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Effect of Age of Seedlings on Growth and Yield of *Rabi* Tomato cv. Arka Rakshak

Kumari Vibha Rani, Sushma Kumari, Umesh Narayan Umesh, Seema Kumari, Jyoti Sinha

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ABSTRACT

The quality of seedlings in tomato cultivation plays an important role in good growth and higher yield. The farmers generally using over aged seedlings without root treatment, which leads to a reduction in yield and productivity. For raising healthy seedlings, the nursery beds should be well prepared along with soil treatment, seed treatment, light irrigation and all intercultural operations will be done in well manner. In this trial we had done transplanting of twenty days old seedlings without root treatment and thirty-day-old seedlings with treatment of 2% rhizobacteria solution. The best result was obtained in the findings of transplanting of 30 days old seedlings with root treatment rhizobacteria. The maximum plant height 62.68 cm, the highest number of primary and secondary branches 7:43 and 9.65 per plant, and the highest yield 309.27 Q/ha were recorded in the transplanting of 30 days old seedlings along with root dip in Rhizobacteria solution as compared to other treatments. The maximum gross return 247426 Rs/ha net return 184742.28 Rs/ha with the highest BC ratio 3.95 was recorded in the case of this treatment in one year and gross return 249879 Rs/ha, net return 186031 Rs/ ha and BC ratio 3.91 during other year of trail as compared to other treatments. The healthy crop of tomato depends on healthy seedlings and soil environment. The seedlings' treatment with rhizobacteria solution improves the microbial communities around the root-zone. In this trial the best suitable age of seedlings was 30 days with root treatment with rhizobacteria solution for getting a healthy crop with good and higher yield in Agro climatic and Soil conditions of Nalanda district in Bihar.

Keywords Tomato, Seedlings, Rhizobacteria solution, Growth, Yield.

INTRODUCTION

The tomato (*Solanum Lycopersicum*) is an edible fruit that belongs to family *Solanaceae*. India is second highest in tomato production followed by Nigeria.

Kumari Vibha Rani[1], Sushma Kumari[2], Umesh Narayan Umesh[3], Seema Kumari[4], Jyoti Sinha[5]

[1]Subject Matter Specialist, Horticulture, Krishi Vigyan Kendra, Harnaut, Nalanda, India

[2]Assistant professor, Department of Physics, Nalanda college of engineering, Chandi, Nalanda, India

[3]Subject Matter Specialist, Soil science, Krishi Vigyan Kendra, Harnaut, Nalanda, India

[4]Senior Scientist and Head, Krishi Vigyan Kendra, Harnaut, Nalanda, India

[5]Subject Matter Specialist, Home science, Krishi Vigyan Kendra, Harnaut, Nalanda, India

Email: kumarivibhaa1@gmail.com
*Corresponding author

It originated in Peru, South America. The first report of tomato was from Italy in 1544. Later the spread of this crop in fast and grown throughout the length and breadth of the World. In India it came by Portuguese explorers during the early 16th century. This crop thrives in warm, sunny conditions with no severe frost and adapts well to Indian soil. It is known to be the second most commercially edible vegetable fruit as per findings of Smolinska B, Majak I (2022). In 2017 the worldwide production of tomatoes was 170.8 million tons. China leads in tomato production with 31% of the total production followed by India and Nigeria with second and third highest in production (Source:FAO, Statistical database 2021). In India total area under tomato cultivation was 844.6 thousand hectare with production of 21180.5 thousand metric ton. Among all the states Madhya Pradesh holds the first position in area 103.77 thousand hectare with production of 3001.21 thousand metric tons and Bihar holds third position with area of 62.70 thousand hectare with production of 1161.79 thousand metric tons with production share of 5.48% during 2020-2021. In Bihar Nalanda contributes 1910 thousand hectare area with production of 44461 thousand metric tons (Source: Horticulture statistics division, Department of agriculture and farmers welfare 2021). Tomato occupies an important position in protective foods due to rich source of minerals like calcium, (48 mg/100 mg), sodium (12.9 mg), trace elements, copper (0.19 mg), vitamins like vitamin A (900IU), vitamin C (27 mg), vitamin B-complex (thiamine), essential amino acids and healthy organic acids like citric, formic and acetic acids. Due to the high acid content of tomato it is used for canning more than any other fruit and vegetable. The attractive red and yellow color of fruit is due to lycopene and carotenes. The flavor of the fruit is due to the presence of volatile flavor components, ethanol and acetaldehyde. It is a good appetizer and its soup is a good remedy for preventing constipation. A horticultural vegetable crop like tomato improves consumers' health due to the presence of nutrients and antioxidants like oxalic acid and ascorbic acid (Salehi *et al.* 2019). As per Mallick PK (2021) the antioxidants present in tomatoes neutralize toxic free radicals in the blood circulation, reduce cholesterol level and prevent high blood pressure. After inoculation of crop seedling with an actinomycetes strain of rhizobacterium the harvested fruits have higher content of fructose, glucose, nitrate, maleate, zinc and phosphorus as per findings of Gouda *et al*. (2018). The quality of seedlings in tomato cultivation plays an important role for good growth and higher yield. For raising healthy seedlings, the nursery bed should be 10 to 15 cm high from ground level, 3–5 meter length with 1.00 meter width. The site selected for preparation of nursery bed should have sandy loam soil with FYM properly mixed into it at the rate of 2 kg per meter square. Zaller, J. G. (2007) reported application of vermicompost in seedling potting media also affects germination, biomass allocation, yield and fruit quality of tomato. Fertilizer applied as basal dose at the rate of 100 gm SSP and 50 gm MOP per bed. The depth of sowing of seed should be 0.5 to 1 cm with a spacing of 10 cm from row to row and 5 cm seed to seed within row. After making the seed bed it should be well drenched with formalin at the rate of 2 ml per liter of water. After drenching the seed bed is covered with dry paddy straw or black plastic mulch. After one week mulching should be removed. Due to drenching by formalin the seed bed is sterilized. They should be sown five to seven days after removal of mulch material. As per findings of Olaiya, CO (2010) pre-sowing seed treatment with bioregulators increases the seedling growth and yield of tomato. After sowing the seed bed should be covered with dry paddy straw or any organic mulch. After germination of seed, remove the mulch material. Light irrigation should be done with the help of a watering can. The damping off in nursery seedlings can be controlled by the spraying of 0.2% mancozeb and metalixyl. The seedlings are ready for transplanting after 4 to 5 weeks of sowing in nursery beds. The healthy crop of tomato depends on healthy seedlings and soil environment depends on the soil quality. The sustainability of agriculture depends upon soil health status Odelade KA and Babalola OO (2019). The result of various demonstration shows that the size, development, proper seed multiplication, nutrition, disease resistance and seedling development of tomatoes are affected by microorganisms as per findings of De Coninck T *et al.* (2021) and Patil BL and Fauquet CM (2021). The different soil factors such as nutrients, dissolved oxygen concentration, phytopathogens and parasites, water and weed seed pools affects the plant growth as per Patil BL and Fauquet CM (2021). The size

and healthy growing of tomatoes are affected by interactions between different microbial species as per Jain A and Chakraborty J, Das S (2020). The soil rich in microbial communities and organic matter require less fertilizer than naturally managed soils as per findings of Mahal *et al.* (2019). Bordewijk M and Schifferstein HN (2020) reported the various types of microbes form an interrelationship between plants and their habitat that leads to protection of tomato plants from harmful microorganisms and manufactures the material needed for plant growth. The soil quality also plays an important role on the health status of soil and microbial communities present in it. For maintaining the soil health we must use PGPR formulation at the proper stage for getting optimum yield and a healthy environment. The soil ecosystem must be maintained properly for sustainable development of microorganisms and saving soil for the coming future. It will develop healthy relationships for soil and microorganisms. So, this trial was conducted to find the best suitable age of seedlings and seedling treatment with rhizobacteria solution for getting a healthy crop with good growth and higher yield in agroclimatic and soil condition of Nalanda district in State Bihar.

MATERIALS AND METHODS

This trail was conducted in 2020-2021 and 2021-2022 in the villages Bodhibigha and Mudhari in block Nagarnausa and Harnaut of Nalanda district. The three was taken in this trail as technology option -1 (farmers practice) transplanting of 30 days old seedlings, technology option-2 transplanting of 20 days old seedlings and technology option-3 transplanting of 30 days old seedlings along with root dip in 2% rhizobacteria solution. Farmers prepared the nursery bed with sandy loam soil at 10–15 cm high from ground level. The bed was 3 meters in length and 1.00 m in width. The bed was sterilized with 2% formalin solution. After one week of sterilization the vermicompost was incorporated well in the soil. The seed of tomato was treated with carbendazim @ 2 gm per kg of seed. The seeds are sown in line with spacing of 10 cm from row to row and 5 cm from seed to seed within row. The seeds are sown at a depth of 0.5 to 1 cm. After sowing the seed the bed was covered with paddy straw mulch. The mulch was removed after germination of seed. The irrigation was done with the help of watering can. After germination the farmers are transplanted 20 days old seedlings in one block, 30 days old seedlings in the second block and 30 days old seedlings with root dip in 2% rhizobacteria solution were transplanted in another block. After field preparation the recommended dose of fertilizer N:P:K::120:100:100 kilogram/hectare was incorporated in the field. 100-meter square plot size is selected for one treatment. The seedlings are transplanted at 45×60 cm spacing from row to row and plant to plant. All the intercultural operations like weeding, irrigations, was done at regular intervals. The different growth and yield parameters like plant height (cm), number of primary and secondary branches, number of fruits per plant, fruit diameter (cm), weight per fruit (gm) and yield (q/ha) and different economic indicators like cost of cultivation, gross return, net return and B:C ratio was recorded.

RESULTS AND DISCUSSION

The maximum plant height 62.68 cm and 63.12 cm (Tables 1–2) was recorded in case of transplanting of 30 days old seedlings along with root dip in 2 rhizobacteria solution as compared to transplanting of 20 days old seedlings and 30 days old seedlings without any treatment in both the consecutive years referred to Figs. 1–2. The longest plant height 85.5 cm recorded by Tinni *et al*. (2014) by transplanting of 30 days old seedlings in brinjal.

The maximum number of primary and secondary branches are 7.40,7.90 and 9.70,9.90 was recorded in TO-3 as compared to other treatments referred to Figs. 1–2. Similar findings on growth attributes were also found by Jaiswal *et al.* (2017).The maximum number of branches 31.5 was recorded in brinjal by transplanting of 30 days old seedlings by Tinni *et al.* (2014). The different bacterial species that are found around plant roots promote plant growth and fruitfulness Zia *et al.* (2020) reported also developing resistance in plants to different phytopathogens. The PGPR is used to increase vegetative growth of plants and protects plants from various non-living factors like drought, salinity and different types of infections (20 Numan *et al.* 2018). PGPR found on roots of tomato plants as endophyte by Jambon I *et al.* (2018).

Table 1. Effect of age of seedlings on different parameters in tomato FY-2020-21.

Parameters Treatments	Plant height (cm)	Number of primary branches per plant	Number of secondary branches per plant	Number of fruits per plant	Fruit diameter (cm)	Weight of fruit (gm)	Yield (q/ha)
TO1 FP (Transplanting of 30 days old seedlings)	61.86	6.30	8.80	26.27	3.94	37.96	291.71
TO2 (Transplanting of 20 days old seedlings)	61.47	5.80	7.10	26.06	3.77	34.34	282.64
TO3 (Transplanting of 30 days old seedlings-along with root deep with rhizobacteria 2% solution)	62.68	7.40	9.70	28.99	4.65	42.04	309.27
CD	2.442	0.623	5.837	1.966	0.218	0.794	14.779
SE (d)	1.162	0.269	0.222	0.935	0.103	0.378	97.034

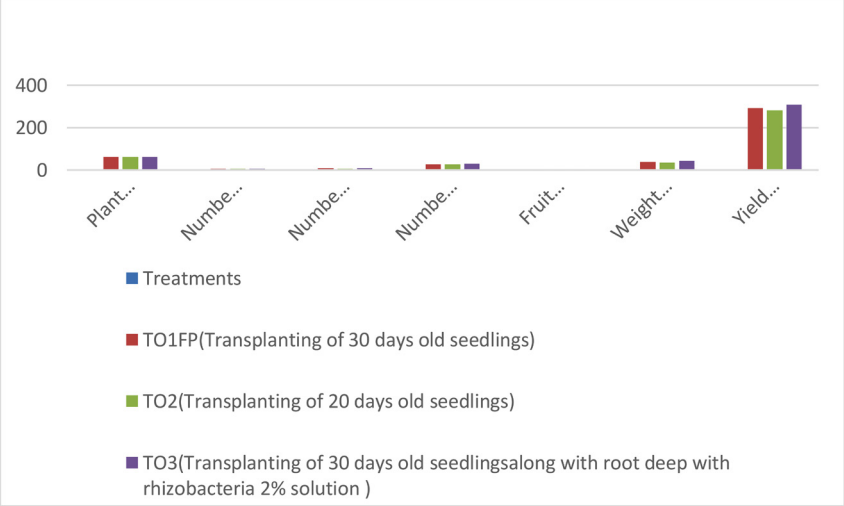

Fig. 1. Graphical Representation of Table No 1.

It also assists in development of plants through direct or indirect mechanisms as per findings of Berger *et al.* (2017). Sahu *et al.* (2019) also reported that the interactions of microbial communities in soil around the roots of plants leads to several physical, chemical and biological changes in the activity of plants.

The highest fruit weight (average of 10 fruits) 42.04 gm and 42.44 gm, maximum fruit diameter 4.65 cm and 4.69 cm, maximum number of fruits per plant 28.99 and 31.10 and highest yield 309.27 q/ha and 310.75 q/ha was recorded in case of transplanting of 30 days old seedlings treated with 2% rhizobacteria solution as compared to other treatment referred to Figs. 1–2. The maximum number of fruits per plant and maximum diameter of fruit was also recorded in brinjal by Tinni *et al.* (2014). The maximum fruit diameter in tomato at different seedlings age was also reported by Awad *et al*. (2001). The highest fruit weight in brinjal 82.8 gm was recorded in 30 days old seedlings by Tinni *et al.* (2014). The maximum number of fruits was reported by Salik *et al.* (2000)

Table 2. Effect of age of seedlings on different parameters in tomato FY-2021-22.

Parameters Treatments	Plant height (cm)	Number of primary br-anches per plant	Number of secondary branches per plant	Number of fruits per plant	Fruit diameter (cm)	Weight of fruit (gm)	Yield (q/ha)
TO1 FP (Transplanting of 30 days old seedlings)	61.94	6.40	9.00	29.00	3.99	40.06	293.62
TO2 (Transplanting of 20 days old seedlings)	61.58	5.90	8.60	26.40	3.40	35.13	284.19
TO3 (Transplanting of 30 days old seedlings-along with root deep with rhizobacteria 2% solution)	63.12	7.90	9.90	31.10	4.69	42.44	310.75
CD	1.108	0.613	0.533	0.802	0.162	1.114	6.838
SE (d)	0.527	0.291	0.253	0.382	0.077	0.530	3.254

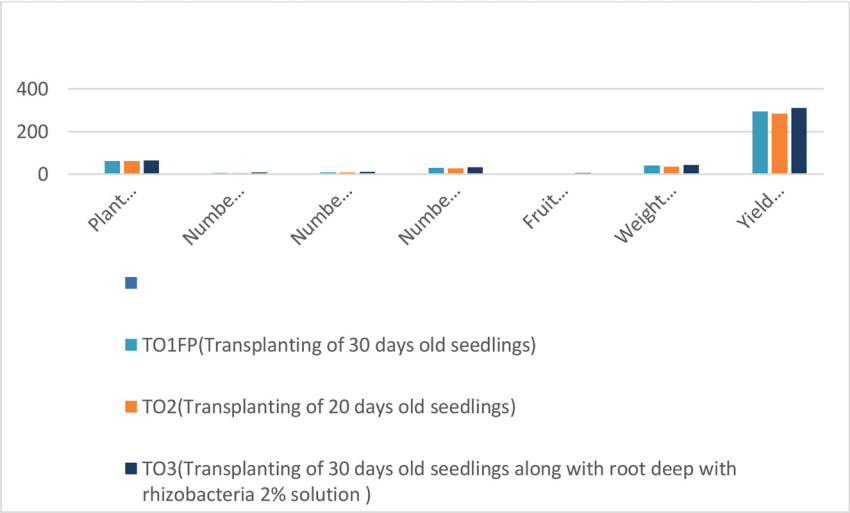

Fig. 2. Graphical Representation of Table No 2.

in middle aged transplants. Higher number of fruits from older transplants was recorded by Renuka and Perera (2002). As per findings of Shukla *et al*. (2013) the higher fruit and seed yield was recorded in case of transplanting of 33 days old seedlings as compared to younger and older ones. The similar findings were observed by Tinni *et al.* (2014) in the case of transplanting of 35 days pot seedlings of brinjal. The maximum B:C ratio was 3.95 in one year and 3.91 in the next year in case of transplanting of thirty days old seedlings with root treatment with rhizobacteria solution. This technology is most cost effective for farmers for getting optimum yield from the crop.

CONCLUSION

It is concluded that transplanting of different age of seedlings affects plant growth and yield of tomato. The root treatment with rhizobacteria solution also influences the growth and yield of the tomato. The symbiotic relationship between plants and microbes in the rhizosphere zone promotes the plant growth, overcomes stress and improves the yield. The best result was recorded in transplanting of 30 days old seedlings along with root dip in rhizobacteria solution as compared to other treatments with maximum B.C ratio was 3.95.

REFERENCES

Awad, S. S., Hassan, H. M. F., Shahien, A. H., & Zayed, A. A. (2001). Studies on intercropping of parsley and demsisa with tomato under different rates of nitrogen fertilization. *Alexandria Journal of Agricultural Research*,46 (2), 97—112.

Berger, B., Baldermann, S., & Ruppel, S. (2017). The plant growth promoting bacterium Kosakoniaradicincitans improves fruit yield and quality of Solanum lycopersicum. *Journal of The Science of Food And Agriculture*, 97(14), 4865—4871.
https://doi.org/10.1002/jsfa.8357

Bordewijk, M., & Schifferstein, H. N. (2020). The specifics of food design: insights from professional design practice. *International Journal of Food Design*, 4, 101—138.

De, C. T., Gistelinck, K., Rensburg, H. C. J. V., Ende, W. V. D., & Damme, E. J. M. V. (2021). Sweet modifications modulate plant development. *Biomolecules*, 11 (5), 756.

Gouda, S., Kerry, R. G., Das, G., Paramitthiotis, S., Shin, H. S., & Patra, J. K. (2018). Revitalization of plant growth promoting rhizobacteria for sustainable development in agriculture. *Microbiological research*, 206, 131—140.

Jain, A., Chakraborty, J., & Das, S. (2020). Underlying mechanism of plant microbe crosstalk in shaping microbial ecology of the rhizosphere. *Acta Physiologiae Plantarum*, 42, 1—13.

Jaiswal, A. K., Singh, J. P., Tombar, S., Abhishek., & Thakur, N. (2017). Effect of seedlings age on growth ,yield attributes and yield of tomato (*Lycopersicon esculentum* Mill.) 6 (9), 1521—1524.

Jambon, I., Thijs, S., Weyens, N. V., & Angronsveld, J. (2018). Harnessing plant bacteria fungi interactions to improve plant growth and degradation of organic pollutants. *Journal of Plant Interactions*, 13, 119—130.

Mahal, N. K., Osterholz, W. R., Miguez, F. E., Poffenbarger, H. J., Sawyer, J. E., Olk, D. C., Archontoulis, S. V., & Castellano, M. J. (2019). Nitrogen fertilizer suppresses mineralization of soil organic matter in maize agroecosystems. *Frontiers in Ecology and Evolution*, 7, 59.

Mallick, P. K. (2021). Medicinal values of tomato (*Lycopersicon esculentum* Mill, *Solanaceae*). *International Journal of Applied Sciences and Biotechnology*, 9 (3), 166—168.

Numan, M., Bashir, S., Khan, Y., Mumtaz, R., Shinwari, Z. K., Khan, A. L., Khan, A., & Ahmed, A-H. (2018). Plant growth promoting bacteria as an alternative strategy for salt tolerance in plants: A review. *Microbiological Research*, 209, 21—32.

Odelade, K. A., & Babalola, O. O. (2019). Bacteria,fungi and archaea domains in rhizospheric soil and their effects in enhancing agricultural productivity. *International Journal of Environmental research and public health,* 16, 3873.

Olaiya, C .O. (2010). Presowing bioregulator seed treatments increase the seedling growth and yield of tomato (*Solanum lycopersicon*). *Journal of Plant Growth Regulation*, 29 (3), 349—356.

Patil, B. L., & Fauquet, C. M. (2021). Eology of plant infecting viruses, with special reference to geminiviruses. *Studies in viral ecology*, 183—229.

Renuka, K. A., & Perera, K. D. A. (2002). Effect of seedling age and its management on growth and yield of chilli. Annals Sri Lanka, Department of Agriculture, 4, 33—38.

Sahu, P. K., Singh, D. P., Prabha, R., Meena, K. K., & Abhilash, P. (2019). Connecting microbial capabilities with the soil and plant health: Options for agricultural sustainability. *Ecological indicators*, 105, 601—612.

Salehi, B., Sharifi-Rad, R., Sharopov, F., Namiesnik, J., Roointan, A., Kamle, M., Kumar, P., Martins, N., & Shari fi-Rad, J. (2019). Beneficial effects and potential risks of tomato consumption for human health : An overview. *Nutrition*, 62, 201—208.

Salik, M. R., Muhammad, F., & Pervez, M. A. (2000). Relationship between age of seedlings on productivity of tomato (*Lycopersicon esculentum* L.) grown under plastic tunnel. *Pakistan Journal of Biological Sciences*, 3 (8), 1260—1261.

Shukla, Y. R., Chhopal, T., & Sharma, R. (2013). Effect of age of transplants on fruit and seed yield of tomato (*Solanum lycopersicum* L.). *Journal of Horticultural Sciences*, 8 (1), 99—102.

Smolinska, B., & Majak, I. (2022).Tomato allergy: the characterization of the selected allergens and antioxidants of tomato (*Solanum lycopersicum*)- a review. *Antioxidants*, 11(4), 644.

Source: FAO, Statistical database, 2021.

Source: Horticulture statistics division, Department of agriculture and farmers welfare 2021.

Tinni, T. B. R., Ali, M. A., Mehraj, H., Shiam, I. H., & Jamaluddin, A. F. M. (2014). Influence of seedling age on growth and yield of brinjal (*Solanum melongena* L.). *Bangladesh Research Publications Journal*, 10 (2), 170—174.

Zaller, J. G. (2007). Vermicompost in seedling potting media can affect germination, biomass allocation, yields and fruit quality of three tomato varities. *European Journal of Soil Biology*, 43, S332—S336.

Zia, R., Nawaz, M. S., Siddique, M. J., Hakim, S., & Imran, A. (2020). Plant survival under drought stress: implications ,adaptive responses, and integrated rhizosphere management strategy for stress mitigation. *Microbiological Research*, 242, 126—626.