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Evaluation of germplasm for qualitative traits in tomato (*Solanum lycopersicum* L.)

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Abstract
Twenty three germplasm of tomato augmented from ICAR-NBPGR, India, WVC, Taiwan and various vegetable research stations were evaluated in RBD in field conditions and were characterized based on 11 qualitative traits *viz.*, leaf type, foliage cover, stem thickness, stem pubescence, stem pigmentation, flower size, flower colour, fruit shape, immature fruit skin colour, blossom-end fruit shape and pulpiness. Genotypes differed significantly in traits explaining uniqueness of characters. The exclusive solitary or combination of characters will be useful as morphological markers in selection of segregating populations and also useful for varietal identification in DUS testing. These traits may be utilized in further improvement studies through various breeding strategies.

Keywords: Tomato, qualitative traits, minimal descriptors, germplasm

Introduction
Tomato (*Solanum lycopersicum* L.) is one of the most important vegetable plants in the world. It originated in western South America, and domestication is thought to have occurred in Central America. These wild tomatoes are important for breeding, as sources of desirable traits, and for evolutionary studies. In many countries it is considered as "poor man's orange" because of its attractive appearance and nutritive value. It is high in nutritional value; one medium fresh tomato (135g) provides 47 % Recommended Dietary Allowance (RDA) of vitamin C, 22% RDA of vitamin A and 25 % calories. It contributes significantly to the dietary intake of vitamins A and C as well as essential minerals and other nutrients.
Characterization consists of recording those characters which are highly heritable, can be easily distinguished by naked eye and are expressed in all environments. Before starting any improvement programme of this crop it is required to collect available germplasm and their characterization is very important for varietal improvement and selection. The evaluation of phenotypic traits such as fruit morphology, color intensity, nutritional quality, firmness, flavour and aroma are challenging and time-consuming because of the quantitative nature of the traits (IPGRI, 1996, Fiorani and Schurr, 2013) [5, 4]. However, study on phenotypic attributes is needed, because those parameters have been widely used for the assessment of genetic diversity, breeding value and yield potential of the crop (Lopez *et al*., 1994; Singh and Sahu, 1998; Agong *et al*., 2001; Dharmatti *et al*., 2001; Mohanty *et al*., 2001; Parthasarathy *et al*., 2002, Naveen *et al*., 2018, Pidigam *et al*., 2019) [6, 11, 1, 3, 7, 9, 8, 10]. Therefore, the present investigation was undertaken with the aim of characterizing and assessing morphological variability of tomato genotypes collected from diverse breeding lines. In this study, we were aimed to identify the morphological characters such as leaf type, foliage cover, stem thickness, stem pubescence, stem pigmentation, flower size, flower colour, fruit shape, immature fruit skin colour, blossom-end fruit shape and pulpiness, those can be used to distinguish the tomato genotypes.

Material and Methods
Twenty three germplasm of tomato augmented from ICAR-NBPGR, India, WVC, Taiwan and various vegetable research stations were evaluated in RBD in filed conditions. The data were recorded on 11 qualitative characters following the minimal descriptors of NBPGR (Srivastava *et al*., 2001) [12]. Qualitative data on 11 traits were recorded in each genotype and the details of trait, classification and stage of scoring are presented in Table 1.

Results and Discussion

Twenty three genotypes of tomato germplasm under present investigation were characterized based on eleven qualitative traits, which were differed significantly from genotype to genotype (Table 2 and Fig. 2).

With respect to leaf type, the observations revealed that 11 genotypes (Pusa Ruby, PKM-1, EC-620382, EC-620389, EC-620406, EC-631369, EC-620503, AVTO-9803, AVTO-9804, AVTO-1002 and AVTO1002) exhibited standard leaf type, 9 genotypes (EC-615055, EC-620463, EC-620428, AVTO-1219, EC-620378, EC-620395, EC-620427, EC-620394 and EC-631379) showed potato leaf type and 3 genotypes (Pant bahar, Arka Vikas and EC-620422) showed pimpinellifolium leaf type.

The observations on foliage cover revealed that 4 genotypes (PKM-1, EC-620382, EC-620395 and EC-620503) exhibited excellent foliage cover, 8 genotypes (Pant bahar, Arka Vikas, EC-620463, EC-620389, EC-620427, EC-631369, EC-631379 and AVTO-0101) were showed good foliage cover and 11 genotypes (Pusa Ruby, EC-615055, EC-620428, AVTO-1219, EC-620378, EC-620406, EC-620394, EC-620422, AVTO-9803, AVTO-9804 and AVTO-1002) showed moderate foliage cover.

The observations in respect of stem thickness revealed that 10 genotypes (PKM-1, Pant bahar, Arka Vikas, EC-615055, EC-620463, EC-620428, AVTO-1219, EC-620378, EC-620395 and EC-620427) showed thick stem, 10 genotypes (Pusa Ruby, EC-620382, EC-620389, EC-620406, EC-620394, EC-631379, AVTO-9803, AVTO-9804, AVTO-1002 and AVTO-0101) showed moderate and 3 more genotypes (EC-620422, EC-631369 and EC-620503) showed thin stem.

The observations on stem pubescence revealed that 12 genotypes (Arka Vikas, EC-615055, EC-620463, EC-620395, EC-620427, EC-620394, EC-620422, EC-631379, EC-620503 and AVTO-9803) exhibited sparse pubescence, 4 genotypes (Pusa Ruby, PKM-1, EC-620428 and AVTO-1219) recorded dense pubescence and 7 genotypes (Pant bahar, EC-620378, EC-620382, EC-620389, EC-620406, EC-631369 and AVTO-1002) showed medium pubescence. Similar reports are made earlier by Anuradha *et al*., 2018 [2] in tomato.

In The trait stem pigmentation, the observations revealed that all the 23 genotypes (Pusa Ruby, PKM-1, Pant bahar, Arka Vikas, EC-615055, EC-620463, EC-620428, AVTO-1219, EC-620378, EC-620382, EC-620389, EC-620395, EC-620406, EC-620427, EC-620394, EC-620422, EC-631369, EC-631379, EC-620503, AVTO-9803, AVTO-9804, AVTO-1002 and AVTO-0101) showed green pigmentation on the stem.

Based on the flower size, the observations revealed that 12 genotypes (Pusa Ruby, Arka Vikas, EC-615055, EC-620463, EC-620428, AVTO-1219, EC-620378, EC-620389, EC-620406, EC-620427, EC-620503 and AVTO-0101) showed large flowers and 11 genotypes (PKM-1, Pant bahar, EC-620382, EC-620395, EC-620394, EC-620422, EC-631369, EC-631379, AVTO-9803, AVTO-9804 and AVTO-1002) showed medium flowers.

The flower colour revealed that 15 genotypes (Pusa Ruby, Pant bahar, Arka Vikas, AVTO-1219, EC-620378, EC-620382, EC-620389, EC-620406, EC-620427, EC-620394, EC-631369, AVTO-9803, AVTO-9804, AVTO-1002 and AVTO-0101) showed deep yellow colour flowers and 8 genotypes (PKM-1, EC-615055, EC-620463, EC-620428, 620395, EC-620422, EC-631369 and EC-620503) showed light yellow colour flowers. Deep coloured flowers attract bees thereby, more pollination occurs. So, the genotypes with deep yellow flowers and yellow flowers can be selected for any further studies.

The qualitative trait fruit shape revealed that 6 genotypes (EC-620389,EC-631369, AVTO-9803, AVTO-9804, AVTO-1002 and AVTO-0101) showed round fruit shape, 2 genotypes (Pusa Ruby and EC-631379) showed slightly flattened, 6 genotypes (EC-620428, EC-620378, EC-620382, EC-620395, EC-620427 and EC-620503) showed oval, 3 (EC-620463, AVTO-1219 and EC-620422) heart shape, 4 (PKM-1, Pant bahar, Arka Vikas and EC-615055) flat round and 2 (EC-620406 and EC-620394) plum shape. Similar reports are made earlier by Anuradha *et al*., 2018 [2] in tomato. Round shaped fruits are used for table purpose and other shaped fruits are used for processing purpose. Hence, genotypes with all different fruit shapes may be utilized in further improvement studies through various breeding strategies.

The observations recorded on immature fruit skin colour revealed that 5 genotypes (EC-615055, EC-620428, EC-620389, EC-620394 and EC-631369) showed light green, 1 genotype (EC-620378) showed greenish white, 15 genotypes (Pusa Ruby, Pant bahar, Arka Vikas, EC-620463, AVTO-1219, EC-620382, EC-620395, EC-620406, EC-620427, EC-620422, EC-631379, EC-620503, AVTO-9803, AVTO-9804 and AVTO-1002) showed green and 2 genotypes (PKM-1 and AVTO-0101) showed dark green colour.

The observations made on the blossom-end fruit shape revealed that 19 genotypes (Pusa Ruby, Pant bahar, Arka Vikas, EC-615055, EC-620428, AVTO-1219, EC-620378, EC-620382, EC-620395, EC-620406, EC-620427, EC-620394, EC-620422, EC-631369, EC-631379, AVTO-9803, AVTO-9804, AVTO-1002 and AVTO-0101) showed flat blossom- end fruit shape, 1 genotype (PKM-1) showed indented and 3 genotypes (EC-620463, EC-620389 and EC-620503) showed pointed blossom- end fruit shape. The genotypes with different blossom end shape are preferred and they can be exploited in the breeding studies.

The observations on pulpiness revealed that 12 genotypes (Pusa Ruby, Pant bahar, Arka Vikas, AVTO-1219, EC-620382, EC-620395, EC-631379, EC-620503, AVTO-9803, AVTO-9804 and AVTO-1002) showed juicy, 7 genotypes (EC-615055, EC-620463, EC-620428 and AVTO-1219) showed pulpy and 4 genotypes (EC-620378, EC-620389, EC-620406 and EC-620427) showed highly pulpy. Juicy varieties of tomatoes are commercially used. Whereas, pulpy varieties are used for processing purpose. Hence, genotypes with juicy nature can be selected for pedigree breeding. Similar reports are made earlier by Anuradha *et al*., 2018 [2] in tomato.

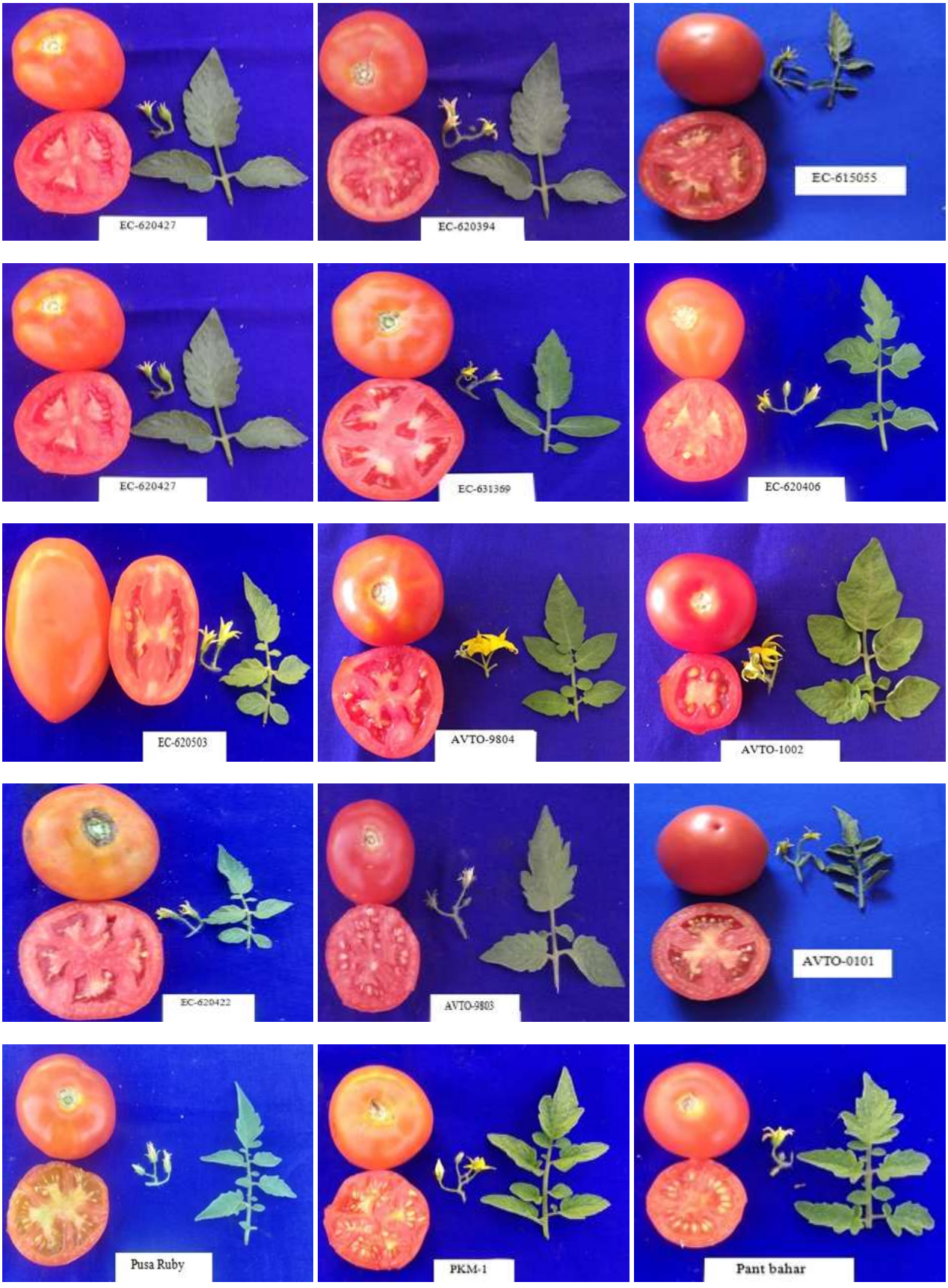
Table 1: Classification and stage of scoring of 11 qualitative traits in tomato

S. No	Minimal descriptors	Classification	Stage of scoring
1.	Leaf type	Small/narrow Potato leaf Standard Peruvianum type Pimpinellifolium type Hirsutum type	At full foliage stage
2.	Leaf/foliage cover	Poor Moderate Good Excellent	At full foliage stage
3.	Stem thickness	Thin Medium Thick	At full foliage stage
4.	Stem pubescence	Absent Sparse Medium Dense	At full foliage stage
5.	Flower size	Small Medium Large	At full blossom stage
6.	Flower colour	Light yellow/crem Deep yellow Reddish yellow	At Full flowering stage
7.	Fruit shape	Flat round Slightly flattened Round Oval Heart shaped Lengthened cylindrical (banana type) Pyriform Plum shaped	At near maturity stage
8.	Immature fruit skin colour	Greenish white Light gree Green Dark green Very dark green	Fully developed fruit
9.	Blossom-end fruit shape	Indented Flat Pointed/nippled	At near maturity stage
10.	Pulpiness	Juicy Pulpy Highly pulpy	At fruit maturity stage
11.	Seediness	Low Medium High	At fruit maturity stage

Table 2: Qualitative traits of 23 genotypes of tomato

S.N	Accession number	Leaf type	Leaf/ foliage cover	Stem thickness	Stem pubescence	Stem pigmentation	Flower size	Flower colour	Fruit shape	Immature fruit skin colour	Blossom -end fruit shape	Pulpiness
1	Pusa Ruby	Standard	Moderate	Medium	Dense	Green	Large	Deep yellow	Slightly flattened	Green	Flat	Juicy
2	PKM-1	Standard	Excellent	Thick	Dense	Green	Medium	Light yellow	Flat round	Dark Green	Indented	Juicy
3	Pant bahar	Pimpinellifolium	Good	Thick	Medium	Green	Medium	Deep yellow	Flat round	Green	Flat	Juicy
4	Arka vikas	Pimpinellifolium	Good	Thick	Sparse	Green	Large	Deep yellow	Flat round	Green	Flat	Juicy
5	EC-615055	Potato leaf	Moderate	Thick	Sparse	Green	Large	Light yellow	Flat round	Light green	Flat	Pulpy
6	EC-620463	Potato leaf	Good	Thick	Sparse	Green	Large	Light yellow	Heart shaped	Green	Pointed	Pulpy
7	EC-620428	Potato leaf	Moderate	Thick	Dense	Green	Large	Light yellow	Oval	Light green	Flat	Pulpy
8	AVTO-1219	Potato leaf	Moderate	Thick	Dense	Green	Large	Deep	Heart	Green	Flat	Juicy

								yellow	shaped			
9	EC-620378	Potato leaf	Moderate	Thick	Medium	Green	Large	Deep yellow	Oval	Greenish white	Flat	High pulpy
10	EC-620382	Standard	Excellent	Medium	Medium	Green	Medium	Deep yellow	Oval	Green	Flat	Juicy
11	EC-620389	Standard	Good	Medium	Medium	Green	Large	Deep yellow	Round	Light green	Pointed	High pulpy
12	EC-620395	Potato leaf	Excellent	Thick	Sparse	Green	Medium	Light yellow	Oval	Green	Flat	Juicy
13	EC-620406	Standard	Moderate	Medium	Medium	Green	Large	Deep yellow	Plum shaped	Green	Flat	High pulpy
14	EC-620427	Potato leaf	Good	Thick	Sparse	Green	Large	Deep yellow	Oval	Green	Flat	High pulpy
15	EC-620394	Potato leaf	Moderate	Medium	Sparse	Green	Medium	Deep yellow	Plum shaped	Light green	Flat	Pulpy
16	EC-620422	Pimpinellifolium	Moderate	Thin	Sparse	Green	Medium	Light yellow	Heart shaped	Green	Flat	Pulpy
17	EC-631369	Standard	Good	Thin	Medium	Green	Medium	Deep yellow	Round	Light green	Flat	Pulpy
18	EC-631379	Potato leaf	Good	Medium	Sparse	Green	Medium	Light yellow	Slightly flattened	Green	Flat	Juicy
19	EC-620503	Standard	Excellent	Thin	Sparse	Green	Large	Light yellow	Oval	Green	Pointed	Juicy
20	AVTO-9803	Standard	Moderate	Medium	Sparse	Green	Medium	Deep yellow	Round	Green	Flat	Juicy
21	AVTO-9804	Standard	Moderate	Medium	Sparse	Green	Medium	Deep yellow	Round	Green	Flat	Juicy
22	AVTO-1002	Standard	Moderate	Medium	Medium	Green	Medium	Deep yellow	Round	Green	Flat	Juicy
23	AVTO-0101	Standard	Good	Medium	Sparse	Green	Large	Deep yellow	Round	Dark Green	Flat	Pulpy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AVTO-0101
Pusa Ruby
PKM-1
Pant bahar

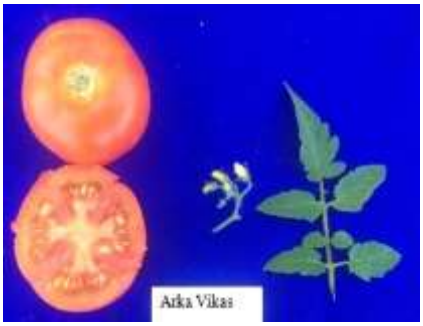

Fig 1: Fruit shape, pulpiness, leaf shape and flower characters of tomato germplasm

Conclusion

From the present study, it was concluded that there is a variable for most of the traits in tomato germplasm. Genotypes differed significantly in traits explaining uniqueness of characters. The exclusive solitary or combination of characters will be useful as morphological markers in selection of segregating populations and also useful for varietal identification in DUS testing. These traits may be utilized in further improvement studies through various breeding strategies.

References

1. Agong SG, Schittenhelm S, Fried W. Genotypic variation of Kenyan tomato (*Lycopersicon esculentum* Mill.) germplasm. Journal of Food Technology in Africa. 2001;6:13-17.
2. Anuradha B, Saidaiah P, Harikishan, S, Geetha A, Ravinder RK. Study of qualitative traits of germplasm of tomato (*Solanum lycopersicum* L.). Journal of Pharmacognosy and Phytochemistry. 2018;7(6):539-543.
3. Dharmatti, PR, Madalgeri BB, Mannikeri IM, Patil RV, Patil G. Genetic divergence studies in summer tomatoes. Karnataka Journal of Agricultural Science. 2001;4:407-411.
4. Fiorani F, Schurr U. Future scenarios for plant phenotyping. Annual Review of Plant Biology. 2013;64:267-291.
5. IPGRI [International Plant Genetic Resources Institute]. Descriptors for tomato (*Lycopersicon* spp). IPGRI, Rome, Italy; c1996.
6. Lopez MR, Santiaguillo JFH, Lomeli Pena A, Guevas, JAS, Sahagun-Castollanos J. Evaluations of 60 accessions of husk tomato in Chapingo, Mexico. Revista-Chapingo. Serie-Horticultura. 1994;1:131-134.
7. Mohanty BK, Pusti AM. Analysis of genetic distance in tomato. Research on Crops. 2001;2:282-285.
8. Naveen BL, Ravinder RK, Saidaiah P. Genetic divergence for yield and yield attributes in tomato (*Solanum lycopersicum*). 2018;88(7):1018-1023.
9. Parthasarathy VA, Aswath C. Genetic diversity among tomato genotypes. Indian Journal of Horticulture Science. 2002;59:162-166.
10. Pidigam S, Suchandranath BM, Srinivas N, Narshimulu G, Srivani SA, Hari Y, *et al*. Assessment of genetic diversity in yardlong bean (*Vigna unguiculata* (L.) Walp subsp. *sesquipedalis* Verdc.) germplasm from India using RAPD markers. Genetic Resouces Crop Evolution. 2019; 2019;66:1231-1242.
11. Singh DN, Sahu AA. Performance of tomato cultivars in winter seasons on entisol of Orissa. Environment and Ecology. 1998;16:760-772.
12. Srivastava U, Mahajan RK, Gangopadhyay KK, Singh M, Dhilon BS. Minimal Descriptors of Agri-Horticultural crops, Vegetable crops part-II; c2001.
13. Srivastava S, Saidaiah P, Shivraj N, Ravinder RK. Yield and Quality Based Phenotyic Evaluation of Germplasm of Brinjal (*Solanum melongena* L.) Under Semi-Arid Conditions. Int. J Curr. Microbiol. App. Sci. 2009;8(7):415-422.