragaria x ananassa Duch.) cv. Nabila**	*Azotobacter 6* kg/ha + vermicompost 30 tonnes/ha, followed by *Azotobacter* 7 kg/ha + vermicompost 20 tonnes/ha (32.02 and 29.06, respectively), whereas the least number of fruit set per plant was produced from unfertilized (contol) plants (17.83 and 14.85	*Azotobacter* and PSB concentration resulted in higher fruit set in tomato. *Azotobacter* is expected to hasten plant development; hence an increase in fruit set in the present studies is due to the cumulative effect of *Azotobacter* and vermicompost application.	Gajbhiye *et al.* (2003),

7	**Strawberry (Fragaria x ananassa Duch.) cv. Nabila**	Moreover, control registered the lowest yield (196.23 q / ha). The treatment T11 (RDF + Azospirillium @ 7 kg/ha + Phosphate Solubilizing bacteria (@ 6 kg/ha) + VAM (@10 kg/ha) registered highest benefit cost ratio (4.20:1	Flowering and physical parameters of fruit i.e. number of flowers, number of fruits per plant, fruit of length, diameter, volume and weight of fruit were significantly influenced under the treatment	http://www.thepharmajournal.com/
8		organic fertilizer (wheat remains compost) at three levels (0, 15 or 30 g/plant) and/or bio fertilization with Azospirillum or Azotobacter at concentration of 10 ml/Plant, individually or in combination, beside the water sprayed control plants during the 2017 and 2018 growing seasons	Compared to the control treatment, the combined treatment of organic fertilizer (30 g/plant) with the two bio-fertilizers(Azospirillum and Azotobacter) among all the other treatments resulted in significantly higher values in number of fruits.plant-1, fruit weight, yield.plant-1, fruit content of total sugars, ascorbic acid, anthocyanin pigment and lowest content of total acidity	Shymaa S. Neamah1 *, Ghalib B. A. Al-Abbasi1 and Alaa E. Hasan2
9	**Strawberry (*Fragaria* x *ananassa* Duch.) Cv.**	application of 25 per cent nitrogen in the form of FYM + 75 per cent through urea + Azotobacter and were at par with each other.	The maximum increase in plant height (21.50) ,spread (28.67cm) and leaf area (75.31cm2) was recorded by the application of cent per cent nitrogen was applied in the form of urea along with Azotobacter	Pang, X.P. and J. Letey (2000). Organic farming: challenge of timing nitrogen availability to crop nitrogen requirements. Soil Sci. Soc. Am. J., 64: 247.253.
10	**Sweet Orange (Citrus sinensis)**	FYM@46Kg/plant + Neemcake@22Kg /Plant + Azospirillum@200g/Plant+PSB@200g/ Plant))	for obtaining higher yield among organic treatments. recorded highest yield of 3.39 t/ha(0.41 B:c ratio). Considering the yield as well as benefit : cost ratio in view among organic treatments, it can be concluded that application of	Goswamy, N. N and Rattan, R. K. 2004. Singh A K, Narayanasamy G, Rattan R K and Goswami N N.

11	**Sweet Oranges (Citrus sinensis)**	(under a treatment of 80ml Azotobactor + 80ml PSB + 50kg FYM + RDF (800:400:400g NPK)	107.36kg) and marketable yield (105.46kg) of fruits was evaluated The highest average Effect of Bio-Fertilizers and Organic Manures on Growth, Yield and Fruit Quality of Fruit Crops 3771 yield	(Bhalerao et al., 2009)
12	strawberry cv. Sabrina	application of 100% recommended dose of fertilizersRDF + Vascular Arbuscular Mycorrhiza VAM @10 kg ha-1 + 0.4% Boron + 0.5% ZnSO4 than control plants, which might be due to potential role of VAM in solubilization of insoluble phosphorus, uptake and proliferation of beneficial organisms in the rhizosphere. I	Reported maximum fruit weight, fruit length and diameter, number of fruits per plant	Esmatullah A, Honnabyraiah MK, Ashok S, Alur J, Dinakara A, Rao, V. Impact of integrated nutrient management on yield and quality parameters of strawberry (Fragaria x ananassa Duch.) cv. Sabrina under polyhouse. Int J cur Micro Appl Sci. 2017;6(9):3481-3487.

CONCLUSION

Today, intensive strawberry cultivation employs inorganic fertilizers and manures which disrupts the natural order and affects economic efficiency, but cannot be discontinued without greatly reducing food production. Integrated nutrient management is needed to focus on agricultural inputs and reduce the negative environmental impact of fertilizers and practices. Biofertilizers, when used in conjunction with other organic manures such as FYM and compost, improve soil fertility, increase crop productivity, lower production costs, and reduce pollution. Studies have found that using biofertilizers in combination with organic manures results in greater growth, production, and quality characteristics than using biofertilizers alone or with chemical fertilizers or pesticides. Different fruit crops given different biofertilizer treatments have shown significant gains in yield, growth, quality, and Benefit Cost Ratio. It has been found that the application of chemical fertilizers alone provides minimal advantages to the fruit crop and may boost productivity but at the cost of fruit quality and soil health.

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