# EFFECT OF DIFFERENT GROWTH MEDIUM ON SEED VIGOR CHARACTERISTICS OF TOMATO (Solanum lycopersicum L.) cv. Gaurav-555 IN ARGHAKHANCHI, NEPAL

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*ABSTRACT*

*A research experiment was conducted in Arghakhanchi district of Nepal during April to May, 2019 in greenhouse to evaluate the effect of different growth medium on seed vigor characteristics of tomato (Solanum lycopersicum L.) cv. Gaurav-555. The growth mediums used were farmyard manure, vermi-compost, bio-bacterial compost, coco peat and control (soil). This experiment was contrived in Completely Randomized Design (CRD) with four replications and five treatments. There was significant difference among the treatments on seed vigor characteristics and the result showed that germination percentage was significantly higher in coco peat (95%) which was statistically similar with bio bacterial compost (92.5%) and farmyard manure (92.5%) but different from vermi-compost and control. Similarly, significantly higher seed vigor index(1033.125 ), plant height(11.15 cm ), root and shoot length ratio(2.186), and dry weight(0.087 g) were found in bio bacterial compost. However, higher speed of germination(1.964 seedling day$^{-1}$ ) and minimum days to true leaf emergence(19) was found in coco peat.*

*Key words: tomato, seed vigor, bio-bacterial compost, coco peat*

## 1. Introduction

Tomato *(Solanum lycopersicum L*) is an annual plant, belongs to the Solanaceae family, which is 10-30 cm tall, having soft woody stem. It is warm season crop and is rich source of minerals, vitamins and organic acids. Agriculture is the mainstay of Nepalese economy which contributes 26.98% of total GDP (MoALD, 2019). Diverse climatic condition from tropical to temperate region provides topographical variation and ecological variation that create the scope of farming. Suitable growing media is a necessity for obtaining quality horticulture crops. It has a direct effect of development of functional root system. Appropriate growth medium provides sufficient anchorage (Omaliko, 2006). Seed germination is affected by various factors which include types of substrate used (Hartmann et al., 2001). Strong and healthy seedling is the prerequisite for successful tomato production. Use of growth media like farmyard manure, vermi-compost, bio-bacterial compost and coco peat could possibly be an effective technique for raising seedling. Adverse environmental condition like rainfall could raise problem for farmers in raising tomato seedling in due time. Use of plastic tray inside greenhouse could minimize the adversities. Organic fertilizers have a direct effect on soil organic matter content that can improve soil fertility, soil physical characteristics, augment microbial activities, as well as meliorate metal toxicity. Soil fertility and health have been improve by the use of organic fertilizers and enhance efficiency which ultimately reduce the need for chemical fertilizers (Roy & Kashem, 2014). Hence, the study was conducted to evaluate the effect of different growth medium on seed vigor characteristic of tomato inside greenhouse.



## 2. Objectives

The main objective of the research is to study the seed vigor of Gaurav-555 variety of tomato in different growth medium for better yield.

The specific objectives are as follows:

- To assess the germination percent of Gaurav-555 variety of tomato in different growth medium.
- To determine speed of germination of Gaurav-555 variety of tomato in different growth medium.

- To determine root to shoot length ratio, dry weight and plant height of Gaurav-555 variety of tomato in different growth medium.
- To determine seed vigor index.

## 3. Methodology

The variety of tomato is Gaurav-555 and it was collected from the Agro-vet located nearby Vegetable Zone, Arghakhanchi. The research was conducted in green house in Sandhikharkha Municipality-01,which is the site of Vegetable Zone, Arghakhanchi.

The experiment was conducted in Completely Randomized Design (CRD) which consists of five treatments and for each treatment, four replications were done.

Five treatments were used and each treatment consists of different growth medium. The different treatments are farmyard manure, vermi-compost, bio-bacterial compost, coco peat and soil as control. All the growth medium was mixed in soil and seed was sown in plastic tray. All of growth medium and soil was mixed in 1:1 ratio. The research was conducted inside green house.

Seed was sown directly in plastic tray. The seed was treated with Fungicide, Insecticide and Rhizobium treatment. In each replication, 20 seeds were sown. The different seed vigor testing parameters are as;



### 3.1. Speed of germination

Twenty seeds of each treatment in each replication were sown for germination. Number of seedlings emerging daily was counted from days of planting the seeds till the time germination was completed or ceased. The days to germination/emergence of each replication was noted. Also, the speed of germination or emergence (X) was computed by using the following formula

$$X=\frac{number\ of\ seedling\ emerged}{days\ to\ first\ count}+\ldots\ldots+\frac{increase\ of\ seedlings\ emerged\ from\ previous\ count}{days\ to\ final\ count}$$

(Maguire, 1962)

Higher the X, higher is the speed of germination.

### 3.2. Germination percentage

The germination percent of seeds for each replication was computed as

$$\text{Germination \%} = \frac{\text{Number of seeds germinated}}{Number\ of\ seeds\ sown} * 100\ \%$$

### 3.3. Seed vigor index

Seed vigor index was determined using following formula of Baki and Andersen (1973) as shown below:

Vigor Index= (Mean of Root Length + Mean of Shoot Length)*Percentage of Seed Germination (Abdual-Baki & Andersen, 1973)

### 3.4. Days to true leaf emergence

True leaf refers to leaf other than cotyledon leaf. The days to true leaf emergence in over 50% of sample seedling was observed and noted per replication of tomato seedling.

### 3.5. Root and shoot length ratio

After 30 days the root and shoot length of tomato seedling was measured. It was done with simple random sampling. Around 6 seedlings was uprooted from each replication and root and shoot length of each seedlings was measured. Then the root shoot length ratio was determined as

Root Shoot length ratio= $\frac{root\ length}{shoot\ length}$

### 3.6. Dry weight determination

The sample was subjected to oven dry along with root for about 17 hours at $105^0$C and its biomass was determined by measuring the dry weight

### 3.7. Plant height

Plant height was measured as the length of shoot and root.

Plant height = (root length + shoot length)

The data obtained from the experimental plots on various parameters were statistically analyzed to find out the significance of treatments according to the principles of experimental design. The obtained data were tabulated in Microsoft Excel and Gen Stat to analyze the data. Duncan's Multiple Range Test (DMRT) was employed to find out the significant differences between the mean values at 5% level of significance. The Gen stat used to find the coefficient of variance, grand mean.

## 4. RESULTS AND DISCUSSION

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Table 1: Seed vigor characteristics as influenced by different growth medium on tomato seed (*Solanum lycopersicum L.)* in Arghakhanchi, Nepal, 2019

| Treatment | Germination (%) | Speed of Germination (Seedling day$^{-1)}$ | Vigor index | Dry weight (g) | Days to true leaf emergence | Root to shoot length ratio | Plant height (cm) | Remarks |
|---|---|---|---|---|---|---|---|---|
| FYM | 92.50$^{a}$ | 1.642$^{b}$ | 745.875$^{bc}$ | 0.04875$^{c}$ | 20.75$^{b}$ | 1.589$^{b}$ | 8.025$^{b}$ | III |
| Vermi-compost | 81.25$^{b}$ | 1.135$^{c}$ | 642.250$^{c}$ | 0.06500$^{b}$ | 22.25$^{c}$ | 1.481$^{b}$ | 7.900$^{b}$ | IV |
| Bio-bacterial Compost | 92.50$^{a}$ | 1.479$^{b}$ | 1033.125$^{a}$ | 0.08667$^{a}$ | 20.75$^{b}$ | 2.186$^{a}$ | 11.150$^{a}$ | I |
| Control | 65.0$^{c}$ | 0.974$^{c}$ | 331.75$^{d}$ | 0.04333$^{c}$ | 23.25$^{d}$ | 1.318$^{b}$ | 5.100$^{c}$ | V |
| Coco peat | 95.0$^{a}$ | 1.964$^{a}$ | 837.250$^{b}$ | 0.07042$^{b}$ | 19$^{a}$ | 1.668$^{b}$ | 8.800$^{b}$ | II |
| SEm(±) | 2.8 | 0.0826 | 61.7 | 0.00343 | 0.289 | 0.1225 | 0.5522 | |
| LSD | 8.43*** | 0.249*** | 186*** | 0.01033*** | 0.87*** | 0.369** | 1.66*** | |
| C.V,% | 6.56% | 11.5% | 17.2% | 10.9% | 2.72% | 14.9% | 13.5% | |
| Grand Mean | 85.2 | 1.44 | 718 | 0.0628 | 21.2 | 1.65 | 8.2 | |

Note: Treatments means followed by common letter (s) within column are not significantly different among each other based on DMRT at 5% level of significance.

**Germination percentage**

The study revealed the fact the there was significant difference between seed germination percentage among different growth medium. The maximum seed germination percentage (95%) was found in coco peat which was statistically similar with bio-bacterial compost (92.5%) and farmyard manure (92.5%). The least germination percentage (65%) was found in control medium.

Growth medium promotes water absorption, nutrient availability and supply of oxygen to the germinating seeds and seedlings which favor the germination of seeds.
( Dayeswari, Rayaprolu, & Jone, 2017).
Coco peat favor high germination of seed because of its good physical and chemical properties which decrease compactness and increasing the porosity of the medium
( Chiranjeevi, Hongal, Vinay, Sneha, & Muralidhara, 2018).
Seed germination is positively affected by the use of fertilizers in soil and all fertilizers enhanced the germination percentage compared to control ( Azam, Ishtiaq, & Shahzaman, 2017)

The results obtained above are similar with the result of (Humair, et al., 2016) which stated that higher germination percentage is due to different composition of growth media as well as increase in water absorption, nutrient availability, physical and chemical properties of growth media.

**Speed of germination**

There was significant difference between speed of germination among different growth medium. The maximum speed of germination (1.964) was found in coco peat. The least speed of germination (0.974) was found in control (soil).

Speed of germination is favored by nutrient composition and physical properties of media. The growth medium coco peat and vermi-compost, higher speed of germination is found due to interactive combination of all factor which improve physical condition and nutritional factor of media (Sahni, Sharma , Singh, Singh, & Singh, 2008).

**Seed Vigor index**

The study revealed that there was significantly difference between seed vigor index among different growth medium. The maximum seed vigor index (1033.125) was found in bio-bacterial compost. The least seed vigor index (331.75) was found in control.

High seed vigor index in bio-bacterial compost is due to high phosphorous content (Humair, et al., 2016). Larger seeds were found to have higher seed vigor index. Increased seed vigor index in larger seed might be due to presence of higher amount of carbohydrate and other nutrients (Gholami, Sharafi, Sharafi, & Ghasemi, 2009). Similar result was shown by ( Zia-ul-Haque, Baqual, Mir, Wani, Maqbool , & Dar, 2017) as Dalweed that initiates vigorous and fast growth in seedlings due to better water holding capacity and availability of nutrients than other manure..

**Dry weight**

The study revealed that there was significantly difference between dry weight among different growth medium. The maximum dry weight (0.08667g) was found in bio bacterial compost. The least dry weight (0.04333g) was found in control.

The accumulation of dry weight in the early stage of seedling in larger seed is due to a result of mobilization of storage reserve from cotyledons (Abdul-baki & Anderson, 1973).

Dalweed may have increased supply of nutrients at the younger stages of seedling growth which in mulberry seedlings result in increased number of leaves per seedling and hence more photosynthates are synthesized in the leaves which leads to increased thickness and dry shoot of the seedlings ( Zia-ul-Haque, Baqual, Mir, Wani, Maqbool , & Dar, 2017).

The porosity and water holding capacity of soil is improve by organic altercation which induces more growth of root, so enhances the uptake of nutrients from soil and ensue increases the above ground biomass accumulation (Gogoi & Sarma, 2015).

Similar research finding was shown by (Gama, Wani, Marcelo-d'Ragga, & Misaka, 2015) in compost as it is obtained by controlled biological decomposition of organic material (mainly plant) which are well decomposed and all the required nutrients were readily available to the plant

**Days to true leaf emergence**

The study revealed the fact the there was significant difference between days to true leaf emergence among different growth media. The earliest days for true leaf emergence (19) was found in coco peat. The delayed days to true leaf emergence (23.25) was found in control

Days to true leaf emergence was found earlier in coco peat medium because of its higher speed of germination and seed vigor index.

**Root and shoot length ratio**

The study revealed that there was significantly difference between root to shoot length ratio among different growth medium. The maximum root to shoot length ratio (2.186078) was found in bio bacterial compost. The least root to shoot length ratio (1.318511) was found in control which was statically similar to coco peat (1.668137), farmyard manure (1.589764) and vermi-compost (1.481646)

The result above showed that bio-bacterial compost have high root to shoot length ratio. Higher root shoot length ratio might be due to high investment in root tissues promoting greater development of root systems that reach deeper levels of substrate with more water and nutrients (Canadell & Zedler, 1995)

Root and shoot length ratio is the amount of plant tissues that have supportive functions to the amount of those that have growth functions. Plants having higher proportion of roots can compete more effectively for soil nutrients, while higher proportion of shoots can collect more light energy. Shoot production are characteristic of vegetation in early successional phases, while high proportions of root production are characteristic of climax vegetation phases (Hussain, 2017).



**Plant height**

The study revealed that there was significantly difference between plant height among different growth medium. The maximum plant height (11.150cm) was found in bio bacterial compost. The minimum plant height (5.100cm) was found in control.

The maximum contribution to the plant height was observed in compost manure because compost is obtained by controlled biological decomposition of organic material (mainly plant) which are well decomposed and all nutrients were easily available to the plant (Gama, Wani, Marcelo-d'Ragga, & Misaka, 2015).

Similar research finding was found by (Tshegofatso, Mathowa, Mojeremane, Matsuane, Oagile, & Legwaila, 2016) growing media can sustain growth and development of the seedlings.

## 5. Conclusion

The effect of different growth medium on seed vigor characteristics of tomato cv. Gaurav-555 was conducted in green house. Significant variations were observed among different growth medium with respect to seed germination percentage, speed of germination, days to true leaf emergence, seed vigor index, root to shoot length ratio, dry weight and plant height. Bio bacterial compost was found effective and appropriate growth medium for seed vigor characteristics with high seed germination percentage, speed of germination, root to shoot length ratio, seed vigor index, dry weight and plant height.

**Acknowledgement**

I take the pleasant opportunity to express my deepest sense of gratitude and heartfelt thanks to Prof. Chandeshwar Prashad Shriwastav, Major Supervisor, Agriculture and Forestry University (AFU) for his continuous motivation, valuable suggestion, friendly help and support during my research period.

I would like to express my sincere gratitude to the Mr. Hari Bahadur KC, Chief, Vegetable Development Directorate and Mr. Buddhiram Bhattarai, Senior Agriculture Officer for their guidance, encouragement, continuous help and valuable suggestion.

I express my prideful gratitude to Prof. Jay Prakash Dutta (Dean, Faculty of Agriculture, AFU), Prof. Arjun Kumar Shrestha (Director, Planning Directorate, AFU) and Prof. Kalyani Mishra Tripathi, Asst. Dean (Academic) for providing academic environment and moral support.

I take the pleasant opportunity to express my deepest sense of gratitude and heartfelt thanks to my friends and helping hands for continuous motivation, valuable suggestion, friendly help and support during research period. . I would like to thank and dedicate this research to my parents Mr. Bijaya Prasad Bhandari and Mrs. Suchana Bhandari who are the main reason of my academic achievements.



## References

Abdual-Baki, A., & Andersen, J. (1973). Realationship between decarboxilation of glutamatic acid and vigor in soyabean seed. *Crop Science 13*, 222-226.

Abdul-baki, A., & Anderson, J. (1973). Vigor determination in soyabean seed by multiple criteria. *Crop Sci. 13*, 630-633.

Agbo CU, Omaliko CM (2006). Initiation and growth of shoots of Gongronema latifolia Benth stem cuttings in different rooting media. Afr. J. Biotechnol.5:425-428

Azam, A., Ishtiaq, M., & Shahzaman, M. (2017, March). Effect of different fertilizers on seed germination and seedling growth of sunflower (Helianthus annuus L.) from district Bhimber of Azad Jammu and Kashmir, Pakistan. *International Journal of Botany Studies*, 10-15.

Canadell, J., & Zedler, P. (1995). *Underground structures of woody plants in Mediterranean Ecosystem of Australia, California and Chile. Ecology and Biogeography of Mediterranean Ecosystems in Chile, California and Australia.* New York: Spring-Verlag.

Chiranjeevi, M. R., Hongal, S., Vinay, G. M., Sneha, M. K., & Muralidhara, B. M. (2018). Influence of Media and Biofertilizers on Seed Germination and Seedling Vigour of Aonla. *International Journal of Current Microbiology and Applied Sciences*.

Cuartero, J., & Munoz, R. F. (1999). Tomato and salinity. *Scientia Horticulturae*.

Dayeswari, D., Rayaprolu, S., & Jone, A. (2017). Effect of Potting Media on Seed Germination, Seedling Growth and Vigour in TNUA papaya Co.8(Carica papaya L.). *International journal of pure and applied bio science*.

Gama, P. B., Wani, L. B., Marcelo-d'Ragga, P. W., & Misaka, B. C. (2015). Effect of Soil Media on Growth of Tomato Seedlings (Solanum lycopersicum L.) under nursery (Greenhouse) Conditions. *International Journal of Agricultural Research and Review*.

Gholami, A., Sharafi, A., Sharafi, S., & Ghasemi, S. (2009). Germination of different seed size of PInto bean cultivars as affected by salinity and drought stree. *Food, Agric. Environment, 7*, 555-558.

Gogoi, N., & Sarma, B. (2015). Germination and seedling growth of Okra (Abelmoschus esculentus L.) as influenced by organic amendments. *SOIL & CROP SCIENCES*.

Hartmann HT, Kester DE, Davies FT, Geneve RL(2001). Plant propagation; Principles and Practices 7th Edition, Prentice Hall Publishers, New Jersey

Humair, M., Jellani, G., Atif, M. M., Ullah, H., Saleem, N., Malik, A., et al. (2016). Different Growth Media Effect the Germination and Growth of Tomato Seedlings. *Pakistan Council for Science and Technolog*.

Hussain, S. (2017, JUly 7th ). What is the significance of root- shoot ratio in crops? (K. Pandita, Interviewer)

Maguire, J. (1962). Speed of germination-aid in selection and evaluation for seedling emergence and vigor. *Crop sci. 2*, 176-177.

MoALD. (2019). *STASTICAL INFORMATION ON NEPALESE AGRICUTURE*. Kathmandu: Government of Nepal.

Roy, S., & Kashem, M. A. (2014). Effects of Organic Manures in Changes of Some Soil Properties at Different Incubation Periods. *Open Journal of Soil Science, 4* .

Sahni, S., Sharma , B. K., Singh, D. P., Singh, H. B., & Singh, K. P. (2008). Vermicompost enhances performance of plant growth promoting rhizobacteria in Cicer arietinum rhizosphere against Sclerotium rolfsii. *Crop protection*.

Tshegofatso, N., Mathowa, T., Mojeremane, W., Matsuane, C., Oagile, O., & Legwaila, G. M. (2016). Effect of commercial growing media on emergence, growth and development of tomato seedlings. *International Journal of Agronomy and Agricultural Research (IJAAR), 09*, 83-91.

Vivek, P., & Duraisamy, V. M. (2017, june). Study of Growth Parameter and GGermination on Tomato Seedlings With Different Growth Media. *International Journal of Agricultural Science and Research, 7*(3).

Zia-ul-Haque, S., Baqual, M. F., Mir, M. R., Wani, M. Y., Maqbool , S. A., & Dar, A. S. (2017). Influence of different manures on the Germination and Seedling growth of Mulberry (Morus sp.). *Journal of Phamacognosy and Phytochemistry*.