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The impact of various organic sources on tomato yield and quality: A review

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Abstract

Organic matter plays a crucial role in maintaining soil health and boosting crop productivity. A firmer basis for increased crop yields and resilience to environmental challenges can be achieved by creating and preserving a healthy soil with more organic matter. Increased soil organic matter levels frequently result in more sustainable systems with higher yields that are more reliable over the long run. The highest crop yields typically were acquired when the soil contained approximately 3.75% organic matter, according to an analysis of various soil types with differing levels of organic matter. Organic matter in productive soils was often 3.0-3.5 percent. Organic fertilizers have been found to boost tomato yields and enhance fruit quality. The complex effects of organic fertilizers on tomato yield and quality have been found to be influenced by a number of factors, including the amount of organic matter in the soil, the total amount of nitrogen in the soil, and the type of organic fertilizer used. These results provide insightful information and useful recommendations for the efficient application of organic fertilizers in greenhouse farming.

Keywords: Organic sources; lycopene; organic matter; nitrogen

1. Introduction

It is commonly recognized that eating a balanced diet improves antioxidant levels, helps control body weight, and prevents chronic diseases like cancer, cardiovascular disease, osteoporosis, and cognitive decline. Tomatoes and their derivatives are rich in nutrients and also have anti-inflammatory, anti-cancer, and antioxidant properties. Low blood or plasma levels of lycopene are linked with an higher risk of cancer. Moreover, one of the most extensively grown veggies is the tomato. Over 180 million tons of tomatoes are produced globally, and because of their useful compounds—like lycopene, vitamins, minerals, and other nutrients—they are crucial for a balanced and healthful diet. as well as proteins.

Additional materials not present in chemical fertilizers are provided by vermicompost-enriched soil. It is an additional benefit of vermicompost. The minerals NO3, PO4, Ca, K, Mg, S, and micronutrients found in vermicompost, which is mostly composed of C, H, and O, have an impact on plant development and yield that is comparable to that of inorganic fertilisers added to soil. (Singh *et al.*, 2008). The proportion of nutrients required for plant growth in easil y accessible forms is higher in vermicompost, an organic so urce of plant nutrients (Nagavallemma *et al.*, 2004). Biofertilizers provide plants with nutrients through the natur al processes of nitrogen fixation, phosphorus solubilization, and chemical synthesis that promotes growth.

In addition to fixing nitrogen from the atmosphere, biofertilizers increase plant nutrient availability when applied to seed or soil and provide an environmentally responsible, financially feasible, and socially acceptable alternative to chemical fertilizers. Tomato crop mulching has been investigated in sub-humid regions with clayey soils in India; in those conditions, applying straw mulch enhanced tomato yields by 30% in comparison to un-mulched controls. Rice straw mulch has been shown to increase barley yields in a related experiment conducted in a different sub-humid Indian region with finely textured soils. Similar findings are reported by experiments conducted in other East African nations; adding mulch to shallow tillage

systems enhances soil quality and crop production. Mulch should be put prior to the conclusion of the rainfall to guarantee the moisture supply. By doing this, weed growth may be inhibited and rainwater infiltration increased. When growing tomatoes in the winter, planting time can also be quite important.

2.1 Impact of integrated nutrient management on tomato crop growth and yield

A. Vegetative growth attributes

Nanthakumar and Veeraraghavathatham (1996) [60] state that growth, yield (36.48 t per ha), and general quality of brinjal were all improved with the application of 12.5 t per ha of farmyard manure (FYM), 2 killogram of Azospirillum and phosphate-solubilizing bacteria (PSB), 75% by mixing together and the recommended amounts of phosphorus and nitrogen, and the full dose of potassium. Varu *et al*. (1997) [102] observed that using FYM at 95 t/ha, along with an NPK dose of 50:25:25 kg/ha and 2 t/ha of Dharatidhara (a concentrated organic manure), led to the greatest plant height (43.45 cm) and the highest number of leaves per plant (7.05) in onion cultivation. According to a study by Sendur *et al.,* (1998) [82], applying manures (FYM, vermi-compost, and neem cake) along the recommended dosage of inorganic fertilizers produced better results for tomato growth and fruit yield. The greatest plant height (75.76 cm) was achieved in tomatoes treated with Farm Yard Manurs + 100 percentage NPK (150:100:50) kg ha/1 with Azospirillum and Phosphobacteria, according to Kumaran *et al.,* (1998) [47]. According to Terry *et al.,* (2000) [95], the improved treatment that improved growth metrics and yield was an Azospirillum inoculation at the time of sowing, which also raised plant height in tomatoes. For the first female flower appearance and closest sex ratio in cucumbers, Nirmala and Vadivel (2000) [62] acquired the highest vine length, number of leaves/plant, leaf area, minimal number of days, and earlier node by the combined application of 30 t FYM and *Azospirillum* + PSB+ VAM bacteria as soil inoculation (2 kg/ha each). It was also noted that these outcomes significantly outperformed both the recommended dose and the control. Additionally, it was said that these outcomes were noticeably better than the suggested dosage and management. The plant height, root biomass, and shoot biomass of the tomato crop rose significantly when Atiyeh *et al.,* (2000) [12] replaced 20% of the conventional horticultural medium with vermicompost. arekar (2000) [15] reported that chilli plants treated with 150:50:50 kg NPK/ha combined with 10 t FYM/ha and PSB biofertilizers exhibited early 50% flowering. Sannigrahi and Borach (2001) [80] found that when 20 t ha-1 FYM + NPK 50% was applied to okra crops, plant height increased considerably in comparison to the control. In a field study of fenugreek crops cultivated on Jobner's loamy sand soils. Meena (2001) [87] found that applying 75% nitrogen through FYM and 25% through urea significantly enhanced plant height, number of branches per plant, and dry matter accumulation per metre row length compared to other FYM and urea combinations. Additionally, the combined Azospirillum treatment—comprising soil application and seedling dipping—resulted in the greatest plant spread (46.22 cm), plant height (26.44 cm), and number of leaves per plant (22.70) in cabbage. According to Bhagvantagoudra and Rokhade (2001) [16], 38 t/ha or Agrimagic at 16.87 t/ha. Additionally, these treatments showed the fruit's lowest physiological weight loss and longest shelf life. According to Anburani and Manivannan (2002) [7], the maximum plant height, number of primary branches, and number of leaves per plant were recorded by FYM + poultry manure at 12.5 t/ha each, in combination with 100% NPK + biofertilizers. In contrast, the maximum number of secondary branches per plant was recorded by FYM at 25 t/ha combined with 100% NPK + biofertilizers in brinjal cv. In comparison to the recommended fertilizer dosage at Prabhani (Maharashtra), Anamalai Prabu *et al.,* (2002) [70] found that a 25% recommended fertilizer dose (RDF @ 90:80:50 NPK kg ha-1) + 10 t FYM ha-1 with biofertilizers (Azotobacter + VAM) resulted in significantly higher coriander plant height and root:shoot ratio. Naidu *et al.,* (2002) [58] used 75:35:0 kg per ha N P K in conjunction with organic manures to achieve the highest plant height, fruit girth, and 50% flowering of brinjal. In comparison to NPK alone, Malawadi (2003) [53] reported that the combined use of NPK and FYM led to a significant increase in plant height, number of branches, leaf area, and total dry matter production in different parts of the chilli plant. Similarly, Kumar *et al.* (2003) [46] observed that applying vermicompost at 5 t/ha significantly improved plant height and dry matter accumulation per plant in mung beans when compared to the control. According to Arancon *et al.,* (2003) [10], pepper plants' shoot weight and leaf area rose when vermicompost was applied at 5 or 10 t ha-1 as opposed to using only inorganic fertilizers. The growth of chillies was greatly impacted by the use of organic fertilizers, such as FYM, chilli stalks, and FYM chilli stalks, in conjunction with inorganic fertilizers. The combined effect of the non- ionic and ionic fertilizers greater than that of the inorganic fertilizer alone, according to Kattimani (2004) [37]. In 2004, according to Patil *et al*., the administration of the prescribed amount of N_2 in the form of FYM + ionic fertilizer in a 1:1 ratio over FYM or just using ionic fertiliser produced a considerable increase in cumin growth, includes height of plant and branches/plant. Khoja (2004) [38], based on field experiment findings, observed that applying nitrogen through a combination of FYM (N30), urea (N30), and Azotobacter led to a significant increase in plant height, number of branches, dry matter accumulation, leaf area, leaf area index (LAI), crop growth rate (CGR), and chlorophyll content compared to other treatment combinations. According to Jat and Ahlawat (2004) [33], using 3 tons of vermicompost per hectare greatly enhanced the chick pea's development and yield characteristic (pods/plant) as well as its seed straw production when compared to the control. According to Kumar and Sharma (2004) [44], the best plant height results (178.3 and 30.8 cm, respectively) were obtained when FYM + 150% NPK was applied to tomatoes and cabbage. Conjunctive application of 75% N_2 from vermi-compost and the remaining 25% N_2 from ionic fertilizer resulted great hike in increase the soy bean plant height and leaf area index, which was comparable to 100% N from vermicompost alone. Its greater nutritional levels and crop availability may be the reason for the added benefit of vermicompost application (Govindan and Thirumurugan, 2005) [26]. Seeds of okra treated with Azospirillum and 100% N:P:K + 15t FYM exhibited the highest plant height

(42.37, 56.97, and 66.18 cm) days after planting, according to Ray *et al.,* (2005) [77]. According to Powan and Aguzyoh (2005), 100 kg P and 20 t FYM ha-1 together applied which produce the highest height of the plant in potatoes, whereas the control produced the lowest plant height. According to Yadav *et al.,* (2006) [106], applying FYM and gypsum to cauliflower plants produced the highest height of the plant (in 2001-02, 59.2 cm and in 2002-03, 57.9 cm) and the highest number of leaves/ plant (14.6 in 2001-02 and 13.6 in 2002-03) in both experimentation years. Different organic nitrogen sources were applied, and this had a substantial impact on tomato yield and growth. Plant height, branch count, yield were comparable to those of 100% nitrogen as urea among the various organic sources when 100% N was substituted as FYM (Kannan *et al.,* 2006) [36]. According to Rajan and Mahalakshmi (2007) [73], cowpea and radish seedlings generated the most leaves under the treatment that included 75% vermicompost. Plots with 100% vermicompost applied had the highest radish leaf area, tuber length, and wet weight. In 2007, Peyvast *et al.,* [67] shown that adding vermicompost to soil can greatly boost spinach plant height and leaf count. Kumar and Sharma (2007) [45] revealed that tomato seeds were treated with *Azotobacter* + 100% NPK + FYM showed highest plant height (153.20 cm) in both the years of experimentation. Bharadiya *et al.,* (2007) [18] found that applying 50% RDF + 50% nitrogen through neem cake increased the okra's maximum plant height, fruit number per plant, yield of green fruit, total yield, individual fruit's weight and length of the fruit compared to the control. When Vitakar *et al.* (2007) [104] compared the chilli crop to RDF, they discovered that the treatment that generated the greatest plant height, only primary branches, and total yield per hectare was 50 percentage of N from vermicompost and 50 percentage of N from neem cake. *Gowda et al.,* (2008) [27], in a field study on wheat, observed that the application of vermicompost at 3.8 t/ha along with poultry manure at 2.45 t/ha led to a significant improvement in plant height, number of leaves, tiller count, test weight, straw and seed yield, as well as seed protein content, compared to the untreated control.

According to Anchal *et al.,* (2008) [9], 50% RDF + Biofertilizer + Vermicompost produced better vegetative parameters in tomato crops than either treatment alone or another combination treatment, including height of the plant, primary branches number, accumulation of dry matter, and yield. According to Suthar (2009) [94], the application of different treatments employing 15 t per ha vermicompost, 50 percentage of N:P:K had the largest range of certain parameters of plant, such as length of the root, length of the shoot, fresh weight, and the number of cloves in garlic. FYM also demonstrated a significantly higher plant production result with applied vermicompost than with manure. Abduli *et al.,* (2012) [1] discovered the increasing in ratio of vermicompost to soil greatly increases tomato plant growth. According to research by Premsekhar and Rajashree (2009), okra exhibited noticeably higher values of growth characteristics and yield attributes when FYM @ 20 t per ha was applied, co-related to other organic manure treatments. Compared to the available dose of NPK, Mishra *et al.,* (2009) [55] studed a significant improvement in all growth parameters. Compared to the other treatments, the application of vermicompost @ 2-5 t per ha + NPK + PSB + Azotobacter resulted in the highest height of the plant and branch count. Kondappa *et al.,* (2009) [39] investigated how INM affected the economics, yield, and growth of chilli varieties. Byadgi Dabbi and came to the conclusion that using vermicompost in conjunction with fertilizers was still advantageous. Hari *et al.,* (2009) [28] conducted field research in the winter season of 2005-06 and 2006-07 to examine the effects of organic manures, such as vermicompost and neem cake, grown on clayey soil in conjunction with nitrogenous fertilizer on onion bulb growth, yield, and quality. Both weight of the bulb and yield of the bulb were significantly higher in the vermicompost treatment. The same authors also reported similar outcomes with the chilli crop. The impact of various non-ionic manures and ionic fertilizers on the growth and yield of brinjal (*Solanum melongena* L.) was investigated in an experiment by Kumar and Gowda (2010) [42]. The highest plant height, number of leaves, and total dry matter were observed when the recommended 25 t/ha of FYM, N through vermicompost and green manure (50 percent each) + recommended NPK (125:100:50 kg/ha) were applied. The treatment with 150% recommended FYM alone had the fewest branches, while 100% recommended FYM alone showed first 50% of early flowering and the first early harvest. In order to ascertain how various fertilizers with equal nutrient concentrations affected various growth parameters, Chanda *et al.,* (2011) [20] investigated the vermicomposting effect and other ionic fertilizers on tomato plant cultivation. When vermicompost and ionic fertilizers were applied, they discovered that the fruit yield was 73% higher than the control. According to Sharma and Choudhary (2011) [85], height of the okra plant at harvest, branches number per plant and area of the leaf, all increased significantly when 100% of the recommended fertilizer and farm yard manure were put in @ 20 t per ha. According to Kumar *et al.,* (2011) [43], the T_{12}, which received applications of 60 kg of P_2O_5 and 120 kg of nitrogen/ hectare respectively, had the highest height of the plant, the greatest, branches number per plant, the diameter of the fruits, the average weight of the fruits, and the earliest flowering. The main stem's diameter did not significantly change. However, when connect to other treatments and the control, the treatment combination I2B2 performed better due to the interaction effect on height of the plant, branches number/plant, diameter of main stem, days until first flowering, diameter of the fruit, average weight if the fruit and yield. The purpose of the study by Mamta *et al.,* (2012) [54] was to determine how vermicompost affected the brinjal plant's growth and yield. Under field conditions, brinjal plants were combined with vermicompost made from dung of the cow, waste opf gardens, and waste of kitchen. The test crop's seed germination was considerably impacted by the various treatments. Plant height, leaf count, and weight of the fruit were all higher by the vermicompost-treated field than in the control and there was zero evidence of fruits disease in the vermicompost-treated plot. In 2013, according to Bajshya *et al.,* [14] production of potato cultivar Kufri Mega with 75% RD from ionic fertilisers with 25% RD from FYM and 100% RD from ionic fertilisers showed highest growth, higher yield of tuber, and potato profit is also higher in the northeastern hill region of India.

According to Bahrampour and Ziveh (2013) [13], adding 15

t/ha of vermicompost considerably boosted tomato growth and yield when related to the control. Additionally, it was evident that the fruit dry matter percentage increased by 24% and EC of fruit juice to 30%. The highest height of the plant (133.53 cm), the days of earliest flowering (29.47 days), the number of maximum flower clusters per plant, the number of flowers/ cluster, the number of fruits per cluster, and the number of fruits per plant were all noted by Laxmi *et al.,* (2015) [51] after varying combinations of organic manures, such as FYM, poultry manure, and vermicompost, and inorganic fertilizers, (50% RDF + 50% FYM). The highest TSS content in fruits was found in 50% RDF + 50% FYM, followed by 50% RDF + 50% vermicompost. Interestingly, the combination of 50% recommended dose of fertilizer (RDF) with 50% vermicompost resulted in the highest titratable acidity (1.06%), the greatest ascorbic acid content (26.54 mg per 100 g of juice), and the longest shelf life at room temperature (11.67 days). This was followed closely by the treatment combining 50% RDF with 50% farmyard manure (FYM).

B. Fruiting and yield

According to research by Jablonska (1976) [31], the maximum total yield and commercial yield were identified with an application of FYM of 30 tonnes/ha combined with 800 kg per ha of N_2, P_2O_5, and K_2O. When 12 tonnes of FYM + 50% RDF was applied to the plot, Subbiah *et al.,* (1982) [92] observed that the fruit yield of chilli was the highest @ 60 t/ha, while the yield in the control plot was relatively low (29.7 t/ha). Applying a 5 ppm NAA spray on seeds, soil, and seedlings after Azospirillum inoculation + 70 kg N ha^{-1}produced the highest yield in the chili crop, according to Amrithalingam and Balakrishnan (1988) [5]. In 3 year field tests with cabbage, onion and carrot, Kropisz (1992) [41] found that applying various compost sources and FYM (@ 25 t ha-1) increased yields for all three crops when FYM + NPK was applied as opposed to FYM or inorganic fertilizers applied separately.

This maximum mean yield of 24.5 t/ha in chillies was obtained with the Azospirillum + 75% N treatment (56 kg N ha^{-1}), according to Paramaguru and Natarajan (1993) [67]. According to Ahmed (1993) [3], the tomato cultivar Pusa Ruby produced the most fruit when FYM and coir pith were added (19 & 17 t/ha, respectively). This combination also enhanced strength of the soil, bulk density, and moisture-retention capacity compared to crops treated with none of the chemical. Nanthakumar and Veeraraghathatam (1996) [60] found that the growth, yield @ 36.48 t/ha, and brinjal quality were positively impacted by the mixed application of nutrients using 12.5 t/ha of FYM + 2 kg of Azospirillum and PSB + inorganic fertilizers at 75% of the trusted dose of N, P, and 100% of K. According to Lopes *et al.,* (1996) [52], cowpea dry matter yield was considerably increased over the control treatments when vermicompost levels were raised by up to 10 t per hectare. While Patil (1995) [66] found that adding vermicompost in addition to 100% RDF + FYM increased the dry chilli yield by 1.68 q per ha. Jasvir Singh *et al.,* (1997) [32] identified that vermicompost replication at 10 t/ha maximize the fruit yield per plant in chilli. According to Kurup *et al.,* (1997) [50], the highest yield of okra cv was obtained by applying 100 kg N per ha as urea-blended neemcake. Kiran Thanunathan *et al.,* (1997) [96] found that applying soil, mine spoil, vermicompost (1: 1: 1) increased onion yield. According to Kalembasa and Deska (1998) [35], the use of vermicompost greatly enhanced the yield of radish and sweet pepper. According to Kalembasa and Deska (1998) [35], applying vermicompost greatly increased the yield of sweet pepper and radish. Vermicompost produced the highest yield in brinjal, according to Tomar *et al.,* (1998) [97]. Tomar *et al.,* (1998) [97] discovered that applying vermicompost produced the highest yields in carrot and brinjal, respectively, at 97g and 94.9g/fruit. In a similar vein, the yield of radish rose proportionately as vermicompost dosage increased (Buckfield *et al.,* 1999) [19]. According to Vadiraj *et al.,* (1998) [99], the coriander herbage yield was significantly increased by applying vermicompost @15 t/ha, which was comparable to applying chemical fertilisers @ 20:20:40, NPK kg ha-1. Sixty days after seeding, they discovered that the plots handled with 15 t/ha vermicompost produced the most herbage @ 6075.5 kg/ha. Additionally, the investigation showed that applying vermicompost @ 15-20 t/ha maximised the seed weight in addition to herbage and seed yield. Applying non-ionic manures (FYM, vermicompost, and neem cake) in conjunction with the supplied dosage of ionic fertilizers demonstrated the superior performance in terms of tomato's growth and fruit yield, according to Sendur *et al.,* (1998) [82].According to Nanthakumar and Veeragavathatham (1996) [60], the use of FYM considerably increased brinjal yield equated to the use of ionic fertilizers alone. According to Kumari *et al.,* (1999) [98], the greater yield was achieved @ 12 t/ha vermicompost plus the full dosage of the recommended fertilizer (N_2-50: P_2O_5-80: K_2O- 25 kg/ha), and the cost of producing okra was considerably decreased using vermicompost as an organic source. In 1999, according to Usha Kumari and his co-workers, the maximum yield was obtained with 12 t/ha vermicompost plus the full dosage of the applied fertilizer (N_2-50: P_2O_5-80: K_2O- 25 kg/ha), and the cost of producing okra was considerably decreased by using vermicompost as an organic source. Ridge gourd cv. was used by Shreeniwas *et al.,* (2000) [88]. Pusa Nasdar discovered that fruit yield rose with higher vermicompost rates. In ridge gourds, the vermicompost at 10 t/ha plus 50:25:50 kg/ha of NPK enhanced fruit weight and yield per vine. According to Terry *et al.,* (2000) [95], the best treatment that improved growth parameters and yield was an Azospirillum inoculation at the time of sowing, which also increased plant height in tomatoes. In comparison to other pepper treatments, Aliyo (2000) [4] found that applying FYM + poultry manure at a rate of 5 t/ha each, along with 50 kg N/ha, produced noticeably more fruit. In Assam, Sannigrahi and Barah (2000) [81] carried out field tests on the yield response of tomatoes, Kidney beans, and cabbages to the application of compost or onon- ionic manures like FYM with or without NPK fertilizers and inoculation of mycorrhizal root. The highest tomato yield (17.3 t/ha) was obtained by applying the recommended NPK fertiliser, whereas the highest yields of Kidney beans @ 36.1 t/ha and cabbage @26.6 t/ha were obtained by applying 10 t/ha FYM + 15 kg N + 10 kilogramme K2O and 10 t compost, inoculation, 40 kg N, 30 kg K2O, respectively. According to Rao and Sankar (2001) [76], organic fertilizer had a noticeably better impact on brinjal yield parameters than

inorganic fertilizer. FYM + Vermicompost treatment produced the highest fruit yield (12.31 t per ha-1). Patil and Biradar (2001) [65] found that applying 200% of the recommended fertilizer dose plus farm yand manure + vermicompost produced the highest fruit yield of the chilli variety Byadgikaddi. As the nutrient levels of rose, so did the absorption of Nitrogen, Phosphorus and Potassium. the following levels were examined: 100% RDF @ 150:75:75 kg/ha + farm yard manure 10 t/ha; 100% recommended fertilizer + farm yard manure + vermicompost @ 2.5 t/ha; 150% recommended fertilizer + farm yard manure + vermicompost; and 200% recommended fertilizer + farm yard manure + vermicompost. In contrast, Sharu and Meerabai (2001) [87] found that 50% poultry manure plus 50% inorganic N produced the maximum yield of fruit @ 9.66 t/ha). Subbarao and Ravisankar (2001) [90] found that applying FYM + Vermicompost and then FYM + Neem cake produced the highest yield of brinjal fruit (12.31 t/ha). According to Asha and Geethakumari (2001) [108], the highest yield of fruit in okra cv was obtained by applying FYM and Neem cake in a 1:1 ratio in conjunction with Azospirillum inoculation. Anamika Arka (166.92 q/ha). According to Samawat *et al.,* (2001) [79], vermicompost significantly impacted the quantity of tomatoes that produced fruit. Fruit production in the 100 percent vermicompost treatment was four times higher than in the treatment control. According to Shalini *et al.,* (2002) [84], a greatest yield of 37.00 tonnes/ha was obtained by applying 50% (N) vermicompost, 50% (N) urea, azospirillum.

Mohd *et al.,* (2002) [56] reported that the best yield and quality were achieved by applying 12.5 tons per hectare of farmyard manure (FYM) at 50% of the recommended rate, along with a reduced dose of chemical fertilizers (50% of the standard 100:50:50 NPK kg/ha recommendation). The investigation also showed that the commercial companies' artificial organic manures, which were used in this study, were more popular than ancientt organic manures, such as vermicompost and FYM. Naidu *et al.,* (2002) [58] used 75:35:0 kg /ha N P K in conjunction with organic fertilizer to achieve the greatest fruit girth, 50% flowering, and yield of brinjal cv. JB-64. This can occur either by increasing the rate of respiration through changes in cell permeability or by promoting growth through hormone stimulation, the FYM appears to directly increase crop yield. Through biological decomposition, it provides the plants with available forms of phosphorus, sulfur, and nitrogen. Indirectly, it enhances the soil's permeability, aeration and water-holding capacity, investigarted by Chandramohan in 2002) [21]. Sengupta *et al.,* (2002) [83] discovered that when tomato plants were treated with 100% nitrogen (120 kg ha-1) and Azospirillum seedlings, the highest fruit diameters were 6.75cm and 6.45 cm, with marketable fruit yields of 284.38 q ha-l and 268.81 q ha-l in the corresponding years. Bhagavantagoudra and Rokhade (2002) [17] found that Azospirillum treated with soil + seedling dipping produced the highest values for the cabbage's head diameter (13.33 cm), head surface area (577.31 cm2), number of inner leaves per head (41.92), and head weight (687;98 g). According to Harikrishna *et al.,* (2002) [29], the treatment of FYM 75% of NPK + Azospirillum produced the highest fruit yield (54.32 t ha-1), while the treatment of FYM alone produced the lowest yield (30.31 t ha-1). According to research by Rafi *et al.,* (2002) [72], applying 50% of the recommended FYM dose@ 12.5 t per ha and using 50% of the standard fertilizer dosages (100: 50: 50 N:P:K kg/ha) produced the maximum yield with the best quality. The impact of applying NPK artificial fertilizer with or without organic or natural manures (FYM and Agrimagic) on tomato cultivar yield and quality was investigated by Krishna and Krishnappa (2002) [40]. During Rabi 2000-01, Avinash-2 was studied in Bangalore, Karnataka, India. The highest yield values were generally obtained with N:P:K at 250:250:250 kg/ha plus either FYM at 38 t/ha or Agrimagic at 16.87 t/ha. The application of 25 t ha FYM + 100:50:50 kg NPK ha-1 + biofertilizer produced the highest weight of the fruit and yield of brinjal cv, according to Anburani *et al.,* (2003) [8]. According to Annamalai Arancon *et al.,* (2003), all vermicompost-treated plots had marketable tomato yields that were substaintially maximum than those of the inorganically fertilized plots when vermicompost was usable @ 5 t/ha. According to Datt *et al.,* (2003) [23], applying FYM @ 10 t/ha enhanced vegetable green pea pod yield by 16% compared to control. When FYM @ 10 t/ha and N, P2O5, K2O @ 20, 26.2, and 25 kg/ha were applied together, the soil's available N @ 398.00 kg/ha, P @ 38.30 kg/ha, K @ 328.00 kg/ha, and organic carbon @ 7.70 g/kg content was higher than when inorganic materials were usable alone (362, 30.5, 296 kg/ha N, P and K respectively and 7.3 g/kg organic carbon). As werll as, when FYM @10 t per ha and N, P2O5, and K2O were usable together, there was a greater uptake of NPK than when they were applied separately. According to Netwal (2003) [61], applying 5 t of vermicompost per hectare greatly maximise the number of cowpea pods/plant, seeds/pod, harvest index, seed yield and straw yield when compared to the control. In 2.5 t and 5 t vermicompost and FYM per ha respectivaly, Rajkhowa *et al.,* (2003) [74] found that the pods number/plant, seeds/pod, and 1000 grain weight of green gram increased significantly when vermicompost was applied at a rate of 2.5 t/ha, which was comparable to 2.5 FYM t per ha. The growth and development of chillies was greatly impacted by the application of non-ionic fertilizers such as FYM, chilli stalks, and FYM chilli stalks in conjunction with ionic fertilizers. The combined effect of the non-ionic and ionic fertilizers was greater than that of the ionic fertilizer alone (Kattimani, 2004) [37]. According to Jat and Ahlawat (2004) [33], applying 3 tonnes of vermicompost per hectare greatly enhanced the chick pea's growth and yield attribute (pods/plant) as well as its seed straw yield when compared to the control. In an experiment on cauliflower, Kumhar (2004) [49] found that applying vermicompost at a rate of 7.5 t per hectare greatly increased the volume of curd. Similarly, Hashemimajd *et al.,* (2004) [30] found that tomatoes' shoot and root dairy matters (DM) are higher when treated with vermicompost made from raw dairy manure (RDM) and a few other composts (sewage sludge + rice hull) than when treated with a control. Poul *et al.,* (2004) [68] discovered that applying 50% of the confident dose of N P K along with half does produce the most fruits/fresh fruit yield/tomato plant. According to Sajitha *et al.,* (2005) [78], inoculating garden beans with biofertilizers in addition to vermicompost and vermiwash improves yield. When non-ionic fertilizer

like FYM and PSB were applicable together, the yield of soy beans maximise to 502 kg/ha, compared to 423 kg/ha when inorganic fertilizers were applied alone (Deshmukh *et al.*, 2005) [24]. In comparison to the control, Yadav *et al.*, (2006) [106] discovered that the application of 90 kg Nitrogen per ha through poultry manure, farm yard manure, urea, and vermicompost resulted in a significantly higher fruits number, length of the fruit, fruit girth, and total yield of okra. The growth and yield of tomatoes were greatly impacted by the practical of various organic nitrogen sources. In comparison to RDF, Vitakar *et al.*, (2007) [104] found that a treatment of 50percent N through vermicompost and 50percent N through neem cake resulted in the highest height of the plant, primary branches, and total yield per hectare in the chilli crop. When 50% RDF + 50% nitrogen was applied through neem cake, Bharadiya *et al.*, (2007) [18] observed the highest plant height, fruits number per plant, green yield of fruit, total yield, individual fruit weight and length of the fruit of okra compared to the control. According to Anchal *et al.*, (2008) [9], 50% RDF + Biofertilizer + Vermicompost produced better vegetative parameters in tomato crops than either treatment alone or another combination treatment, including height of the plant, number of primary branches, accumulation of dry matter and yield. Abdullah (2008) [2] found that plots amended with vermicompost and vermiwash had significantly higher average weights of potato tubers and onion bulbs. Dharade *et al.*, (2009) [25] concluded the effects of fertilizers and organic manure on ginger yield and nutrient uptake and found that applying 50% N through RD, 25 t FYM t ha-1 fertilization to the crop was advantageous in terms of net returns. The treatment with RDF, 25 t FYM ha-1 had the highest uptake of P and K, while the treatment with RDF, 50% N through RDF, 50% N through either vermicompost or poultry manure had the highest uptake of N. According to Kumar *et al.*, (2011) [43], the T12, which received applications of phosphorus @ 60 kg and nitrogen @ 120 kg per hectare, had the highest height of the plant, the greater in branches number per plant, the diameter of the fruits, the average weight of the fruits, and the earliest flowering. The main stem's diameter did not significantly change. However, when co-related to other treatments and the control, the treatment combination I2B2 performed better in height of the plant, branches number/plant, diameter of main stem, days until first flowering, fruit diameter, average fruit weight, and yield due to the interaction effect. According to Suchitra and Manivannan (2012) [93], the impact of organic inputs on brinjal yield characteristics varies by season. They found that applying vermicompost at a rate of 5 t/ha and 0.2% humic acid resulted in 30.11 fruits per plant, as well as fruit lengths of 14.30 cm and girths of 13.75 cm. In their 2013 study, Bahrampour and Ziveh examined the vermicompost effects on tomato (*Lycopersicum esculentum* var. Super Beta) growth, yield, and fruit quality under field conditions. They added varying amounts of vermicompost @ 0 t/ha, 5 t/ha, 10 t/ha, and 15 t/ha to the top 15 cm of surface soil. The results showed that adding 15 t/ha considerably maximize tomato growth and yield when compared to the control. In addition, it was discovered that the percentage of fruit dry matter raised to 24% and the EC of fruit juice to 30%, respectively. According to Laxmi *et al.*, (2015) [51], various combinations of inorganic fertilizers, such as 50% RDF + 50% FYM, and OM (FYM, poultry manure, and vermicompost) recorded the highest in fruit number per plant, weight of the fruit, and fruit yield per plant, fruit yield per plot, and the highest fruit yield followed by 50% RDF + 50% poultry manure.

C. Fruit chemicals characters

In their 1997 study, Valenzuela and Gallardo examined the effects of various vermicompost and soil characteristics on tomato cv. Platense and discovered that adding more than 20% vermicompost was appropriate for raising the substrates' available levels of salts, phosphorus, potassium, and nitrogen. According to Mohd *et al.*, (2002) [56], the best quality was obtained by applying 50% of the selected dose of farm-yard manure (FYM) at 12.5 t/ha and lowering the levels of recommended fertilizer doses @ 50% of the selected dose of fertilizers of N-100: P-50: K-50 NPK kg/ha. The study further showed that the commercial companies' off-the-rack organic manures, which were used in this survey, were more popular than universal biological dung, such as vermicompost & FYM. In an experiment to examine the effects of INM on brinjal quality parameters, Anburani *et al.*, (2003) [8] found that the best way to improve fruit quality was to apply FYM + NPK @ 100: 50: 50 kg/ha, biofertilizers @ Azospirillum and PSB @ 2 kg/ha. According to Rajkhowa *et al.*, (2003) [74], vermicompost application @2.5 t/ha in conjunction with 100-75% fertilizer added on the uptake of N_2 and P_2O_5 in green grams significantly. Black gram treated with earthworms digesting organic waste @ 2 t/ha and 100% of the approved dose of P, K and N had the highest P, K and N accumulation and uptake, according to Vasanthi and Subramanian (2004) [103]. In survey, to evaluate the impact of vermicompost herb waste on the quality characteristics of chillies, Yadav and Vijyakumari (2004) [107] discovered that the protein content increased on 60 and 90 DAS. On 60 DAS, the vermicompost treatment had a higher carbohydrate content. Higher levels of chlorophyll b @ 2.61 mg/g along with total chlorophyll @ 3.62 mg/g were seen on 60 DAS, whereas vermicompost alone produced higher levels of chlorophyll a (1.01 mg/g) and total chlorophyll (1.92 mg/g) 90 days after sowing. Applying organic fertilizers, such as farm yard manur, chilli stalks, and Farm Yard Manur chilli stalks with inorganic fertilizers (RDF), greatly improved the quality and nutrient uptake of chillies, and the combined effect of ionic and non-ionic fertilizers was greater. In soybean crops, Chaturvedi and Chandel (2005) [22] discovered that the treatments that received the recommended NPK + FYM quantity 10 t per ha had the highest overall uptake of P, K, and N. Rajshree *et al.*, (2005) [75] found that, in soybeans grown in a soy-based cropping system, the use of farm-yard manure @7.50 t per ha, combined with 50 kg/ha N and 30 kg/ha P, produced the highest protein and oil content corelated to the control and approved fertilizer dose. According to Varalakshmi *et al.*, (2005) [101], applying the full recommended amount of fertilizer plus 7.5 t FYM/ha greatly increased the organic soil carbon, available NPK content. In the survey, Kalalbandi *et al.*, (2007) [18] found that the cabbage cv. had a greater head yield/plot, a head yield/hectare, a mean head TSS, a mean Vitamin C, a

staying head capacity and a head keeping quality. Pride of India with approved NPK concentration (RDF) of 25% and an FYM of 75%. In a field survey on wheat, Gowda *et al.*, (2008) [27] found that applying earthworms digesting organic waste t at 3.8 t ha-1 and the waste produced by poultry @ 2.45 t/ha resulted in a noticeably higher protein content in the seed compared to the control. Dharade *et al.*, (2009) [25] evaluated the fertilizers effect and organic manure on ginger yield and nutrient uptake and found that applying 50% N through RDF, 25 t FYM /ha, fertilization to The crop provided good net returns. The treatment with RDF + 25 t/ha FYM had the highest uptake of P and K, while the treatment with RDF + 50% Nitrogen through RDF + 50% N through either vermicompost or the waste produced by poultry had the highest uptake of N. When compared to the control, In 2009, Premsekher and Rajashree [71] found that the okra fruit had course fiber content under this treatment (FYM 20 t/ha) was lower. Applying 5 tonnes vermicompost/ha resulted in significantly higher yield of the fruit and protein content @18.0% and Benefit Cost ratio (2.11) with net returns of ₹ 35614/ha in the okra crop, according to Sharma *et al.*, (2010). According to Bahrampour and Ziveh (2013), adding 15 t/ha of vermicompost considerably enhanced tomato growth and yield in respect to control. Additionally, it was drawn that the percentage of fruit dry matter maximized to 24% and the EC of fruit juice to 30%, respectively. In order to ascertain how various fertilizers with equal nutrient concentrations affected various growth parameters, Chanda *et al.*, (2011) investigated the effects of earthworms digesting organic waste and other fertilizers on tomato plant cultivation. When earthworms digesting organic waste and chemical ionic fertilizers were applied, they discovered that the fruit yield was 73% higher than the control. According to Sharma and Choudhary (2011), okra's plant height at harvest, number of branches per plant, and leaf area all increased significantly when 100% of the recommended fertilizer and farm yard manure were applied at a rate of 20 t/ ha. In 2011, Kumar *et al.*, studded that T12, where phosphorus and nitrogen were applied at 60 kg and 120 kg/ha, respectively, had the highest height of the plant, the most branches/ plant, the diameter of the fruits, the average weight of the fruits, and the earliest flowering. The main stem's diameter did not significantly change. However, when correlated to other prescription and the control, the prescription combination I2B2 performed better height of the plant, branches number/plant, diameter of main stem, days until first flowering, diameter of the fruit, fruit weight in average and yield due to the interaction effect. The purpose of the study by Mamta *et al.*, (2012) was to determine how vermicompost affected the brinjal plant's growth and yield. Under field conditions, brinjal plants were combined with vermicompost made from cow trash, waste of the garden and kitchen waste. The test crop's seed germination was considerably impacted by the various treatments. Plant height, leaf count and weight of the fruit were all higher in the earthworms digesting organic waste - treated field than in the control and there was no evidence of disease in the fruits of the vermicompost-treated plot. According to Bajshya *et al.*, (2013), in the north-eastern hill region of India, growing the potato cultivar Kufri Mega @75% RD from chemical fertilizers plus @25% RD from FYM and @100% RD from chemical fertilizers demonstrated improved production, increased yield of tuber and higher potato profit. According to Bahrampour and Ziveh (2013) [13], adding 15 t/ha of vermicompost considerably boosted tomato growth and yield when correlated with control. Additionally, it was observed that the EC of the fruit juice increased to 30%, while the fruit dry matter content rose to 24%. The maximum height of the plant (133.53 cm), the less number of days until first flowering (29.47), the maximum flower clusters in number/plant, flowers number/cluster, fruits number /cluster, and fruits number /plant were all recorded by Laxmi *et al.*, (2015) [15] after varying combinations of o.m., such as FYM, poultry manure and vermicompost, and ionic fertilizers, (50% RDF + 50% FYM). The highest TSS content in fruits was found in 50% RDF + 50% FYM, followed by 50% RDF + 50% vermicompost. In contrast, the highest titratable acidity @ 1.06%, vitamin C content @26.54 mg/100 g fruit juice, and shelf life @ 11.67 days at room temperature were found in 50% RDF + 50% vermin-compost, followed by 50% RDF + 50% FYM.

D. Fruiting and yield

According to research by Jablonska (1976) [31], the maximun total yield and commercial yield were surveyed with use of FYM of 30 tonnes/ha combined with 800 kg per ha of N, P2O5, and K2O. When FYM @ 12 t + 50% RDF was applied to the plot, Subbiah *et al.*, (1982) [92] observed that the fruit yield of chilli was the highest (60 t/ha), while the yield in the control plot was relatively low (29.7 t/ha). The treatment of Azospirillum inoculation to seeds, soil, and seedlings + 70 kg N ha-1 with NAA spray at 5 ppm produced the highest yield in the chili crop, according to Amrithalingam and Balakrishnan (1988) [5]. According to Subbiah (1990), tomato seeds treated with Azospitillum and 100% R.D. of N @120 kg/ha produced the highest yield of fruit @ 66.33 t/ha. In 3year field trials with cabbage, onion and carrot, Kropisz (1992) [41] found that applying various compost sources and FYM (@ 25 t ha-1) increased yields for all three crops when FYM + NPK was applied as opposed to FYM or inorganic fertilizers applied separately. According to Paramaguru and Natarajan (1993) [67], the combination of Azospirillum with 75% nitrogen applied at 56 kg/ha resulted in the highest average chilli yield of 24.5 t/ha. According to Ahmed (1993) [3], the tomato cultivar Pusa Ruby produced the most fruit when FYM and coir pith were added @19 and 17 t/ha, respectively. This combination also upgraded the strength of soil, bulk density, and moisture-retention capacity compared to crops investegated with neither. In 1996, Nanthakumar and Veeraraghathatam [60] found that the develipment, yield @36.48 t/ha and character of brinjal were positively impacted by the combined application of nutrients using 12.5 t ha-1 of FYM + 2 kg of Azospirillum and PSB + inorganic fertilizers at 75% of the recommended dose of N, P, and 100% of K. According to Lopes *et al.*, (1996) [52], cowpea dry matter yield was considerably increased over the control treatments when vermicompost levels were raised by up to 10 t per hectare. While Patil (1995) [66] found that adding vermicompost in addition to 100% RDF + FYM increased the yield of dry chilli by 1.68q/h. Jasvir Singh *et al.*, (1997) [32] found that vermicompost application at 10 t/ha increased the fruit yield per plant in chilli. According to Kurup *et al.*,

(1997) [50], the maximum yield of okra cv was obtained by applying 100 kg N per ha as urea-blended neemcake. Kiran Thanunathan *et al.,* (1997) [96] found that applying soil, mine spoil and vermicompost (1: 1: 1) increased onion output. According to Kalembasa and Deska (1998) [35], the use of vermicompost greatly enhanced the yield of radish and sweet pepper. According to Kalembasa and Deska (1998) [35], applying vermicompost greatly maximise the yield of radish and sweet pepper. Vermicompost produced the highest yield in brinjal, according to Tomar *et al.,* (1998). Tomar *et al.,* (1998) [35] discovered that applying vermicompost produced the highest yields in carrot and brinjal, respectively @ 97 g and 94.9 g/fruit. In a similar vein, the yield of radish rose proportionately as vermicompost dosage increased (Buckfield *et al.,* 1999) [19]. According to Vadiraj *et al.,* (1998), applying vermicompost @ 5 t/ha considerably enhanced coriander herb yield, which was equivalent to applying ionic fertilizers at a rate of 20:20:40, NPK kg/ha. They found that plots treated with 15 t/ha vermicompost had the highest herbage yield (6075.5 kg ha-1) 60 days after sowing. Additionally, the study showed that applying vermicompost at a rate of 15-20 t ha-1 increased seed weight in addition to herbage and seed yield. Applying organic manures (FYM, vermicompost, and neem cake) in conjunction with the recommended dosage of inorganic fertilizers demonstrated superior performance in terms of tomato growth and tomato fruit yield, according to Sendur *et al.,* (1998) [82]. According to Nanthakumar and Veeragavathatham (1996) [60], the use of FYM considerably increased brinjal yield correlated to the use of ionic fertilizers alone. According to Kumari *et al.,* (1999) [98], the yield was achieved highest with 12 t/ha vermicompost plus the full dosage of the recommended fertilizer (50:80:25 kg NPK/ha) and the cost of producing okra was considerably decreased using vermicompost as an organic source. According to Usha Kumari *et al.,* (1999) [98], the yield was obtained highest with 12 t/ha vermicompost plus the full dosage of the recommended fertilizer (50:8:25 kg NPK/ha) and the cost of producing okra was considerably decreased by using vermicompost as an organic source. Ridge gourd cv. was used by Shreeniwas *et al.,* (2000) [88]. Pusa Nasdar discovered that fruit yield rose with higher vermicompost rates. In ridge gourds, the vermicompost at 10 t/ha plus 50:25:50 kg NPK/ha enhanced weight of the fruit and yield per vine. According to Terry *et al.,* (2000) [95], the best treatment that improved growth parameters and yield was an Azospirillum inoculation at the time of sowing, which also increased plant height in tomatoes. In comparison to other pepper treatments, Aliyo (2000) [4] found that applying FYM + poultry manure at a rate of 5 t/ha each, along with 50 kg N/ha, produced noticeably more fruit. In Assam, Sannigrahi and Barah (2000) [81] carried out field tests on the yield response of tomatoes, kidney beans and cabbages to the utilization of compost with or without NPK fertilizers and mycorrhizal root inoculation. In brinjal, Rao and Sankar (2001) [76] discovered that organic fertilizer had a noticeably better impact on yield parameters than inorganic fertilizer. The FYM + Vermicompost treatment produced the highest fruit yield (12.31 t per ha). By applying 200% of the recommended fertilizer dose along with farm yand manure and vermicompost, Patil and Biradar (2001) [65] were able to maximize the fruit yield of the chilli cultivar Byadgikaddi. As nutrient levels rose, so did the uptake of N, P and K. RDF @ 100% (150:75:75) kg per ha + farm yard manure 10 t/ha, 100% recommended fertilizer + farm yard manure + vermicompost @ 2.5 t/ha, 150% recommended fertilizer + farm yard manure + vermicompost, and 200% recommended fertilizer + farm yard manure + vermicompost were the various levels that were examined. However, Sharu and Meerabai (2001) [87] found that 50% poultry manure and 50% inorganic fertilizer produced the highest yield of fruit (09.66 t/ha). N. Subbarao and Ravisankar (2001) [90] found that applying FYM + Vermicompost and then FYM + Neem cake produced the highest yield of brinjal fruit (12.31 t/ha). According to Asha and Geethakumari (2001) [108], the highest fruit yield of okra cv was obtained by applying FYM and Neem cake in a 1:1 ratio in conjunction with Azospirillum inoculation. According to Samawat *et al.,* (2001) [79], vermicompost significantly impacted the quantity of tomatoes that produced fruit. Fruit production in the 100% vermicompost method was used for four times higher than in the control. In knol-khol, Shalini *et al.,* (2002) [84] found that a maximum yield of 37.00 tonnes/ha was achieved by applying 50% (N) vermicompost + 50% (N) urea + azospirillum. According to Mohd *et al.,* (2002) [56], the highest yield with the best quality was obtained by applying 50% of the approved dose of farmyard manure (FYM) at 12.5 t/ha along with lower levels of the approved fertilizer doses (50% of the recommended dose of fertilizers of 100:50:50 NPK kg/ha). Additionally, the study found that the commercial companies' ready-made organic manures utilized in this study were in fervor for traditional organic manures close to FYM and vermicompost. Naidu *et al.,* (2002) [58] used 75:35:0 kg /ha N P K in conjunction with organic fertilizer to achieve the highest fruit girth, flowering 50%, and yield of brinjal cv. JB-64. Either by intensifying the respiratory process through permeability of cell or by stimulating growth hormone, the FYM appears to directly increase crop yield. Through biological decomposition, it provides the plants with available forms of phosphorus, sulfur, and nitrogen. Indirectly, it enhances the soil's permeability, aeration, and water-holding capacity (Chandramohan, 2002) [21]. Sengupta *et al.,* (2002) [83] discovered that when tomato plants were treated with 100% nitrogen (120 kg ha-1) and Azospirillum seedlings, the highest diameters of the fruit (6.75cm and 6.45cm) and marketable yield of the fruit (284.38 q ha^{-1} and 268.81 q ha^{-1}) both the respective years were produced. Bhagavantagoudra and Rokhade (2002) [17] discovered that the highest head diameter values for cabbage's (13.33 cm), surface area for head (577.31 cm^2), inner leaves number per head (41.92), and weight of the head (687.98 g) were obtained when Azospirillum was treated through soil + seedling dipping. According to Harikrishna *et al.,* (2002) [29], the dose of FYM 75% of NPK plus Azospirillum produced the highest fruit yield (54.32 t/ha), while the treatment of FYM alone produced the lowest yield (30.31 t/ha). According to research by Rafi *et al.,* (2002) [72], applying 50% of the recommended FYM dose at 12.5 t per ha and using 50% of the approved fertilizer dosages (100 kg/ha: 50 kg/ha: 50 kg/ha NPK) produced the enhanced yield with the best characters in tomato. The impact of applying NPK ionic fertilizer with or without non - ionic fertilizers (FYM and Agrimagic) on tomato cultivar

yield and tomato cultivar quality was investigated by Krishna and Krishnappa (2002) [40]. During Rabi 2000-01, Avinash-2 was studied in Bangalore, Karnataka, India. The highest yield values were generally obtained with NPK at 250 kg/ha: 250 kg/ha: 250 kg/ha with either FYM at 38 t/ha or Agrimagic at 16.87 t/ha. The application of 25 t ha FYM + 100 kg/ha: 50 kg/ha: 50 kg/ha of NPK + biofertilizer produced the highest fruit weight and yield of brinjal cv, according to Anburani *et al.,* (2003) [8]. According to Annamalai Arancon *et al.,* (2003) [10], all vermicompost-treated plots had marketable tomato yields that were significantly higher than those of the inorganically fertilized plots when vermicompost was applied at a rate of 5 t/ha. According to Datt *et al.,* (2003) [23], applying FYM @ 10 t/ha enhanced vegetable pea mature pod yield by 16% compared to control. When FYM @ 10 t/ha and N:P2O5: K2O @20:26.2:25 kg/ha were applied together, the soil's available N (398.00 kg/ha), P (38.30 kg/ha), K (328.00 kg/ha) and organic carbon (7.70 g per kg) content was higher than when inorganic materials were applied alone (362 kg/ha, 30.5 kg/ha, 296 kg/ha N, P and K respectively, and 7.3 g/kg organic carbon). Similarly, when FYM @10 t/ha and N, P2O5, and K2O were applied together, there was a greater uptake of NPK than when they were applied separately. According to Netwal (2003) [61], compared to control 5 tonnes/ha FYM and 2.5 tonnes/ha earthwarm organic waste, the application of vermicompost 5 t/ha significantly hike the pods number per plant, seed per pod, harvest index, and seed yield and straw yield of cowpea. Rajkhowa *et al.,* (2003) [74] found that the pods number per plant, seed number per pod, and 1000 grain of weight of green gram increased significantly when vermicompost was used @ 2.5 t/ha, which was comparable to 2.5 FYM t per ha. The production of chillies was greatly impacted by the use of organic fertilizers such as FYM, chilli stalks, and FYM chilli stalks, in conjunction with ionic fertilizers. The combined effect of the ionic and non-ionic fertilizers was greater than that of the inorganic fertilizer alone (Kattimani, 2004) [37]. According to Jat and Ahlawat (2004), applying 3 tonnes of vermicompost per hectare greatly enhanced the chick pea's growth and yield attribute (pods/plant) as well as its seed straw yield when compared to the control. In an experiment on cauliflower, Kumhar (2004) [49] found that applying vermicompost at a rate of 7.5 tonnes per hectare greatly enhanced the volume of curd. Similarly, Hashemimajd *et al.,* (2004) [30] found that tomatoes' shoot and root dairy matters (DM) are higher when treated with vermicompost made from Raw Dairy Manure (RDM) and a few other composts (sewage sludge with rice hull) than when treated with a control.

The growth of tomato and yield of tomatoes were greatly impacted by the application of various organic nitrogen sources. Plant height, the number of branches per plant, and yield were comparable to those of 100% nitrogen as urea when compared to other organic sources (Kannan *et al.,* 2006) [36]. In comparison to RDF, Vitakar *et al.,* (2007) [104] found that a treatment of 50% N through vermicompost and 50% N through neem cake resulted in the highest height of the plant, primary branches, and total yield/hectare in the chilli crop. When 50% RDF + 50% nitrogen was applied to okra using neem cake, Bharadiya *et al.,* (2007) [18] evaluated that the highest height of the plant, fruits number per plant, fruits green yield, total tomato yield, weight of individual fruit and length of the fruit over control. According to Anchal *et al.,* (2008) [9], 50% RDF + Biofertilizer + Vermicompost produced better vegetative parameters in tomato crops than either treatment alone or another combination treatment including height of the plant, primary branches number, accumulation of dry matter and yield. Abdullah (2008) [2] found that plots amended with vermicompost and vermiwash had significantly higher average weights of potato tubers and onion bulbs.

Conclusion

It was certified from the study that growth and development, tomato yield attributes and total yield was significantly enhanced by organic sources. Among inorganic fertilizers, organic fertilisers showed the greatest potential for improving tomato production. These findings suggest that a balanced and optimal use of fertilizers can improve tomato production while ensuring economic sustainability.

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