

Research Article



Evaluation of Growth Parameters and Germination Behaviour of Different Tomato (*Lycopersicon esculentum* Mill.) Cultivars under Hydroponic Condition

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Abstract | Tomato (*Lycopersicon esculentum* L.) is an important vegetable crop of Pakistan. Tomato is most edible and nutritious vegetable crop. The study was performed at the Institute of Hydroponic Agriculture PMAS Arid Agriculture University Rawalpindi to check the growth and germination behaviour of different tomato (*Lycopersicon esculentum* L.) varieties grown under hydroponic conditions. Five different tomato varieties (Berberana F1, Lezaforta F1, Elipida F1, Premium Ruby and Cherry Tomato) were used for the experiment. Growth related parameters such as shoot length, root length; stem diameter and number of leaves were observed at 30 days aged seedlings in coco peat media. The experiment was executed according to completely randomized design (CRD) with four replications. Analysis of variance (ANOVA) was performed on the data. Significant changes were observed in growth parameters among different tomato varieties. Data were collected on germination percentage after two days interval. The results revealed that the germination percentage (100%) was higher in Cherry Tomato. The seedling root length (37.62 mm), seedlings shoot length (89 mm), number of leaves (6), stem diameter (1.74 mm) were observed in Berberana tomato variety than the other varieties and therefore it is found that tomato varieties such as Cherry and Berberana in hydroponics system can use for good seedling quality and germination behaviour.

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Introduction

Tomato (*Lycopersicon esculentum* L.) is one of the most important vegetable crops of Pakistan. Tomato is most edible and nutritious vegetable and widely grown in regions such as tropical, subtropical and temperate environments worldwide due to their widespread acceptance and compensating prices in the market. Tomato is the most consumed, profitable and popular vegetable for producer in the world

(Fernandes et al., 2007; Nasir et al., 2015). Tomato is a rich source of protein and carbohydrates (Perveen et al., 2015), play significant functions in human diet and provide well-balanced essential nutrients (Ilahy et al., 2016). However, tomato contain large amount of total antioxidant, total phenolic contents, ascorbic acid and carotenoids (Vinha et al., 2014).

Varietal selection is the major factor for healthy seedling along with better production and quality of

tomato and its vigor. Seed germination is a critical stage because the entire plant lifespan depends directly on the germination rate (Qadir and Shahzadi, 1969). The higher growth parameters (root length, shoot length, stem thickness and number of leaves) were found at 30 days aged seedlings in coir pith media (Vivk and Duraisamy, 2017). Growth media have significant effect on flowering plants and play a vital role in rate of germination and many growth-related parameters such as plant height, leaf number, leaf length, stem girth and yield etc. (Vendrame et al., 2005).

Protrays are currently used for rising most of the vegetables seed in hydroponic system as compared to traditional nursery bed. The seedlings raised in the protrait are germinate quickly and healthy. Seed sown in protrait showed better root development and reduce mortality rate. Seeds sowing are done manually in protarys. The protrait plugs are properly filled with a media and finally transplanted into growth chamber. Single seed is put in one cell of protrait plug. The plants grown in protrait enhanced transplanting efficiency and provide a better supply of good quality seedlings (Jeong, 1992).

Cocopeat is an organic matter used as plant growing media which are prepared from coconut husk also known as coconut coir. It is an essential growing media in horticulture plant nurseries. Cocopeat is by-product of agriculture obtained by extracting fiber from coconut shell (Abad et al., 2002). Cocopeat as a hydroponic growing media can be used to produce a large quantity of horticultural crops with adequate quality in the tropics (Yahya and Mohklas, 1999; Yau and Murphy, 2000). Abad et al. (2002) reported that cocopeat is a good growing and rooting media with high water holding capacity, acceptable pH and EC, good aeration, low shrinkage, less bulk density and increase shelf life of the plants (Evans et al., 1996; Prasad, 1997).

Little research has been reported on these tomato cultivars evaluation especially in temperature controlled glasshouses and hydroponic system in Pakistan. The present research work aimed to check the growth and germination behaviour of different tomato varieties grown under hydroponic system.

Materials and Methods

The study site, Institute of Hydroponic Agriculture PMAS Arid Agriculture University Rawalpindi. Five

different tomato varieties (Berberana F1, Lezaforta F1, Elipida F1, Premium Ruby and Cherry Tomato) were used for the experiment. The well decomposed coco peat was used as media for raising the tomato seedlings. The media was filled half of each cell in the tray. Single seed was kept in each cell an inch deep of the protrait (Figure 1) and covered all seed plug on the top with cocopeat. Seeds were sown in trays in the germination room which was maintained at 25°C temperature and 95% relative humidity (RH). The temperature was recorded on daily bases the average maximum and minimum temperatures of 33.4°C and 15.3°C and average maximum and minimum R.H. of 90% and 40% respectively. The protrait was completely covered with polythene sheets to keep them moist. The seed start sprouting within 4 to 5 days with two or three leaves and regularly water application was increased depending on moisture level in protarys (Figure 2). At the end of 14th day of germination test, the number of normal seedlings in each tray was counted and germination was calculated at two days interval and expressed in percentage (Figure 3). Simultaneously, germination per cent of seedlings were calculated using the following formula (Atif et al., 2016).

$$\text{Germination \%} = \frac{\text{Seed germinated}}{\text{Total No of seeds}} \times 100$$

After 30 days, the growth parameters i.e., leaf number, shoot length (mm), root length (mm) and stem girth (mm) were calculated (Table 2). The seedlings were removed manually from the protrait cells. The seedling root and shoot length was noted with a steel rule with least count of 0.5 mm. The stem girth was calculated by using a digital vernier caliper with least count of 0.02 mm. The measurements were taken after 30 days old tomato seedlings. Brief description of tomato cultivars are described in Table 1.



Figure 1: Tomato seed grown in protrait with coco peat media.

Table 1: *Tomato cultivars description used in the experiment.*

Varieties	Growth habit	Unique character	Seedling emergence	Maturity days
Berberana F1	Indeterminate	It is a very large beef tomato variety, vegetative with a good force of growth Development of brushes, uniform throughout all vegetation, roundish mass of a fruit 250-280 g Color of a fruit: bright red	5 to 12 days	95-105 days
Lezaforta F1	Indeterminate	beef tomato, fruits are larger in size, fruit weight 220-250g; High yielding variety	5 to 14 days	100 days
Elipida F1	Indeterminate	Beef tomato, Market leader throughout the world Low-maintenance hybrid. Strong plant with short internode. Good resistance to temperature drops. Uniform large round fruits of bright red color, weight of fruit 200-230 g. High quality fruits with good shelf life	14 days	80 days
Premium Ruby	Indeterminate	Outstanding flavour and colour and high yield potential, high sugar contents	5 to 14 days	Medium early 70 days
Mimi Cherry Tomato	Indeterminate	Good productivity and excellent flavour and has high commercial value. Cherry tomatoes are small and brightly colored. They are generally red or yellow flavorsome, sweet and sometimes slightly sour, fresh and crisp	4 to 10 days	65 to 70 days

Statistical analysis

The study was planned according to completely randomized design (CRD). The data was subjected to analyze by using Statistix 8.1 software. To test the significance of overall data execute analysis of variance (ANOVA) system and to compare treatment means least significant difference LSD ($P \leq 0.05$) test was used (Steel et al., 1997).

Results and Discussion

Germination percentage

Highly significant changes were found among different tomato cultivars with respect to germination percentage. Cherry Tomato recorded significantly (1.25 fold) highest germination percentage than Lezaforta F1 tomato variety after 12 days (Table 2).

Cocopeat as a growing media in hydroponic system is a best reservoir of plant nutrition and moisture contents because it effects the seed germination, seedling growth and emergence (Grower, 1987; Baiyeri and Mbah, 2006). Moreover, cocopeat media also provide good seedling performance when seedlings are shifted in the hydroponic greenhouse system (Adediran, 2005). According to Bruckner (1997) and Nkongolo and Caron (1999) reported that relative balance between air and water in the pore spaces of growing media is important step for seed germination and plant development. In this study, seedling germination was calculated after four days of sowing in protray. Since cocopeat media were more effective to enhance germination percentage

in papaya seedlings compared with media without cocopeat (Bhardwaj, 2014).

Table 2: *Response of tomato varieties to different growth parameters.*

S. No	Treatments	Germination %	Root length (mm)	Shoot length (mm)	Stem diameter (mm)	No of leaves
1	Berberana	95 ab	37.62 a	89 a	1.74 a	6 a
2	Lezaforta	80 d	31.25 b	83.75 b	1.46 b	5 ab
3	Cherry	100 a	32.12 b	79.62 c	0.75 e	4 b
4	Premium ruby	89.17 bc	30.50 b	71.87 d	1.28 c	3 c
5	Elipida	88.33 c	29.87 b	72.12 d	1.10 d	3 c
LSD ($P \leq 0.05$)		2.77	1.19	1.61	0.03	0.54
CV (%)		4.33	5.23	2.88	3.6	16.79

The mean value in the same column followed by different letters are significant when $P \leq 0.05$

Root length

The root length was one of the influenced growth parameter with different age of seedlings and varieties of tomato. Root length of Berberana tomato variety was increased 1.2 fold higher after 30 days aged seedling as compared to Elipida tomato variety (Table 2). The use of appropriate growing media promotes root growth and plant vigor is important for quality production horticultural crops. Cocopeat is a better growing media serve as a storage for nutrients and water for the plant, allow diffusion of oxygen in root zone and external atmosphere of root substrate which provide adequate support to the plant (Abad et al., 2002). These results are match with the finding of

Kumar (2007) who found the small changes (6.4-6.59 cm) in the root length of tomato varieties in India. According to Unal (2013) reported that best outcomes regarding tomato seedling root length in M4 (peat-stable manure-perlite) and M5 (peat-sand-NPK) media.

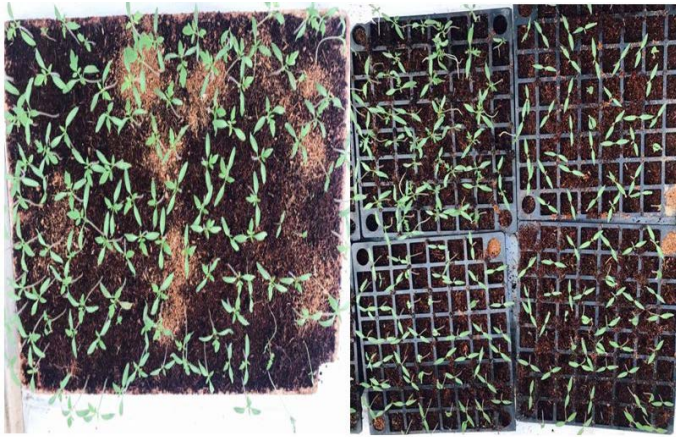


Figure 2: Tomato seedlings germination grown in protray with cocopeat media.



Figure 3: Tomato seedling at transplanting stage.

Shoot length

The shoot length of Berberana tomato variety was significantly increased by 1.24 fold higher as compared with Premium Ruby tomato variety after 30 days aged seedlings respectively (Table 2). These outcomes are match with the results of Atif et al. (2016) found that equal proportion of compost, peat and traditional practicing media also enhanced tomato shoot length. After 30 days aged seedling higher shoot length were observed in coir pith media (Vivk and Duraisamy, 2017). The increased growth parameters in cocopeat media may be due to higher phosphorous content. Phosphorous is used in the development of high energy compounds, which in return cause several bio-chemical reactions in plant such as adenosine triphosphate and adenosine diphosphate (Memon,

1996). Riaz et al. (2008) reported application of different parameters like diverse growing media on the growth and flowering of zinnia. Therefore, physical and chemical properties of growing media are very critical factor for plant growth and development.

Stem diameter

The stem girth was also influenced by the age of seedlings according to tomato varieties. It was quite high in 30 days old seedlings having the maximum thickness (1.74 mm) in Berberana tomato. The minimum stem thickness (0.75) was found in same days of seedling in Cherry Tomato (Table 2). The treatments effect was also significant at 5 per cent level. Related findings were stated by Singh et al. (2007). As plant height was increases automatically the stem thickness was also increased. According to Meena et al. (2017) found that papaya stem girth was recorded higher in vermiculite with 2cm cocopeat media because these media supply sufficient nutrients and improves physiological properties and water holding capacity than soil. Stem diameter was significantly showed superior results among different combination of medium used (cocopeat+soil+sand + vermicompost +vermiculite) (1:1:1:1:1) with Azotobacter in acid lime seedling (Yadav et al., 2012).

Number of leaves

The number of leaves was significantly increased two times in Berberana tomato variety after 30 days old seedlings than Premium ruby and Elipida tomato varieties on same day of seedlings. Age of seedlings and different tomato varieties grown in coco peat media were also significant (Table 2). These consequences are similar with the conclusions of Kumarasinghe et al. (2015) found that cocopeat media is good to increase leaf number per tomato seedling. Higher vegetative growth induced in hydroponics greenhouse system due to more water contents and greater nutrient holding capacity (Wahome et al., 2011). Higher number of leaves was produced due to nutritional contribution of the media. Inden and Torres (2004) reported that utilization of rock wool blocks and perlite media in hydroponics greenhouse system for tomato production provide higher yields than other inert materials.

Conclusions and Recommendations

Results of the present study indicated that cocopeat media was successfully used for growth and

germination of tomato seedling. All growth related parameters were significantly ($P \leq 0.05$) different among the five tomato varieties evaluated. All tomato varieties perform good in cocopeat media, hence the Cherry and Berberana tomato varieties was found to be good in comparison to other tomato varieties with respect to germination percentage, root length, shoot length, stem diameter and number of leaves.

Author's Contribution

Mehwish Liaquat: Wrote paper, wrote the abstract, introduction, methodology, result and discussion, conclusion, and references. Arshad Mahmood Malik: Conceived the idea, decide paper title, technical input at every step, overall management of the article. Muhammad Ishaq: Support in research work. Hafiz Muhammad Qasim Ashraf: Data collection, stat analysis, arrange references. Ismara Naseem: Team member.

Conflict of interest

The authors have declared no conflict of interest.

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