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Effect of Bio-fertilizers and Farm Yard Manure in Production of Tomato: A Review

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ABSTRACT: Bio-fertilizers are organic fertilizers that contain live microbial inoculants and may provide plants with otherwise inaccessible vitamins. Bio-fertilization is crucial in the development and application of sustainable agriculture practices in order to prevent the degradation of the environment and natural resources. The traditional methods of managing nutrients are becoming more and more necessary in order to increase soil nutrient content and decrease environmental contamination. In order to raise crop output, improve and restore soil fertility, promote plant development, lower production costs, and lessen the environmental effect associated with chemical fertilization; biofertilizers are seen as a viable and attractive biotechnology option. Numerous microorganisms, such as nitrogen-fixing soil bacteria (such as Azotobacter and Rhizobium), nitrogen-fixing cyanobacteria (such as Anabaena), solubilizing phosphate bacteria (such as Pseudomonas), and arbuscular mycorrhizal fungi, are frequently utilized as biofertilizers. The findings demonstrated that the bio-fertilizers alone helped to keep the pH of the soil neutral and greatly increased its C, N, P, and K content.

Keywords: Tomato, INM, Organic manures, Bio fertilizers, growth, yield and quality.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is an annual vegetable crop grown everywhere in the world that ranks 2nd in significance simplest to potatoes. The beginning location of tomatoes was in Central Africa and South America (Vavilov, 1951). In India, it's far brought in the sixteenth century via way of means of the Portuguese and it's grown on a area of 1.504 million hectares with an annual production of 22.962 million tonnes. In Uttar Pradesh, the common place beneath neath tomato for the final five years is 10.6 thousand hectares with mean annual production of sixty-seven thousand metric tonnes (Anonymous, 2017). It is an herbaceous annual that's sexually propagated via way of means of seed. It is used as a fresh, processed shape and the production of margarine. Tomatoes are universally handled as a "Protective food" and also are a superb supply of profits for poor and minimal farmers. Tomato is a wealthy supply of nutrients, acids and minerals (Parmar *et al*., 2019). Tomatoes are cultivated in tropical in open fields and temperate climates in greenhouses. Hot weather required mild depth for boom, around 45 days are important from germination to anthesis and 90-100 days to attain the start of fruit ripeness (Nuez, 2001).

The boom dependency of the plant varies from indeterminate to determinate and might attain up to three meters in height. Organic manures are now no longer have the simplest stability the nutrient delivers however additionally enhanced the bodily and chemical homes of the soil. Vermicompost is understood to boom protein synthesis in vegetation, which has a particular impact on plant boom and yield. N_2 is an important nutrient, a part of the protein, and it improves the photosynthetic performance of the plant and, ultimately, the yield. Phosphorus is the crucial detail as it's far a constituent of nucleic acid, phospholipids, and co-enzymes and is the maximum essential in strength transfer. Bio-fertilizers that are green and greater economical, can play an essential function in decreasing the dependence on chemical fertilizers. Application of Azospirillum inoculants in vegetable vegetation has been of plenty of importance due to the fact they now no longer simplest restoration of atmospheric nitrogen however additionally produces boom-selling and antifungal materials. The incorporated use of natural and inorganic fertilizers is the want of the hour and is being endorsed for sustainable agriculture. Natural manures can complement the vitamins when inorganic fertilizers aren't to be had on time because of better expenses and insufficient delivery. An incorporated technique to nutrient control regarding an appropriate aggregate of inorganic fertilizers, incorporated nutrient control is useful in growing the yields of vegetation in addition to retaining soil fertility. The particular facts on incorporated nutrient control for max manufacturing and higher pleasant can be of sizeable cost to tomato growers (Parmar *et al*., 2019).

Azotobacter and Azospirillum are the 2 maximum essential non-symbiotic N-fixation micro-organisms in non-leguminous crop. Under suitable situations, Azotobacter and Azospirillum can decorate plant improvement and sell the yield of numerous essential agricultural vegetation in special soils and climatic regions. These useful results of Azotobactor and Azospirillum on vegetation are attributed especially to development in root improvement, a boom with inside the price of water and mineral uptake via way of means of roots, displacement of fungi and plant pathogenic micro-organisms, and to a lesser extent, organic nitrogen fixation (Okon and Itzigshohn 1995).

Besides N_2 fixation, Azotobacter synthesizes and secretes large quantities of biologically lively materials like nutrients B, nicotinic acid, pantothenic acid, biotin, heterodoxies, gibberellins, etc., which decorate the foundation boom of vegetation (Rao, 1986). Another essential function of Azotobacter affiliation with crop development is the secretion of ammonia into the rhizosphere with inside the presence of root exudates, which facilitates with inside the change of nutrient uptake via way of means of the vegetation. The cap potential of Azospirillum to supply plant boom regulatory materials together with N2 fixation stimulates plant boom and thereby productivity (Meena *et al*., 2011).

Bio-fertilizers are merchandise containing one or greater species of microorganisms that have the cap potential to mobilize nutritionally essential factors from non-usable to usable shape thru organic methods which include nitrogen fixation, phosphate solubilization, excretion of plant boom selling materials or cellulose, and biodegradation in soil, compost, and different environments. In different words, bio-fertilizers are herbal fertilizers that are dwelling microbial inoculants of micro-organisms, algae, or fungi on my own or in aggregate, and they increase the provision of vitamins to the vegetation (Rakesh Kumar *et al*., 2017).

***Rhizobium*:** *Rhizobium* is a soil habitat bacterium, which colonizes legume roots and fixes atmospheric nitrogen symbiotically. Rhizobium's morphology and body structure range from free-dwelling situations to the bacteroid of nodules. They are the maximum green biofertilizers as in step with the amount of nitrogen fixed. They have seven genera and are fairly particular for forming nodules in legumes, known as the cross-inoculation group.

***Azotobacter*:** Among the diverse *Azotobacter species*, *A. chroococcum* is the dominant inhabitant in arable soils able to solve N_2 (2-15 mg N_2/g carbon supply) in lifestyle media. The bacterium produces considerable slime, which facilitates soil aggregation. The numbers of *A. chroococcum* in Indian soils do not often exceed 105/g soil because of a loss of natural count and the presence of hostile microorganisms in the soil.

***Azospirillum*:** *Azospirillum lipoferum* and *A. Brasiliense* (*Spirillum lipoferum* in advanced literature) are the number one population of soil, the rhizosphere, and intercellular areas of the root cortex of gramine coups vegetation. They increase associative symbiotic dating with gramineous vegetation. Apart from nitrogen fixation, boom selling substance manufacturing (IAA), disorder resistance, and drought tolerance are a number of the extra blessings of inoculation with Azospirillum (Yogesh Kumar *et al*., 2017).

Effect of organic manure and bio fertilizers on Morphological characters of tomato in different treatments: Parmar *et al.* (2019). The statistics that the maximum plant height become recorded in treatment T_7 control (RDF 180:100:60 kg of NPK), observed with the resource of the usage of T_5 (75% of RDF + 25% of RDF) + T_4 (Neem cake-6.25% + Vermicompost-6.25% + FARM YARD MANURE-6.25% + Poultry manure-6.25% + PSB + *Azospirillum*). While the minimum plant height recorded in treatment T8 control (No application of inorganic and herbal fertilizers). This might to be use of major and minor nutrients through fantastic herbal manures and bio fertilizers, which prolonged the photosynthetic interest, chlorophyll formation, nitrogen metabolism, and auxin contents with inside the vegetation, which ultimately improved the plant height. The studies are in agreement with the findings of Kumaran *et al*. (1998).

The advised leaf duration prolonged considerably with the increase in days to transplanting. Maximum leaf duration changed into considerably higher in treatment T_6 (50% of RDF) T_4 (Neem cake-12.5% + Vermicompost-12.5% + FARM YARD MANURE-12.5% + Poultry manure-12.5% + PSB + Azospirillum) than in T_5 (75% RDF% + 25% of RDF T4] [Neem cake-6.25% + While the minimum duration changed into positioned in treatment T_8 control (No application of inorganic or herbal fertilizers). This might be due to the application of most important and minor nutrients thru first-rate herbal manures and bio fertilizers, which delayed the photosynthetic leisure activity, chlorophyll formation, nitrogen metabolism, and auxin contents with inside the vegetation, which in the end stepped forward the leaf duration. The findings are also in agreement with the findings of Amer *et al*. (2003); Raut *et al*. (2006). T_6 [50% of RDF] T4 [Neem cake-12.5% + Vermicompost-12.5% + FARM YARD MANURE-12.5% + Poultry manure-12.5% + PSB + Azospirillum] had the very nice leaf location in line with plant and changed into superior to extraordinary herbal manure and biofertilizer treatments, observed with the resource of the use of T_5 [75% of RDF% + 25% of RDF] Leaf location changed into considerably prolonged with the resource of the use of nitrogen, in all likelihood because of the reality nitrogen permits in extra assimilation of food material with the resource of the use of the plant, which ended within side the extra meristematic hobby of cells and, consequently, the huge sort of leaves, duration and width of leaves of the plant. These findings are in agreement with the results cited with the resource of the use by Meena *et al*. (2011).

Significant versions have been positioned with inside the huge type of flowers consistent with plants under Neath's various treatments. T_5 [75% of RDF + 25% of RDF] T_4 [Neem cake-6.25% + Vermicompost-6.25% + Farm Yard Manure -6.25% + Poultry manure-6.25% + PSB + Azospirillum] changed into decided to be

substantially advanced, observed with the useful resource of the use of T7 [100% of RDF 180:100:60), which recorded 53.77 and 52.13 flowers consistent with plant, respectively. The minimum huge type of flowers consistent with the plant changed into recorded in treatment T8 control (No software of inorganic and herbal fertilizers), really well worth 29.33. This might be due to the prolonged shipping of major plant vitamins, which may be required in huge quantities for the growth and development of vegetation. Nitrogen speeds up the development of growth and reproductive ranges and protein synthesis, because of this promoting yield-attributing characteristic. Similar results have been stated with the useful resource of the use of Biswas *et al*. (2015). The treatment T_7 (100% RDF 180: 100: 60) is really well worth 39.70 days, followed by the resource of the use of T_5 [75% of RDF + 25% of RDF + Farm Yard Manure -6.25% + Poultry manure-6.25% + PSB + Azospirillum] really well worth 41.67 days, which changed into at par. Most days of flowering in line with plant changed into recorded in treatment T8 (No application of inorganic and herbal fertilizers), really well worth 53.69. This trait is useful for obtaining a higher return. This trait could be implemented with inside the breeding programme. Similar results were cited with the resource of the use by Kumar *et al*. (2011); Laxmi *et al*. (2015).

The information indicated that the treatments' results were appreciably stimulated with the resource of the use of days to 50% of flowering. The treatment T_7 [100% of RDF + 180:100:60 of NPK] had the shortest time to 50% of flowering at 43.53 days, followed with the resource of the use of T_5 [75% of RDF + 25% of RDF + Farm Yard Manure -6.25% + Poultry manure-6.25% + PSB + Azospirillum] at 44.75 days. The maximum days to flowering consistent with plant changed into recorded in treatment T_8 (No application of inorganic and herbal fertilizers), really well worth 56.90. This might be due to the reality that nitrogen in flora will boom molecular department and molecular differentiation. Thus, the plant remained with inside the vegetative section and resulted in an imbalance in many of the C: N ration, for this reason delaying flowering at a higher nitrogen level Kumar *et al*. (2011).

Effect of N, P, & K, on growth, yield and quality of Tomato:

Kumari *et al.* (2018) Influence the uptake of various macronutrients due to ion antagonism (Marschner 1995). Because of this background; many investigations have these days involved approximately the response of tomatoes to the N form provided to the flora via fertilization. According to earlier research on the effects of nitrogen reasserts on tomatoes and their interactions with certain dietary and environmental conditions, tomatoes are susceptible to the transport of ammonium as the only or dominant nitrogen form. Tan *et al*., (2000), used fifteen N-labeled compounds in a hydroponic subculture of tomato and decided that the absorption, translocation, and assimilation of urea are bad at the seedling diploma but will grow to almost similar stages to that of NO_3-N at the reproductive growth diploma. Based mostly on nutrition, breeding, and post-harvest technology for tomatoes, from the above results, Tan *et al*. (2000) advocate that urea may be used as an N-deliver in soilless tomato plant life at the same time as the flowers are at the reproductive growth diploma. Contemporary studies have proven this consideration. Thus, in keeping with Claussen (2002), using ammonium because the simplest or dominating N deliver in a solution subculture of tomato brought about impaired growth and yield restrictions. Siddiqi *et al*. (2002); Akl *et al*. (2003) observed a restriction of the vegetative growth and the fruit yield of tomatoes at the same time as NH4-N/widespread-N with inside the nutrient solution has become higher than 0.1. However, Claussen (2002); Dong *et al*. (2004) observed a boom in every widespread and fruit dry weight at the same time as the ammonium fraction has become 0.25. According to Akl *et al*. (2003), the impaired growth of tomatoes at the same time as the ammonium fraction has become with inside the kind of 0.15–0.25 of the general N supply has become associated with low pH levels (5) in the root zone. In contrast to Siddiqi *et al*. (2002); Akl *et al*. (2003); Claussen (2002) maintained the rhizosphere pH above 6 by adding $CaCO_3$ to the growth medium.

Effect of bio-fertilizers on growth, yield, and quality of tomato: Jat *et al.*, (2018). The treatment comprising of one hundred in steps with cent endorsed RDF along Vermicompost (2 t per ha) and bio-fertilizers (each 2 kg per ha of Azotobactor and PSB) inorganic manures) on the storage life of tomatoes grow to be said that an aggregate of Farm Yard Manure and inorganic aggregate (120:106:84 of NPK kg per ha) drastically advanced the keeping awesome over control remedies. However, no good-sized difference will become located with spotting to awesome attributes in every herbal and inorganic treated result. Sharma (1995) studied the consequences of numerous biofertilizers on tomato seed production, especially *Azotobacter*, *Azospirillum*, *Pseudomonas*, and Vesicular *Arbuscular mycorrhiza* (Vesicular *Arbuscular mycorrhiza*). The commentary observed out that Azotobacter at the same time as done to nursery, seedling and location soil resulted with inside the widest type of bringing about line with the plant (19.23), fruit yield in step with a plant (1109 g), a thousand seed weight (3.63 g), seed yield in step with a plant (4.58 g) and line with hectare (152.70 kg consistent with ha) and the very quality cost-benefit ratio (2.31). Renuka and Shankar (2001) stated that plant life inoculated with Azospirillum and Phospho micro-organism recorded better plant height (110.41 cm) and a wide variety of branches (3.66 per plant) in comparison to NPK by myself (92.23 cm and 2.33 respectively) in tomato. Sudhakar and Purushotham (2008) stated that application of 75% of RDF (150:60:80 of NPK kg per ha) and biofertilizer PSB (15 kg per ha) ended in better yield parameters like a wide variety of results in line with a plant (25.75g), yield in line with a plant (751.8 kg), and yield (75.10 t per ha) of tomato. Anchal *et al*. (2008) stated that vegetative parameters consisting of plant height (61cm), a wide variety of number one branches (14.7), dry be counted accumulation (243.9 g per plant), yield (20.75 t per ha),

and B:C ratio (3.0) had been determined to be advanced with 50 % of RDF + Biofertilizer + Vermicompost compared to both by myself or some other mixture remedy in tomato crops. Sudhakar and Purushotham (2008) stated that application of 75% of RDF (150:60:80 of NPK kg per ha) and bio-fertilizer 15 kg per haof PSB ended in better yield parameters like a wide variety of results in line with a plant (25.75 g), yield in line with the plant (751.8 kg), and yield (75.10 t per ha) of tomato. When in comparison to different remedies, Mahato *et al*. (2009) determined that *Azotobactor* (2 kg per ha) with 50 % of RDF (150:50:50 of NPK kg per ha) ended in better boom parameters consisting of shoot length (35.5 cm), a wide variety of leaves in line with a plant (5.6), and root length (7.8 cm). Premshekhar and Rajashree (2009) determined that Azospirillum (2 kg per ha) + 75% of nitrogen + 100% P and K application resulted within side the maximum plant height (72.60 cm), a wide variety of results in line with the plant (33.70), and fruit yield (43.85 t per ha) in tomato while as in comparison to different remedies. Chumyani *et al*. (2010) determined that the application of 50% of NPK + 50% of Farm Yard Manure + biofertilizers resulted within side the best boom in tomato plant height (69.37 cm), a wide variety of leaves in line with the plant (50.87), fruit yield (48.68 t per ha) and TSS (5.07 Brix) while as in comparison to different remedies. Neerja *et al*. (2010) studied the mixed application of seedling dip with 2 kg per ha of *Azotobactor* + 75 % of N + a complete dose of P & K + complete dose of Farm Yard Manure (25 t per ha) remedy mixture) appreciably expanded boom, yield, and great traits over RDF or natural manures by myself. There with the aid of using a saving of 25 in line with cent chemical nitrogen application in the course of the year of observation, the most internet returns to the music of Rs. 1, 48, 089/-and the very best value-gain ratio of 1:2.51 become recorded in tomato. Yeptho *et al.* (2012) found that included application of 50 % of NPK + 50 % of manure + bio-fertilizer recorded appreciably better plant height (164.33 cm), a wide variety of branches in line with a plant (12.26), a wide variety of leaves in line with a plant (58.19), a wide variety of result in line with a plant (33.27), fruit yield (77.54 t per ha) and TSS content (6.67 ^{o}Brix) over the opposite remedies in tomato. Neerja *et al.* (2010) studied the mixed application of seedling dip with *Azotobactor* (2 kg per ha) + 75% of N + a complete dose of P & K + complete dose of Farm Yard Manure (25 t per ha) remedy mixture) appreciably expanded boom, yield, and great characters over RDF or natural manures by myself there with the aid of using a saving of 25 % chemical nitrogen application during the year of study, the maximum net returns to the tune of Rs.1,48,089/- and maximum value: gain ratio of 1:2.fifty one become recorded in tomato. Thakur and Thakur (2012) stated that the natural change application of vermicompost (10 t per ha) recorded the very best fruit yield (21.93 kg plot^{-1}, 2.7×2.1 m^2 plot size) accompanied with the aid of using *Azotobactor* (5 kg per ha) application in tomato. Ramakrishnan and Selva Kumar (2012) studied the impact of mixed inoculation of *Azotobactor* (2 kg per ha) and *Azospirillum* (2 kg per ha) which ended in a better fruit yield (518.47 g per plant) accompanied with the aid of using *Azotobactor* (2 kg per ha) by myself dealt with plant life (502.23 g per plant) in tomatoes. The observation concludes that the mixed application of bio-fertilizers complements the boom and yield of the tomato crop.

Kumar *et al*. (2014) stated that application of PSB at 2 kg per ha affects most plant height (39.50 cm), a better wide variety of branches in line with a plant (6.93) and a wide variety of clusters in line with a plant (9.83) compared to *Azospirillum* 2 kg per ha even as all boom parameters had been determined to be minimal beneath Neath manipulate in tomato.

Table1: Effect of organic manure (FARM YARD MANURE) and Biofertilizers on tomato crop.

Sr. No.	Treatment	Yield	References
1.	T5- 75% RDF% + 25% RDF T4 [(i.e., Neemcake (6.25%) + Vermicompost (6.25%) + FARM YARD MANURE (6.25%) + Poultry manure (6.25%) + Poultry manure (6.25%) + Poultry manure (6.25%) + Poultry manure (6.25%) + (6.25% + PSB + *Azospirillum*	359.9 q/ha	Parmar *et al.* (2019)
2.	*Azospirillum* + 75% N + 100% PK	438. q/ha	Premshekhar and Rajashree (2009)
3.	RDF (100:50:50 NPK kg per ha.	586. q/ha	Neerja *et al*. (2004)
4.	PSB (15 kg ha^{1}) +75% RDF	751.8 q/ha	Sudhakar and Purushotham (2008)
5.	*Azospirillum* (2kg ha^{1}) + 75% N + 100% PK	438.5 q/ha	Premshankar and Rajashree (2009)
6.	100 % NPK +FYM + *Azotobacter*	127.0 q/ha	Naval *et al.* (2012)
7.	100% RDF (NPK) + B + Zn	356.68 q/ha	Manohar *et al.* (2013)

CONCLUSION

It can be safely concluded from the research on organic manure and bio-fertilizers on tomatoes that organic manure and bio-fertilizers play an important role in enhancing the maximum plant height, leaves per plant, number of branches per plant, length of internodes, and maximum number of flowers per plant in vegetative characters. Farm Yard Manure and bio-fertilizers were also effective for fruiting characteristics, producing maximum fruit weight, length, the volume of fruit per

plant, and yield quintal/hector. It also works on TSS, acidity, total sugar, and vitamin C levels in tomatoes. After seeing all of this, we can conclude that Farm Yard Manure sand bio-fertilizers are quite beneficial to tomato growers.

Conflicts of Interest. None.

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