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Effects of Different Seed Extraction Methods on Seed Quality Parameters in Tomato var pkm.1

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A B S T R A C T

Tomato (*Solanum Lycopersicum* L.) belong to family solanaceae is one of the largest vegetable crop. A Field experiment was conducted at Mother Teresa College of Agriculture to study the effects of different seed extraction methods on seed quality parameters in Tomato. The extraction methods was taken to make different treatments (i.e,) T_1-Manual Extraction, T_2-HCl@10ml for 15mins, T_3-HCl@10ml for 30mins, T_4-Fermentation for 24hrs (1day), T_5-Fermentation for 48hrs (2days), T_6-Sodium carbonate 10% for 24hrs and T_7-Sodium carbonate 10% for 48hrs. The result revealed that the significantly increased the Germination (%), Shoot length (cm), Root length (cm), Dry matter Production, Vigour Index-I and Vigour Index-II.

Introduction

Tomato (*Solanum lycopersicum*) (2n = 2x = 24) is a self pollinated crop and belonging to family Solanaceae. This crop is originated in south and central America. It is the world's 3rd largest vegetable crop after potato and onion. China is leading in the world tomato production followed by India and the united states and in 2018, the global production of tomato was 182 millions tonnes, china-61.5 millions of tonnes and India 19.4 millions of tonnes. Under the horticulture crops, production of fruits is estimated to be around 97.38 million tonnes in 2018-19. Tomato is 95% water, contains 4% carbohydrates and less than 1% each of fat and protein. Tomatoes are the major dietary source of the antioxidant lycopene, which has been linked to many health benefits better to restrict the harvest upto seventh picking in the seed crop of tomato to extract maximum quantity of quality seeds. The seed vigour and viability is depends on the method on which, including reduced risk of heart disease and cancer. They are also a great source of vitamin C, potassium, foliate, and vitamin K.

Tomato seed is used as propagation source. The fruits from in between 6-7 harvested at the "dead-ripe" stage should be used for seed extraction. The number of harvests may go upto ten depending n the duration of the crop. Hence it is be the seeds were

extracted and hence, it is more important to choose proper methods of seed extraction. Before seed extraction, the fruits are to be graded for true to type and selection of medium to large size fruits for getting higher recovery of quality seeds. The seed quality of tomato is affected by factors such as seed extraction methods, duration and fermentation temperature for seed extraction and fruit maturity (Kailappan and Karunanithy, 2006).

In tomato the seed extraction is basically done by three methods namely fermentation, Acid extraction & Alkali extraction. Fermentation method it is a natural process that is least harmful to the seed, low seed recovery %, dull seed colour and can destroy bacterial canker and other seed-borne diseases. Fermentation should be a controlled process. Though not difficult to do, it can be done incorrectly, in which case the ferment produces a bad smell and an overgrowth of white fungus which can produce heat and mechanical damage of seed.

The process basically consists of breaking or mashing up the fruit into pulp, seeds, and juice, and then pouring the mixture into a large container where it ferments for a period lasting usually three days. After fermentation is complete the seed is separated by washing, and then the seed is dried.

The acid method of seed extraction is the best method for tomato seed extraction. In this method, the fruits are to be crushed into pulp and taken in a plastic containers (or) cement tank. And then add 30 ml of commercial Hydrochloric acid per kg of pulp, stir well and allow it for ½ hour. In between this duration the pulp may be stirred well for one or two times. This facilitates the separation of seed and pulp. After ½ hour, the seeds will settle down at the bottom and then the floating fraction is to be removed. The collected seeds should be washed with water for three or four times.

In alkali method, the extracted material with pulp is treated with Na_2CO_3 at required concentration for a particular period and later on washing the seed with water. Seeds are washed thoroughly with clean water and allowed to dry in the sun. Once the seed has been washed and made ready for drying, it should be dried as quickly as possible without heat. Drying should take place at a temperature of less than 90^{o}F (32^{o}C). Once the temperature reaches 95^{o}F (35^{o}C) damage to the seed can occur. For this reason, seed should not be dried in the sun when the air temperature is much over 80°F (32°C).

To address all those problems of seed extraction methods, the present study is proposed to evaluate the effects of different seed extraction methods on seed quality parameters in Tomato and further to standardize the seed extraction methods in tomato.

Materials and Methods

Different seed extraction treatments was carried under laboratory conditions in a CRD design with 3 replication. The Laboratory experiment was conducted at Department of Seed Science and Technology, Mother Teresa college of Agriculture, Pudukkottai.

Treatments Details

T_1-Manual Extraction

T_2-HCl@10ml for 15 mins

T_3-HCl@10ml for 30mins

T_4-Fermentation for 24 hrs (1day)

T_5-Fermentation for 48 hrs (2days)

T_6-Sodium carbonate 10% for 24hrs

T_7-Sodium carbonate 10% for 48hrs

Different Methods of Extraction

Manual Method

First take the well riped uniform size tomatoes. Then remove the skin on top of it. The inside fleshy part

should be crushed and squeezed by hands, to remove tomato pulp. Gently press the all seeds with gelatinous material. Then Sieve the seeds and wash to be clean water.

Fermentation Extraction Method

The crushed fruits, which consist of pulp along with seed are mixed with excess of water and kept in a container for 20-24 hours. The pulp should be stirred 3-4 times for achieving uniformity in fermentation process.

Fermentation process will enable the seeds to settle down while the decayed pulp and immature seed tend to float. The floating materials can be decanted to separate the settled seeds. Separated seeds should be repeatedly washed with water.

The wet seeds have to be shade dried initially followed by sun drying for 2-3 hours, until the seeds attain eight percent moisture content.

Acid Extraction Method

The fruits are squeezed and hydrochloric acid (HCl) is added to the pulp @ 20ml/kg of pulp. This is kept as such for 15-20 minutes with 3-4 frequent stirring.

After 15 minutes, the floating fraction is removed and that have settled down are washed with adequate water for 3-4 times. The seeds are then shade dried followed by sun drying. Care should be taken to avoid clogging of seeds while drying.

Alkali Extraction Method

In one liter of water one g of 10% sodium bicarbonate is to be added. In one liter of water. The cool alkali mixture is added to one kg of pulp.

Allow it to stand overnight in an earthen pot. Next day, all the seeds will settle down at the bottom of the container, therefore the supernatant liquid can be decanted. Seeds are washed thoroughly with clean water and allow to dry.

Seed Quality Parameters

Germination

The laboratory germination test was conducted as per ISTA (2007) procedure by adopting "Top of the paper method". Freshly harvested 100 seeds in three replications were taken at random from the seed lot of each treatment and placed uniformly on germination paper.

Petri plate was kept in germinator, where the temperature was maintained at 25 ± 0.5ºC and the relative humidity at 95 ± 1 percent. The final counts were taken on 14^{th} day of germination test for normal seedlings and expressed in percentage.

Seedling length (cm)

Ten normal seedlings were selected at random from the germination test. On the day of final count day the length between the collar region and the tip of the primary shoot was measured as shoot length (cm).

While length between the collar region and the tip of primary root was measured as root length (cm). The seedling length will be computed by using the following formula,

Seedling length (cm) = Shoot length (cm) + Root length (cm)

Shoot length (cm)

Ten normal seedlings were selected at random from each replication and the distance between the collar regions to tip of the primary leaf was measured and the mean expressed in centimeter.

Root length (cm)

Ten normal seedlings were selected at random from each replication and the length of the root was measured from the collar region to the tip of primary root and the mean expressed in centimeter

Seedling dry matter production (g/10 seedlings^{-1})

After measuring the root and shoot length, the ten normal seedlings in each replication was shade dried for 24 h and then in hot air oven maintained at 85 ± 1°C
for 48 h. Then, they were cooled for 30 min in a desiccator which contained calcium chloride and then weighed in an electronic balance. The mean weight was expressed as dry matter production 10 seedlings in gram.

Vigour index

The vigour indices were calculated using the procedure suggested by Abdul-Baki and expressed in whole number.

Vigour index-I = Germination (%) X Seedling length (cm)

Vigour index-II = Germination (%) X Seedling dry weight (g)

Statistical analysis

The observations recorded were statistically analyzed using AGRESS software. The results of different experiments were subjected to an analysis of variance and treatment differences tested for significance (P =0.05) as per Gomez and Gomez (1984).

Results and Discussion

Seed extraction is the process of separation or removing out of seeds from the fruits. Seed separation from fruit is a specialized job. A slight negligence while extracting the seed can considerably damage its viability and vigour besides physical appearance. The in situ germination can also occur due to improper extraction technique.

Tomato seed extraction involves a treatment to remove the gelatinous coating around the seeds. Processing of tomato seeds that includes several steps is accomplished by pulping by machine or hand followed by removal of the gel surrounding the seeds by fermentation, chemicals or by mechanical means.

Seed extraction procedure is showed significantly highest germination per cent in T_3 HCl @ 10ml for 30 minutes (92 %). However, significantly the lowest germination was recordedandT1 (manual extraction) (80%) which differed with others, T_2 HCL@10ml for 15mins (80%), T6 (10 % sodium carbonate for 24 hrs) (90%), T_5 (Fermentation for 48 hours) (85%), T_4 fermentation for 24 hrs (87%), T_7 sodium carbonate for 48 hrs (87 %).

Among the Seed extraction methods T_3 HCL @ 10ml for 30mins recorded maximum (14.06) highest speed of germination, but seed vigour decreased with fermentation longer than 5 days. Reyes *et al.*, 2007 revealed that fermentation seed extraction in a period from 1 to 7 days at room temperature produced seeds with 94.9% of germination and higher; however, fermentation from 5 to 7 days affected negatively the vigor. The use of bicarbonate of sodium in solutions of 5 to 15% and soaking period of 8 to 24 hours, produced seeds with 94.9% of germination and higher, without effect on vigor.

Seedling dry matter was ($p<0.01$) influenced by seed extraction method. The highest dry matter production is (20.37mg) was observed from T_3 HCL@10ml for 30 mins, followed T_2 HCL@10ml for 15mins (20.01mg). The lowest dry matter production T_1- Manual extraction (19.12mg) and (19.53mg) was recorded by T_4 fermentation for 24 hrs, (19.36mg) was recorded by T_5 Fermentation for 48 hrs, while T_6 sodium carbonate 10% for 24 hrs (20.28mg), T_7 Sodium carbonate 10% for 48 hrs (19.87mg) there are recorded. Among different Treatments, T_3 shows significantly higher dry matter (20.37mg) was recorded and the lowest is T_1(19.12 mg) was recorded. Maximum dry matter was observed in seed extracted by T_3 HCL @ 10ml for 30 mins.

Table.1 Effects of different seed extraction methods on seed quality parameters in Tomato

Treatments	Speed of germination	Germination (%)	Shoot length (cm)	Root length (cm)	Dry matter production (mg)	Vigour index-I	Vigour index-II
T_1-Manual extraction	10.83	80	4.1	4.0	19.12	648	1529
T_2-HCl@10ml for 15mins	13.23	89	5.0	4.8	20.01	872	1780
T_3-HCl@10ml for 30mins	14.06	92	5.5	5.1	20.37	975	1874
T_4-Fermentation for 24hrs (1day)	12.89	87	4.5	4.6	19.53	791	1699
T_5-Fermentation for 48hrs (2days)	11.87	85	4.3	4.2	19.36	722	1645
T_6-Sodium carbonate 10% for 24hrs	14.03	90	5.3	5.0	20.28	927	1825
T_7-Sodium carbonate 10% for 48hrs	13.08	87	4.9	4.8	19.87	843	1728
SED	0.230**	2.225**	0.121**	0.094**	9.339**	47.413**	0.381**
CD (0.5)	0.493	4.773	0.260	0.203	20.118	101.702	0.818

Shoot Length among all extraction methods, significantly (P< 0.01) maximum seedling length (5.5 cm) was recorded at T_3 HCl@10ml for 30 minutes followed by T_2 HCl @10ml for 15 minutes (5.0 cm).

The minimum seedling length (10.77cm) T_1 Manual extraction and (4.5cm) recorded at T_4 Fermentation for 24 hours,(4.3) T_5 Fermentation for 48 hours(1 day) and mean while (sodium carbonate 10% for 24 hours (5.3cm), T_7 Sodium carbonate 10% for 48 hrs (4.3 cm). Among the Different Treatments, T_3 shows significantly higher shoot length (5.5 cm) was recorded and the lowest shoot length T_1 (4.5cm).

In Root length Among all extraction methods, significantly (P< 0.01) maximum seedling length (5.1 cm) was recorded at T_3 HCl @ 10ml for 30 minutes followed by T_2 HCl @ 10ml for 15 minutes (4.8cm). The minimum root length (4.0cm) T_1 manual extraction and (4.6cm) recorded at T_4 fermentation for 24hours and T_5 fermentation for 48 hrs (4.2cm) and while T6 sodium carbonate 10% for 24 hrs (5.0 cm), T_7 sodium carbonate 10% for 48 hrs (2 days) (4.8cm).Significantly the highest vigour index1 noticed in T_3 HCL @ 10ml for 30 minutes (975), followed by T_2 HCL @ 10ml for 15 minutes (872), The lowest vigour index 2 noticed in T_1 manual extraction(648). Significantly the highest vigour index I noticed in T3 HCL @ 10ml for 30 minutes (1874),The lowest vigour index-II was noticed by T_1 manual extraction (1529). (Table 1)

Therefore mentioned results showed that most important seed physiological quality and seedling characteristic parameters such as speed of germination, germination percent, shoot length, Root length, seed dry weight, vigour index I and vigour index II were significantly higher at extraction method of T_3 HCl @ 10ml for 30 minutes. Furthermore, the lowest extraction method of T_1 manual extraction Thus, it can be concluded

that maximum physiological seed quality of tomato can be obtained from a seed extraction method of dipping within T_3 HCl @ 10 ml concentration for 30 minutes.

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