

Genetic diversity assessment of tomato (*Solanum lycopersicum* L.) germplasm based on agro-morphological traits

Abstract

Tomato germplasm is a rich wellspring of Genetic differences. Examination work began from the month of March in NARC, Islamabad Pakistan. It's no longer continuing nearly Sixteen weeks here. Being a Plant Breeding and hereditary qualities understudy my principle center was on rearing and advancement of different assortments inside of the genotype. Right from the begin I was appointed to take a shot at Agro-Morphological Traits of Tomato. Every one of the examination with respect to Agro-Morphological Traits was completed to concentrate on the conduct Tomato's distinctive genotypes. Distinctive sorts of test were did to perform my examination work in innovative research centers of PMAS-AAUR. Every one of these regions of my examination venture was profoundly fascinating. To sum things up, I got a fortune of commonsense information by doing this examination. The goal of the present study was to describe tomato germplasm through morphological attributes. This study will be useful for varietal improvement, half breed seed creation and distinguishing proof of attractive genotypes from germplasm.

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Introduction

Tomato is a standout amongst the most well-known vegetable developed in the globe. Tomatoes have a place with the plant family Solanaceae, termed as nightshade gang. The tomato (*Lycopersicon esculentum* Mill.) is local to the Andes district of South America.¹ Tomato is one of the real vegetables with 4.4million ha zone under development and 115million tons creation all inclusive.² Tomato possesses a famous position in vegetable harvests in Pakistan and is developed on a zone of 53.1 thousand hac with an expected generation of 536.2 tons for each annum and normal yield of 10.1tons for every hectare.³ Notwithstanding spring and summer season products, off-season or fall yield of tomato is additionally developed in ice free regions of Pakistan including Dargai, butkhela, Malakand Agency (KPK), Badin (Sindh) and Kattaha Sugral Khusab (Punjab). Regardless of development in zone, the normal yield of tomato is low in Pakistan when contrasted with 27.43tons for every hectare in real tomato creating nations of the world.³

In an experiment leaf shape parameters [leaf area (LA), length (L), width (W), shape factor (SF)] were determined by an image analysis system. During samplings, leaf area index (LAI) was measured non-destructively. Significant year and sampling effects were found for all traits determined. With the progress of the growing season, leaves became smaller (LA, W, and AR were decreased) and rounded. Tomato domestication dramatically increased fruit yield, and changes mainly occurred in fruit morphology or plant development. The most obvious evolution has been the massive increase in fruit size.^{4,5}

Tomato fruit provides especially favorable material for size study, since there are enormous differences between the small one gram fruits of "Red Currant" (*Lycopersicon pimpinellifolium*) and the comparatively gigantic 100-400 gram fruits of some commercial varieties of *L.esculentum*.⁶ Most cultivars produced an average of about four traits per cluster. The small-fruited cultivars of 'Campari' and 'Aranca' had cluster of 5.3 and 6.4 fruits per cluster, respectively.⁷

Similarly difference in internodal lengths in different lines (genotypes) as they show 4.03 cm that is higher internodal length and 4.47, 3.69 and 2.29 produced an average of about four fruits per cluster. Similarly differences in internodal lengths in different lines reported that total number of clusters produced per plant was highest for 'Aranca' at 33.4 clusters.⁶

Tomato is fleeting enduring utilized as yearly. Development propensities for tomato plants are both determinate and uncertain. Vague genotypes forms into vines that are never finish off and keeps on creating organic product until executed by ice and deliver inflorescence after each three leaves, while determinate genotypes creates a predetermined number of inflorescence on every hub and axillary buds are creates on the base of the stem creating a shaggy appearance. Determinate, or hedge sort bear an organic product at the same time and finish off at a particular stature, every shoot on the determinate plant closes in a group, and thus a natural product cluster⁸ this kind of tomato is favored by business producers who wish to gather an entire field immediately, or scraper cultivators keen on canning. Vague sorts are favored by home cultivators and nearby market ranchers who need ready organic product all through the season.⁹

The tomato organic product is named berry. The organic product size shifts from little cherry sort with just two divisions of the ovary (locules) to extensive multi-locular beefsteak sort. In spite of the fact that varieties in shading, flavor, size and state of tomatoes exist in the present assortments, no single assortment can fulfill the inclinations for these characters of distinctive target bunches. In this way, quality parameters must be set for investigating so as to reproduce new market tomatoes the inclinations of diverse shopper bunches.¹⁰ Shoppers measure the nature of tomato organic product fundamentally by three variables: physical appearance (size, shading, shape, deserts and rot), immovability and flavor. A study was directed to think about the customer inclination of tomato for distinctive quality parameters, for example, shading, shape, size and taste. In tomato reproducing,

significant endeavors have been set on yield, organic product size, natural product appearance (absence of imperfections and appealing shading), infection safe and all the more as of late organic product immovability and time span of usability.¹¹

Tomato assortments can be ordered by their utilization. For example, plum tomatoes are utilized for canning and have thick fragile living creature and lessened measure of mash. Beefsteak tomatoes are substantial furthermore have decreased mash, which makes them astounding for sandwiches and sauces. Fantastic or serving of mixed greens tomatoes are succulent, since they have a great deal of mash, yet this tends to fall session when they are cut. Most applicable characteristics of tomatoes fluctuate contingent upon their planned use: taste, appearance, shading and taking care of trademark are essential for new tomatoes, while consistency and solids are the most vital traits for preparing tomatoes.¹² Alwis et al.^{13,14} reported that for curries, 47% customers favored red-shaded natural products, while by 39% favored red organic products for sandwiches; dull red-hued natural products were favored by 49% shoppers for servings of mixed greens and 32% for sandwiches separately; 41% favored natural products with medium pericarp thickness while 38% favored meager pericarps. The objective of the present study was to characterize tomato germplasm through morphological traits. This study will be helpful for varietal development, hybrid seed production and identification of desirable genotypes from germplasm.

Materials and methods

In order to study and evaluate the tomato germplasm, 25 genotypes were grown in glass house in multipots tray at PMAS-AAUR in March 2013. Seed of tomato genotypes was obtained from the gene bank at PGRI, NARC, Islamabad. Three plants of each genotype were grown. After 45 days plants are transplanted in well prepared field.

Data recorded

Data regarding plant inflorescence, flowers and fruit was recorded through visual observation. The parameters for data recording are described below.

Plant characteristics

Plant characteristics for data recording included growth habit, stem pubescence, foliage density, No of leaves below first inflorescence (Table 1).

Inflorescence traits

Inflorescence related traits for data recording included type of inflorescence, no: of inflorescence on main stem, Number of flowers per inflorescence, fruit set per inflorescence, corolla colour, corolla blossom type, petal length, sepal length, stamen length, style position and style hairiness (Table 2A), (Table 2B).

Table 1 Plant characteristics of tomato

Accession	Plant growth type	Stem pubescence	Foliage Density
LA-2662	Determinate	Present	Intermediate
LA-2357	Indeterminate	Present	Low
LA-0146	Indeterminate	Present	Low
LA-0172	Indeterminate	Present	Intermediate
LA-2285	Indeterminate	Present	Intermediate
LA-0147	Indeterminate	Present	Low
LA-2711	Semi determinate	Present	Intermediate
LA-2086	Semi determinate	Present	Low
LA-4026	Determinate	Present	High
LA-4025	Determinate	Present	Low
LA-4133	Indeterminate	Present	Intermediate
LA-3207	Indeterminate	Present	High
LA-3120	Determinate	Present	Intermediate
LA-0358	Indeterminate	Present	Intermediate
LA-2973	Indeterminate	Present	Low
6234	Indeterminate	Present	Intermediate
10578	Indeterminate	Present	Intermediate
17860	Indeterminate	Present	High
17862	Determinate	Present	Intermediate
17863	Indeterminate	Present	Intermediate
17865	Indeterminate	Present	High
17867	Semi determinate	Present	Intermediate
17869	Determinate	Present	Intermediate
17878	Indeterminate	Present	Intermediate
17889	Semi determinate	Present	Intermediate

Table 2(A) Inflorescence traits of tomato

Accession	sepal length mm	Stamen length mm	Style position	Style hairiness	Number of inflorescence on main stem
LA-2662	7	9	Inserted	Present	6
LA-2357	7	8	same as stamen	Present	12
LA-0146	6	6	same as stamen	Present	9
LA-0172	5	6	Inserted	Present	9
LA-2285	7	5	Exerted	Present	10
LA-0147	7	7	Inserted	Present	11
LA-2711	7	7	Inserted	Present	9
LA-2086	10	10	Inserted	Present	9
LA-4026	5	6	same as stamen	Present	6
LA-4025	6	6	same as stamen	Present	7
LA-4133	3	5	Inserted	Present	8
LA-3207	8	7	same as stamen	Present	10
LA-3120	4	8	same as stamen	Present	8
LA-0358	5	6	Exerted	Present	14
LA-2973	5	6	Inserted	Present	8
6234	6	6	Exerted	Present	13
10578	8	7	Exerted	Present	9
17860	8	5	Exerted	Present	9
17862	16	7	Inserted	Present	7
17863	8	7	same as stamen	Present	9
17865	11	8	same as stamen	Present	5
17867	8	8	same as stamen	Present	8
17869	8	7	same as stamen	Present	7
17878	6	6	Inserted	Present	10
17889	6	8	same as stamen	Present	9

Table 2(B) Inflorescence traits of tomato

Accession	Number of flowers per inflorescence	Fruit set per inflorescence	Type of inflorescence	Corolla color	Corolla blossom type	Petal length mm
LA-2662	5	High	Uniparous	Yellow	Closed	8
LA-2357	7	High	Uniparous	Yellow	Opened	9
LA-0146	8	Low	Multiparous	Yellow	Opened	6
LA-0172	7	Intermediate	Uniparous	Yellow	Opened	7
LA-2285	6	Low	Multiparous	Yellow	Opened	8
LA-0147	13	Low	Multiparous	Yellow	Opened	8
LA-2711	6	Low	Multiparous	Yellow	Opened	7
LA-2086	6	Low	Uniparous	Yellow	Closed	14
LA-4026	7	Intermediate	Uniparous	Yellow	Opened	6
LA-4025	8	High	Multiparous	Yellow	Opened	10
LA-4133	11	Low	Uniparous	Yellow	Opened	8
LA-3207	12	Low	Uniparous	Yellow	Opened	9
LA-3120	16	Intermediate	Multiparous	Yellow	Opened	14
LA-0358	11	Intermediate	Multiparous	Yellow	Opened	7
LA-2973	9	Intermediate	Multiparous	Yellow	Opened	9
6234	8	Intermediate	Uniparous	Yellow	Opened	7
10578	8	Intermediate	Multiparous	Yellow	Opened	6
17860	7	Low	Multiparous	Yellow	Opened	8
17862	8	Intermediate	Uniparous	Yellow	Opened	13
17863	8	Intermediate	Uniparous	Yellow	Opened	9
17865	15	Low	Uniparous	Yellow	Opened	10
17867	6	Intermediate	Uniparous	Yellow	Opened	11
17869	5	Intermediate	Uniparous	Yellow	Opened	13
17878	8	High	Uniparous	Yellow	Opened	10
17889	11	Intermediate	Uniparous	Yellow	Opened	9

Data analysis

Microsoft office Excel 2010 was used for data analysis. Means of quantitative data and maximum and minimum values were determined. Graphs were obtained for analysis of qualitative characters.

Result and discussion

Growth habit

Plants with determinate, semi-determinate and indeterminate growth type were observed. Out of 25 accessions, LA-2662, LA-4026, LA-4025, LA-3120, 17862 and 17869 were determinate type, LA-2086, LA-2711, 17867 and 17889 were semi-determinate and remaining 15 were indeterminate type.

Stem pubescence

Stem pubescence was present in all accessions.

Foliage density

High foliage density was observed in LA-4026, LA-3207, 17860 and 17865 while LA-2357, LA-0146, LA-0147, LA-2086, LA-4025 and LA-2973 were the genotypes with low foliage density and rest of genotypes have intermediate foliage density.

Style position

LA-2662, LA-0172, LA-0147, LA-2711, LA-2086, LA-4133, LA-2973, 17862 and 17878 have inserted style position, 17860, 10578, 6234, LA-2285 and LA-0358 have exerted style position while remaining have same style position as stamen.

Style hairiness

Style hairiness was present in all genotypes.

Number of inflorescence on main stem

Maximum 14 inflorescence on main stem were recorded in LA-0358 and minimum 5 inflorescence in 17865 were observed.

Sepal length

Maximum sepal length of 16 mm was observed in 17860 and minimum 4 mm in LA-3120.

Stamen length

LA-2086 had maximum stamen length of 10 mm while minimum 5mm stamen length was observed in LA-2285, LA-4133 and 17860.

Petal length

14 mm was the maximum petal length observed in LA-2086 and LA-3120 while minimum 6 mm was observed in LA-0146, LA-4133 and 10578.

Type of inflorescence

LA-0146, LA-2285, LA-0147, LA-2711, LA-4025, LA-3120, LA-0358, LA-2973, 10578 and 17860 have multiparous inflorescence while rest of genotypes have uniparous type inflorescence.

Corolla blossom type

LA-2662 and LA-2086 were found to have closed corolla blossom

end and others have opened corolla blossom end.

Corolla colour

All genotypes were found to have yellow corolla colour.

Number of flowers per inflorescence

LA-3120 was found to have maximum 16 flowers per inflorescence, 17865 had 15 and lowest 5 flowers per inflorescence were noted in LA-2662 and 17869.

Fruit set per inflorescence

LA-2662, LA-2357, LA-4025 and 17878 have high fruit set per inflorescence, 17865, 17860, LA-3207, LA-4133, LA-2086, LA-2711, LA-0147, LA-2285, and LA-0146 have low fruit set per inflorescence while remaining genotypes have intermediate fruit set per inflorescence.

Conclusion & recommendations

The hybrid development in Pakistan is of hour need to assure food security in developing countries like Pakistan. Vegetable crop research program, HRI, NARC, Islamabad started its breeding program with special emphasis of hybrid development in tomato, chili, bitter gourd and cucumber. After a comprehensive breeding efforts made on the development and evaluation of inbred line/parental lines based on their specific and general combining ability, this program developed no. of hybrids (F1) in the targeted crops mentioned above. In case of tomato special attention was given on field hybrids (determinate), keeping in view the trend of tomato crop cultivation in all over the country under field conditions. In this case almost 16 hybrids (F1) were developed using elite parental lines. These hybrids after passing through observational trials at the vegetable research program were subjected to the preliminary yield trials for their performance in comparison with three international field hybrids (F1) and their parent material. The results of newly developed tomato hybrids (F1) were quite encouraging pertaining to their yield (kg ha⁻¹) and earliness in maturity over the international checks and the parents. It was cleared from the statistical analysis that hybrid yield have the potential to exceed 100% than the commercial cultivars. So, it is concluded that the research work on hybrid development especially in determinate tomatoes is the need of the day to enhance the yield to a great extent at the farmer's field. Moreover, it is pertinent to mention here that the huge foreign exchange being spent on the import of hybrid seed can be minimized through local hybrid seed production. Likewise tomato, the other vegetables of commercial importance in the country also need such research work for the yield enhancement and also to minimize the cost incurred on the import of hybrid seed every year in these vegetables. This can also bring home huge amount of foreign exchange in country as such types of hybrid tomatoes are having excellent market place in Middle East.

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Conflict of interest

The author declares no conflict of interest.

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