Research Article

Impact of Different Media on Germination and Emergence of Tomato Genotypes

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Abstract | An experiment on the "Impact of different media on germination and emergence of tomato genotypes)" was conducted at National Agriculture Research Council (NARC) Islamabad, during June to August 2018. The experiment was laid out in Randomized Complete Block Design (RCBD) consisting of four planting medium treatments (compost, mixture, clay and sand) and six tomato genotypes (Nadir, Money Maker, Pakit, Nagina, Roma and Rio grande) with three replications. The results revealed that the combination of compost and mixture has significant effect on shoot height, number of leaves, stem and root length, however stem diameter was significantly affected by compost and non significantly affected by genotypes. As far as the genotypes performance is concerned, genotype money maker showed the best performance for all the agronomic characters providing maximum shoot height (34.07cm), lengthiest root (47.87 cm), maximum number of leaves (6.42) and the highest stem diameter (1.24 cm). Similarly, there was significant effect of compost on various parameters such as the tallest shoots (42.07 cm), maximum number of leaves (8), wider stem diameter (1.33 cm) and maximum root length (52.41 cm) were produced at the planting medium of compost. So tomato genotype, money maker applied with compost is recommended for better yield.

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Introduction

Tomato (*Solanum lycopersicum* L) is one of the most important summer vegetables with 99.5% self pollinated. It is monoecious plant. Tomato is a well known vegetable in the world. It belong to family Solanaceae and originated from the America continent. China is the largest producer of tomato in the world (Ghazanfar et al., 2019; Wang et al., 2018). It is used in kitchen for cooking purposes in various dishes. It is also eaten raw like salad. It is mixed with other vegetables or cooked as alone. Its products such as ketchup, paste and powder are used round the world particularly in fast food industry (Panthee and Chen, 2010). The demand of tomatoes is increasing day by day due to increasing populations. The supply and demand has a direct relation with tomato production (Fatemi et al., 2018).

After decades of genotype exhibiting rows citeria of each factor are known (Rodriguez et al., 1994) and target values are similar among exporters. Tomato, potato, chillies, onion are famous vegetables grown in Pakistan. Out of total tomato production in Pakistatn, Punjab is producing 15%, Sindh 24.5%, Balochistan 38.0% and KP 22.5%. Swat is the major producer in KP province and the tomato cultivated area is about 5090 hectares followed by FATA 2450 hectares and Charsadda 1276 hecatres (Aman and Rab, 2013; Lohano and Mari, 2005). The demand of tomato may overcome through kitchen gardening. Tomatoes can be grown in houses and on the roof top for domestic consumption. Tomatoes are also produced in off seasons in walk in tunnel, glass houses, green houses and lath houses for local and market consumption. Off season vegetables are available through out the year in the market for customer. The production cost on off season vegetables is relatively more but the price of off season produce is also high in the market (Fatemi et al., 2018). That is the reason that the profit of kharif season tomato is higher as compared to other seasons. Zaman (2006) examined data from trial which pointed out that each dollar invested on off-season tomato cultivation gave annual profit of 3.3 Dollars (Profit cost ratio). The demand for tomatoes in Pakistan is very less as compared to other vegetables (Lohano and Mari, 2005). Few decades ago, Pakistan was importing tomatoes from India due to lack of proper management and production technology while now a days famers have adopted new technology and producing tomatoes on large scale to fulfil the market demand. The production of tomatoes in Pakistan and other south Asian countries like India, Bangladesh provide earning opportunities to farmers and other labors. The farmers in Pakistan showed enthusiasm in producing 4.8 million tons vegetables in 2003-2004 (Meena and Bahadur, 2014).

Tomato is a rich source of important antioxidant enzymes, having high concentration of lycopene and iron (Rai et al., 2013) particularly vitamin A and C which are found abundantly in tomato. Vitamin A help in immune system and in circulation of blood while vitamin C helps to maintain body structure, bone structure and strengthen the teeth. Also helps in muscles contraction and relaxation. Tomato is summer flowering plant and its seeds are sown after proper treatment to break dormany (Aman and Rab, 2013). For breaking of dormancy seeds must be dried before sowing and to store for future production. When seeds are soaked in a solution for some time the germination percentage will be more and rapid as compared to those seeds which have been dried after priming just before sowing (Evans and Pill, 1989). For early germination seeds are soaked which is also known as seed priming. It promote early growth and germination. Seeds can be grown on different media like clay, mixture, compost, sand, wheat straw and vermicompost for quick and early germination (Aman and Rab, 2013).

Major genotypes grown in Pakistan and in many countries are dinar, sahel, money maker, rio grande, roma and roma bulk etc. The best temperature for tomato production is 20-27°C, however, fruit setting is poor if temperature crosses 30°C or go below 10°C (Aman et al., 2013). Tomatoes cultivation are widely practiced in sub-tropical areas where these plants meet high temperature at the time of sowing, emergence and fruit sets (Peet et al., 1998). Its production mainly starts from May to June in plain areas while in monsoon it starts from July to August. But the production in monsoon is not appreciable because pests/insects are active which cause disease and damage to plant and affect production. By counting the above points, the present research work was designed to study and screen out the suitable tomato genotypes for the climatic condition of Swabi and proper media for better production.

Materials and Methods

The experiment was conducted in June to August, 2018 with average monthly temperature of 33- 38°C, to find the impact of different media on germination and emergence of tomato genotypes. The experiment was laid out in RCBD with 3 replications and 4 different media i-e; compost, mixture (combination of compost,clay and sand at the equal ratio), clay and sand.

After proper field management by tillage, preparing bed, drainage system, leveling and other suitable cultural practices, the field was irrigated. All other agronomic practices were done as recommended by Horticulture Research Institute (HRI) at National Agricultural Research Council (NARC) Islamabad. Also applied Topsin M (fungicide) with water for the protection of pests. Topsin M was appllied on the very first day of the research at the concentration of 50 g (powder form) per 3 litres of water.

Genotypes

The following genotypes were included in the trial:

- Nadir
- Money Maker
- Pakit
- Nagina
- Roma
- Rio grande

Parameters

Data were recorded on the following parameters such as shoot height, number of leaves, stem diameter and root length.

Shoot height (cm)

For measuring of shoot height, shoot were cut from the plant with the help of scissor and from bottom to top shoots were measured using measuring tape. Shoots were measured from 5 randomly selected plants from each plot and average was calculated.

Number of leaves

Leaves were counted in the whole plant i.e., from bottom to the top portion of the plant and average was calculated.

Stem diameter (cm)

Plants were selected randomly in each plot and stem diameter were recorded with the help of digital vernier caliper and means were estimated.

Root length (cm)

Plants were randomly selected and all the roots were detached through scissor and then the data recorded through digital vernier caliper and average was calculated.

All the data were recorded and analysis was carried out using statistix software and means were compared using LSD test.

Results and Discussion

Data were collected for different parameters from six tomato genotypes against four medium and analyzed usng statistix as explained below. Parameters studied were included shoot height, root length, stem diameter and number of leaves.

Shoot height (cm)

The effect of different media and genotypes was significant (P≤0.05) on shoot height (Table 1). Maximum shoot height (40.63 cm) was observed in tomatoes grown on compost followed by mixture (36.06 cm) and clay (28.44 cm) while minimum shoot height was recorded in sand (21.08 cm). Similarly, among 6 genotypes, money maker produced tallest shoot (34.06 cm) followed by Nadir (33.09 cm). The best performance was shown at compost; it might be due the high nutrients contents in compost as compared to sand where low nutrients are expected. The results of this study are in line with the findings of Doncean et al. (2013) who reported that shoot length of tomato seedlings showed high growth after the application of compost extracts. Similar trend was also found in tomato cultivars using humic fertilizer during the study by Aman and Rab (2013). The genetic make up of each plant is unique, thus performance of each genotype was found differetly as shown in Table 1 (Zamin and Khattak, 2018).

Number of leaves

Maximum number of leaves (7.33) were noted in tomato genotypes treated with compost followed by mixture and clay producing 6.33 and 5.66 leaves respectively (Table 2). Furthermore, minimum number of leaves were recorded in sand (4.77). As far as the performance of tomato genotypes is concerned, the highest number of leaves (6.41) were produced by money maker followed by Nadir (6.25) while minimum leaves were recorded in Nagina bulk (5.58). The obtained results show that compost is rich in nutrients as compared to other media while sand has less nutrients. Thus higher number of leaves were produced in compost media. Number of leaves behaved like shoot height. The results are also supported by Doncean et al. (2013).

Stem diameter (cm)

Date pertaining to stem diameter show that it was significantly (P≤0.05) affected by planting media (Table 3). Maximum stem diameter (1.31 cm) was observed in compost followed by 1.26 cm in mixture and clay (1.19 cm) while minimum stem diameter was recorded in sand (1.11 cm). Similary, maximum stem diameter (1.24 cm) was found in money maker which was at par with other genotypes Nadir (1.23 cm), Pakit sps (1.23), Rio grande (1.22 cm), Roma bulk (1.2 cm) and Nagina bulk (1.19 cm). From the above result it is clear that compost showed best result as compared to sand and other media. All the other characters also showed better performance on compost media.

Table 1: *Effect of different media on shoot height (cm) of various tomato genotypes.*

Media	Genotypes						Mean
	Money maker	Nadir	Pakitsps	Rio grande	Roma bulk	Nagina bulk	
Compost	42.073 a*	41.963 a	41.190a	40.12 b	39.56 bc	38.93 cd	40.639a
Mixture	38.060 de	37.153 ef	36.497 fg	35.77 gh	34.98 h	33.93 i	36.063b
Clay	32.78 j	30.893 k	29.187 l	27.06m	26.00n	24.78o	28.449c
Sand	23.35 p	22.387 pq	21.913 q	20.57r	19.93r	18.36 s	21.084d
Mean	34.064 a	33.099 b	32.197 c	30.880 d	30.12 e	28.997f	

**Means followed by same letter are statistically non significant at 5% level of probability.*

Table 2: *Effect of different media on number of leaves of various tomato genotypes.*

Media	Genotypes						Mean
	Money maker	Nadir	Pakit sps	Rio grande	Roma bulk	Nagina bulk	
Compost	7.66 a*	7.66 a	7.33 ab	7.33 ab	7.33 ab	6.66abc	7.33 a
Mixture	6.66 abc	6.33 bcd	6.33 bcd	6.33 bcd	6.33 bcd	6.00 cde	6.33 b
Clay	6.00 cde	6.00 cde	5.66 cdef	5.66 cdef	5.33 defg	5.33 defg	5.66 c
Sand	5.33 defg	5.00 efg	4.66 fg	4.66 fg	4.66 fg	4.33 g	4.77 d
Mean	6.416 a	6.25 a	6.00 ab	6.00 ab	5.91 ab	5.58 b	

**Means followed by same letter are statistically non significant at 5% level of probability.*

Table 3: *Effect of of different media on root length (cm) of various tomato genotypes.*

Soil type	Genotypes						Mean
	Money maker	Nadir	Pakit sps	Rio grande	Roma bulk	Nagina bulk	
Compost	52.41a*	51.57 ab	51.51 abc	51.40 abc	51.40 abc	50.30 abcd	51.36 a
Mixture	50.24 abcd	49.86 bcde	49.47 bcde	49.19 cde	48.48 def	47.58 efg	49.14 b
Clay	46.47 fgh	46.40 fgh	45.64 ghi	44.37 hij	43.71 ij	43.47 ijk	45.01 c
Sand	42.39 jkl	41.38 kl	40.54 l	40.25 l	36.18 m	36.07 m	39.47 d
Mean	47.87 a	47.29 ab	46.80 ab	46.30 b	44.84 c	44.35 c	

**Means followed by same letter are statistically non significant at 5% level of probability.*

Table 4: *Effect of different media on stem diameter (cm) of various tomato genotypes.*

Soil type	Genotypes						Mean
	Money maker	Nadir	Pakit sps	Rio grande	Roma bulk	Nagina bulk	
Compost	1.33 a*	1.32 a	1.31 ab	1.30 ab	1.30 abc	1.29 abc	1.31 a
Mixture	1.28 abc	1.27 abc	1.26 abc	1.26 abc	1.24 abc	1.24 abc	1.26 ab
Clay	1.22 abc	1.20 abc	1.20 abc	1.19 abc	1.17 abc	1.16 abc	1.19 ab
Sand	1.15 abc	1.13 abc	1.13 abc	1.11 abc	1.09 bc	1.07 c	1.11 b
Mean	1.24 a	1.23 a	1.22 a	1.22 a	1.20 a	1.19 a	

**Means followed by same letter are statistically non significant at 5% level of probability.*

Our results are very similar with the previous findings of Kanai et al. (2008), where they observed that stem diameter in the control exhibited day time shrinkage and night-time expansion and increased temporally up to 19 days after treatment.

Root length (cm)

According to data given in Table 4, the root length was significantly affected by compost and genotypes (P≤0.05). The interaction was also significant. Maximum root length (51.36 cm) was observed in compost followed by mixture (49.14 cm) and clay (45.01 cm) while minimum root length was observed in sand (39.47 cm). In case of genotypes, money maker was on top having root length 47.87 cm which was at par with Nadir and Pakit sps giving 47.29 cm

and 46.80 cm root lengths respectively. Different response of various genotypes might be due to the genetic make up of each genotype (Bibi et al., 2012). Similarly, the compost showed best result, which might be due to the high nutrients in compost and better soil structure due to compost.

Conclusions and Recommendations

On the basis of results it is concluded that application of compost has improved various parameters of tomato such as shoot height, number of leaves, root length and stem diameter. The genotype money maker performed well as far as shoot height, number of leaves, root length and stem diameter is concerned. In light of above, it is concluded that the compost can improve the plant growth of different tomato genotypes as compared to other media. Money maker proved to be the best among all the 6 genotype of tomatoes. Thus compost is recommended as meida and money maker as genotype for better growth and high production of tomato.

Novelty Statement

Plants genetic make-up and planting medium play key role in production of any crop particularly vegetables which are cash crop and can boost farmers economy if proper genotypes and specific planting medium is used which is explored in this experiment.

Author's Contribution

YA conducted the research and collected the data. MZ contributed in data processing and interpretation of results and organized over all manuscript development. IJ contributed in data analysis. SS contributed in review of literature. MMH helped in experiment designing as co-supervisor. FR and MA contributed in analysis and discussion of results.

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