Journal of Horticulture
ISSN: 2376-0354

Marasini and Paudel, J Hortic 2017, 4:3
DOI: 10.4172/2376-0354.1000204

Research Article Open Access

Phenotypic Characterization of Tomato (*Lycospersicon esculentum*)

Marasini P and Paudel S*

Institute of Agriculture and Animal Science, Sundarbazar, Lamjung, Nepal

Abstract

Tomato is one of the most important fruit vegetable commonly grown in world. Most of the people grow the tomato however they do not know about phenotypic characters of different landraces. Phenotypic characterization of these landraces will be helpful to the farmers to choice better landrace for particular area and practice scientific methods of its cultivation. This experiment was conducted in the field of Institute of Agriculture and Animal Science, Lamjung Campus, Nepal under Randomized Complete Block Design having eight treatments with three replication. The main objective of this study is to characterize the phenotypic appearance of eight varieties which includes Srijana, Acc#8951, C 2422, Collection 333, ACC 6253, ACC 9861, KHG 55 and C 2433. Effect of treatments was found significantly different in the sepal length, petal length, number of fruits per cluster, number fruit cluster per plant, weight of fruit, pH of fruit, pedicle length, first fruiting internode, thickness of pericarp, fruit weight per cluster, fruit yield per plant, number of leaves and non-significant in vine length, number of flower per plant total soluble solid and pedicel length from abscission layer. Among these varieties ACC#8951 has maximum number of fruit per cluster, fruit weight, fruit weight per cluster, fruit yield per plant. Similarly Srijana has maximum number of fruit cluster per plant and ACC 6253 has higher number of leaves.

Keywords: Characteristic; Phenotype; Tomato; Variety

Introduction

Tomato (*Lycospersicon esculentum*) is one of the most important vegetables worldwide. Its fruit is an essential component of human food for the supply of vitamins, minerals, and certain types of hormones precursors, protein and energy [1]. Moreover, tomato is considered as the 2nd greatest significant vegetable crops in the world after potato [2]. The crop out ranks all other vegetables in total contribution to human nutrition because so much of it is consumed fresh and or cooked. It requires relatively cool, dry climate for high fruits yields and qualities. Optimum temperature for growth and development is 20-27°C. It does not tolerate water-logging and flooding [3]. Tomato is a very good appetizer and its soup is said to be a very good remedy for patients suffering from constipation. Tomato is also known as poor man's orange [4]. It covers about 17273 ha of land with the average annual production of 232897 Mt. and productivity 13.5 Mt/ha (Year Book 2014).

The relative magnitude of the association between yield of a crop and various traits used in constructing an indirect selection index for yield [5]. Tomato has many landraces which may be differ in terms of both phenotypic and genotypic characters. Genotypic characters are evaluated in the lab where as phenotype should be observed directly from the field condition. Phenotypic characters include the vine length, petal length, no. of fruit per cluster, first fruiting internode length, fruit weight, fruit yield per plant, no of leaves and so on. When we give same input as irrigation, fertilizer etc. to different variety so their performance is also different and that can be easily observed from the phenotype of the variety.

Many landraces of tomato are available in the Nepal but they are not properly identified. Most of people cultivate the tomato however they use the same type of variety. The people do not know about the phenotypic character of different varieties and this importance. Due to the lack of knowledge about phenotypic character of different varieties there is difficult the management of tomato during cultivation as a result lower productivity of tomato.

Tomato is the one of most important and high value vegetable. The main aim of this study is phenotypic characterization of different varieties of tomato. As phenotypic characters are the yields attributing characters. If we analyze the phenotypic character then this result can be utilized for the breeding purpose because wild types of the varieties are disease resistant and more tolerant to adverse climatic condition. It also helps to conserve different landraces.

The main objectives of the research is the to characterize the phenotypic diversity among 8 landraces of tomato. Phenotypic characters are the yield attributing characters which helps to selection of for cultivation and improvement of the variety.

Literature Review

Kaushik et al. reported that a positive association of yield per hectare observed with number of leaves at 60 days after transplanting followed by number of leaves at 30 days after transplanting, fruit length and plant height [6]. Correlation studies indicated that days to maturity, number of locules/fruit and pericarp thickness were positively and significantly correlated with fruit yield at both genotypic and phenotypic levels, indicating the importance of these traits as selection criteria [7].

Bhattarai and Subedi reported the flowering days of different varieties ranged from 53 to 74 days after transplanting in open field condition [8]. The highest numbers of clusters were recorded from Srijana followed by Dalila, whereas Suraksha gave the lowest number of clusters per plant.

According to Papadopoulos and Tiessen the vegetative growth continues in the form of a side shoot growing from the [9] axil of

***Corresponding author:** Paudel S, Institute of Agriculture and Animal Science, Sundarbazar, Lamjung, Nepal, E-mail: marasiniprakash055@gmail.com

Received July 05, 2017; **Accepted** July 28, 2017; **Published** August 08, 2017

Citation: Marasini P, Paudel S (2017) Phenotypic Characterization of Tomato (*Lycospersicon esculentum*). J Hortic 4: 204. doi: 10.4172/2376-0354.1000204

the last leaf, a process known as sympodial growth. Root growth is determined by the plant's actively photosynthesizing leaf area since the roots being heterotrophic tissues depend on energy captured by the leaves- autotrophs [10]. The notable characteristics observed for determinate and indeterminate classes are; growth period, planting to harvest period, plant height, bearing period and yields. Rapid growth continues for 3-5 weeks cumulating in the mature green stage. At this point the tomato has accumulated the majority of its final weight.

Chishti et al. conducted a study on the analysis of combining ability for yield, yield components and quality [4] characters in tomato (*Lycopersicon esculentum* Mill.); on plant material comprising 12 parental lines and their F1 hybrids (direct crosses). They recorded data on days to flowering, number of flowers per cluster, number of fruits per cluster, number of marketable fruits per plant, fruit length, fruit width, and fruit weight, fruit yield per plant, pericarp thickness, and fruit firmness at red stage, total soluble solids and pH of juice. Analysis of variance revealed highly significant differences among genotypes, parents and hybrids, as well as highly significant mean squares due to GCA and SCA for all the characters

Akinfasoye et al. reported that number of fruits per plant, fruit weight and fruit yield per ha is increased with decreased the numbers of leaves and tomato with fewer leaves can be selected for high fruits producers and these varieties are also likely to earlier.

Chapagain et al. reported that highest marketable yield was obtained from All-rounder followed by Srijana. Srijana took the shortest period for flowering and harvesting with an average of 37 and 77 days after transplanting respectively. This was also the tallest variety with more clusters per plant [11,12].

Pandey et al. reported that the highest number of fruits (6.8) was produced by NSITH-162 whereas the lowest number of fruits (5.5) was produced by BL-410 [11]. The highest number of cluster (38.4) was produced by NSITH-162 whereas the lowest number of cluster (14.8) was produced by Avinash-2 among the four varieties Avinash-2, NSITH-162, LTH-61 and BL-410 [12-14].

Materials and Methods

Field experimentation

The field experiment was conducted in Lamjung Campus Sundarbazar of Lamjung district (725 Masl, 28° 7' to 28° 10' N, 84° 24' to 84° 28' E).

Design of experiment

The experiment was conducted in Randomized Complete Block Design with three replications and 8 treatment combination. First of all seed of different 8 varieties had been collected for study of phenotypic character these varieties of tomatoes. Varieties are shown in Table 1.

Plot/Pot Number	Varieties
1(T1)	Srijana
2(T2)	Acc#8951
3(T3)	C2422
4(T4)	Collection333
5(T5)	Acc6253
6(T6)	Acc9861
7(T7)	kttG55
8(T8)	C2433

Table 1: Varieties of tomatoes.

Nursery establishment

For nursery establishment, first of all we prepared the media containing the composition of sand: Soil: FYM in the ratio of 1:2:2. Soil was collect cultivated land, sand from the construction site and FYM was collected from the farm of IAAS, Lamjung Campus. Media was kept in plastic pot as it is easy to carry on, cheap as comparable to others. Small hole is made at the bottom of pot for draining out excess water before media was kept in the pot. Seed is shown in 2072/8/21. Rose can, shovel used for mixing media preparation, scale for measuring height, register for recording data, measuring tape for field layout, source of water, weighing balance, etc.

We had grown the tomato in two different conditions:

1. Approximately in homogenous condition in under construction site of library.
2. In field, by the side of boys hostel.

Layout of nursery

Field preparation: We had selected the site in which broccoli was previously grown. For the field preparation soil was tilt at the depth of 15 cm by digging with spade. Soil was brought to the fine tilt and was mixed with FYM in the required amount. After the field preparation, spacing of 60 cm was made between plants. Row to row distance was maintained 75 (Table 2).

Layout of experimental field: Before transplanting, height of seedling of each variety has been measured and noted down. Seedling was planted in the above mention spacing and transplanted in 26 days after sowing. During the transplanting five plants were shown in each row. After transplantation light irrigation was given to reduce the transplantation shock to the plant (Table 3).

Observation

Vegetative seedling

In terms of vegetative seedling different parameters are observed such as hypocotyl color, hypocotyl color intensity, hypocotyls pubescence, primary leaf length and primary leaf width. In seedling stage usually all the variety possess purple hypocotyls color and presence of pubescence but in terms primary leaf length and width, variety 4 possess max length (19 mm) and width (3.4 mm).

In field condition

After transplanting in the field condition, we observed different parameters such as plant height, nodes, no of flowers in a cluster and no of leaves, petal length, pedicel length, fruit weight, pH of fruit, total soluble solid, fruit yield per plant. Usually we measured the plant height with the ruler and others were also noted down. We found that variety 4 has maximum plant height and maximum number of leaves while comparison to other varieties.

Pot No. 1	Pot No. 2	Pot No. 3	Pot No. 4	Pot No. 5	Pot No. 7	Pot No. 6	Pot No. 8
T1	T2	T3	T4	T5	T7	T6	T8

Table 2: Layout of nursery.

T1R1	T2R1	T3R1	T4R1	T5R1	T6R1	T7R1	T8R1
T8R2	T4R2	T3R2	T1R2	T7R2	T6R2	T5R2	T2R2
T5R3	T8R3	T4R3	T3R3	T2R3	T7R3	T6R3	T1R3

Table 3: Layout of experimental field.

Results and Discussion

Effect of treatment on vine length was found non-significant as the highest value was found variety 6 and the lowest value of the variety 1.

Effect of treatment was found highly significant different in the petal length. Variety 3 had longest petal length found (9.33) which is statistically at par with variety 1 and 2. Similarly variety 6 had shortest petal length (4.33) which was statically at par with variety 4, 5 and 8. Variety 7 was statistically at par with variety 1 and 2.

Effect of treatment was found significant different in the sepal length. Variety 1 had longest sepal length (7.0) which was statistically at par with variety 2, 3, 5, 6, 7 and 8. Similarly variety 4 had shortest sepal length (4.33) and significantly different with variety 1.

Effect of treatment was found significant different in pedicle length. Variety 5 had longest pedicle length (2.2200) which was statistically at par with variety 1, 3, 4, 6, 7, and 8. Similarly variety 2 had shortest pedicle length (1.5533) which is statistically different with variety 2.

Effect of treatment on number of fruit per cluster was found highly significant. Variety 2 had higher number of fruit per cluster (8.5333) which was statistically at par with variety 6, 7 and 8. Similarly variety 1 had lower number of fruit per cluster (4.4) which was statistically at par with variety 3, 4, and 5. And variety 3, 4, and 5 was statistically at par with variety 6, 7, and 8 (Table 4).

Effect of treatment in number of fruit cluster per plant was found highly significant. Variety 1 1 was found higher no. of fruit cluster per plant (9.50) which is statistically at par with variety 4, 5 and 7. Similarly variety 6 had lowest no. of fruit cluster per plant (4.83) which was statistically at par with variety 8 and 2. And variety 2 and variety 3 were statistically at par.

Effect of treatment was found significantly different in first fruiting internode length. Variety 7 was found highest length of first fruiting internode (8.2) which is statistically at par with variety 1, 2, 3, 4, 5, and 6. Similarly variety 8 had lowest length of first fruiting internode (6.5) which is statistically at par with variety 1, 2, 3, 4, 5, and 6. And variety 7 was significant difference with variety 8.

Effect of treatment was found highly significant difference in thickness of pericarp. Variety 1 had higher thickness of pericarp (0.44). Similarly variety 2 had lowest thickness (0.2700) which was statistically at par with variety 5. Variety 4 was statistically at par with variety 3, 6, 7 and 8. And variety 8 was statistically at par with variety 3 and 4.

Treatment	Vine length (mm)	Petal length	Sepal length	Pedicle length (cm)	No. Of fruit per cluster
Variety 1	79.333	8.67^{ab}	7.0^{a}	2.0666^{ab}	4.4000^{c}
Variety 2	86.7767	8.33^{ab}	5.0^{ab}	1.5533^{b}	8.5333^{a}
Variety 3	77.7733	9.33^{a}	5.0^{ab}	1.7066^{ab}	6.1000^{bc}
Variety 4	76.1067	5.00^{c}	4.33^{b}	1.8066^{ab}	6.0333^{bc}
Variety 5	83.4433	4.67^{c}	4.67^{ab}	2.2200^{a}	6.2000^{bc}
Variety 6	92.7733	4.33^{c}	5.0^{ab}	1.9666^{ab}	8.1000^{ab}
Variety 7	88.4400	6.33^{bc}	6.67^{ab}	1.9000^{ab}	7.0666^{ab}
Variety 8	83.9967	5.67^{c}	5.67^{ab}	1.6633^{ab}	7.1000^{ab}
	NS	**	*	*	**

Level of significance=0.05, NS: Non Significance; *Significant; *Highly significance; Not variety 1, 2, ….. write the its name in result

Table 4: Effect of different treatment on vine length, petal length, sepal length, pedicle length, and no. of fruit per cluster.

Effect of treatment was found highly significant difference in fruit weight. It was found that variety 2 had higher fruit weight (40.36). Similarly variety 6 had lower fruit weight which was statistically at par with variety 5 and 8. Variety 3 was statistically at par with 4 and 7. Again variety 7 and 8 was statistically at par and variety 1 and 2 are statistically different.

Effect of treatment was found non-significant. Variety 4 had highest total soluble solid and variety 7 had lowest total soluble solid (Table 5).

Effect of treatment on fruit PH was found highly significant. Varity 2 had higher PH (3.84) which was statistically at par with variety 8 which was statistically at par with variety 8. Similarly variety 4 had lowest PH (3.31) which was statistically at par with variety 1, 3, 5, 6, and 7. And variety 1 and 2 was significantly different.

Effect of treatment was found highly significant different in fruit weight per cluster. Variety 2 had higher fruit weight per cluster (344, 68). Similarly variety 5 had lower fruit weight per cluster (88.453) which was statistically at par with variety 1, 3, 4, 5, 6, 7, and 8. And variety 1 and 2 are significantly different.

Effect of treatment was found highly significant different in fruit yield per plant. Variety 2 had higher fruit yield (2243.8). Similarly variety 6 had lower fruit yield per plant (530.32) which was statistically at par with variety 3, 4, 5 and 8. And variety 7 was statistically at par with 3, 4 and 5. Variety 1 and 2 were significantly different with each other.

Effect of treatment was found significantly different in no. of leaves. Variety 4 had higher number of leaves (9.83) which was statistically at par with variety 1, 2, 3, 5, 6, 7 and 8. Similarly variety 6 had lower no of leaves. And variety 4 and 5 were significantly different with each other.

Effect of treatment was found non-significant in no. of flowers per plant. Variety 3 had higher no of flower per plant (7.5) and variety 8 had lower no of flower per plant (5.47)

Effect of treatment was found non-significant in pedicel length from abscission layer. Variety 4 had the longest pedicel length whereas variety 1 had the shortest (Table 6).

All the phenotypic parameters of crop showed significant differences expect vine length, total soluble solid and no. of flowers per plant. This is expected since different genotypes perform differently in same environment.

Conclusion

Tomato is one of essential nutritional vegetable commodity and income generation crop in Nepal. Different varieties of tomato have the

Treatment	No. of fruit cluster per plant	First fruiting internode (cm)	Thickness of pericarp (mm)	Fruit weight (g)	Total soluble solid (brix)
Variety 1	9.50^{a}	7.833^{ab}	0.4400^{a}	30.566^{b}	7.990
Variety 2	6.50^{cd}	6.866^{ab}	0.2700^{e}	40.366^{a}	8.2200
Variety 3	7.50^{bc}	6.966^{ab}	0.300^{cd}	18.800^{c}	7.7200
Variety 4	8.50^{ab}	7.633^{ab}	0.31667^{bcd}	18.466^{c}	8.866
Variety 5	8.67^{ab}	7.166^{ab}	0.27000^{e}	14.266^{e}	8.0200
Variety 6	4.83^{d}	6.633^{ab}	0.32667^{bc}	13.566^{e}	8.533
Variety 7	9.00^{ab}	8.200^{a}	0.3400^{b}	17.33^{cd}	7.200
Variety 8	5.00^{d}	6.500^{b}	0.2800^{de}	15.166^{de}	8.3533
	**	*	**	**	NS

Level of Significance=0.05, NS: Non Significance; *Significance; **Highly significance

Table 5: Effect of treatment on no. of fruit cluster per plant, length of first fruiting internode, thickness of pericarp, fruit weight and total soluble solid.

Treatment	Fruit plant	Fruit weight per cluster (g)	Fruit yield per plant (g)	No. of leaves	No. of flower per plant	Pedicel length from abscission layer (cm)
Variety 1	3.5200^{b}	135.69^{b}	1293.6^{b}	7.53^{ab}	5.87	0.50667
Variety 2	3.8433^{a}	344.68^{a}	2243.8^{a}	6.47^{ab}	5.58	0.53
Variety 3	3.5233^{b}	114.62^{b}	858.84^{b-d}	8.72^{ab}	7.83	0.54667
Variety 4	3.3100^{b}	111.48^{b}	950.81^{b-d}	9.83^{a}	6.67	0.68667
Variety 5	3.5067^{b}	88.453^{b}	762.48^{cd}	6.19^{b}	6.19	0.56333
Variety 6	3.3167^{b}	109.98^{b}	530.32^{d}	5.05^{ab}	7.5	0.55333
Variety 7	3.5033^{b}	122.47^{b}	1107.0^{bc}	7.67^{ab}	6.33	0.63
Variety 8	3.600^{ab}	108.13^{b}	535.66^{d}	7.03^{ab}	5.47	0.54667
	**	**	**	*	NS	NS

Level of significance=0.05; **Shows highly significant, *Shows the significant, NS: Non-Significant, Variety 1 indicate Srijana, Variety 2 indicates Acc#8951, Variety 3 indicates C2422, Variety 4 indicates collection 333, Variety 5 indicates Acc 6253, Variety 6 indicates Acc 9861, Variety 7 indicates KHG 55 and Variety 8 indicates C 2433

Table 6: Effect of treatment on fruit PH, fruit weight per cluster, fruit yield per plant, no. of leaves , no of flower per plant and pedicel length from abscission layer.

phenotypic variation due to its genotype. Phenotypic characters are the yield attributing characters. Knowledge of the phenotypic variation of tomato helps in breeding program and also enhances the productivity of the crop. According to this study we concluded that ACC#8952 can be recommended for producing higher number of cluster, fruit weight and fruit yield per plant. Similarly Collection 333 for higher number of leaves and Srijana for number of fruit cluster per plant.

Acknowledgement

I would like to give thanks to the to Mr. Amit Khanal, Assistant Professor, Department of Horticulture and Plant Protection, IAAS Lamjung Campus for providing opportunity to carry out this project work from which we got chance to learn about phenotypes of different varieties of tomato. I would also like to acknowledge my all the friends under horticulture department who plays the supportive role for carrying out this project effectively and efficiently. Furthermore I am highly grateful to Mr. Salikram Ghimire, for his contribution in data recording.

References

1. Naika S, Jeude de LVJ, Goffau de M, Hilmi M, Dam VB, et al. (2005) Cultivation of tomato: production, processing and marketing. Agromisa Foundation and CTA Wageningen pp: 1-92.
2. Mohamed AN, Ismail RM, Rahman HM (2010) In vitroresponse from cotyledon and hypocotyls explants in tomato by inducing 6-benzylaminopurine. Afr J Biotechnol 9: 4802-4807.
3. Grubben GJH, Denton AO (2004) Plant resources of tropical Africa 2. Vegetables.
4. Singh PK, Bhandari RR (2015) Vegetable crops production technology. Samiksha Publication p: 45.
5. Singh M (1992) Genotypic and phenotypic correlations in plant traits. International Centre for Agricultural Research in Dry Areas pp: 1-33.
6. Kaushik SK, Tomar SD, Dixit KA (2011) Genetics of fruit yield and it's contributing characters in tomato (Solanum lycopersicum). J Agric Biotech Sustain Dev 3: 209-213.
7. Aysh AF, Kutma H, Serhan M, Zoubai AA, Naseer AAM, et al. (2012) Genetic analysis and correlation studies of yield and fruit quality traits in tomato (*Solanum lycopersicum* L.). N Y Sci J 5: 142-145.
8. Bhattarai SP, Subedi PP (1996) Heat and bacterial wilt tolerant tomato varietal evaluation during 1992/93-1994/95 season. LARC Working Paper No. 96/56. Lumle Agriculture Research Centre, Kaski, Nepal.
9. Papadopoulos AP, Tiessen H (1983) Root and Air temperature effect on flowering and yield of tomato. J Am Soc Hortic Sci 108: 805-809.
10. Rayburn EB, Sanderson AM, Rotz A, Fultz WS (1993) Plant growth and development as the basis of forage management. Agron J 93: 1282-1286.
11. Pandey RY, Pun BA, Upadhyay PK (2006) Participatory varietal evaluation of rainy season tomato under plastic house condition. Nepal Agric Res J Vol 7: 11-15.
12. Chapagain TR, Khatri BB, Mandal LJ (2011) Performance of tomato varieties during rainy season under plastic house conditions. Nepal J Sci Tech 12: 17-22.
13. Egesi CN, Ilona P, Ogbe OF, Akoroda OM, Dixon A, et al. (2007) Genetic variation and genotype environment interaction for yield and other agronomic traits in cassava in Nigeria. Agronomy J 99: 1137-1142.
14. Chistiti SAS, Khan AA, Bushra S, Khan IA (2008) Analysis of combining ability for yield components and quality characters in tomato (*Lycopersicon esculentum* Mill.). J Agric Res 46: 325-332.