Int.J.Curr.Microbiol.App.Sci (2018) 7(1): 466-471

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 7 Number 01 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.701.055

Estimation of Genetic Parameters for Fruit Yield, Yield Related Traits and Traits Related to WUE in F_5 Generation of the Inter-Specific Cross between EC 771612 × LA 2657 in Tomato

D.L. Savithramma, Sritama Kundu*, K. Mallikarjun and S.V. Madhu

Department of Genetics and Plant Breeding, University of Agricultural Sciences, GKVK, Bengaluru -560065, Karnataka, India
**Corresponding author*

Keywords

Genetic variability, Correlation, Segregants, Tomato

Article Info

Accepted:
06 December 2017
Available Online:
10 January 2018

A B S T R A C T

Study of genetic parameters in F_5 segregating population developed from the cross EC 771612 × LA 2657 during summer 2017 for fruit yield and its attributing traits and traits related to WUE was carried out in augmented design. Analysis of variance indicates the presence of significant variability for all the characters among F_5 segregants which indicates the existence of sufficient variability. Therefore the population was subjected for determination of genetic parameters and correlation. High GCV and PCV coupled with narrow difference between PCV and GCV were found for fruits per plant, plant height, clusters per plant and fruit yield per plant indicating less environmental influence on expression of these characters therefore individual plant selection can be followed for improvement of these characters. High heritability coupled with high genetic advancement as a *per cent* of mean was observed for fruits per plant, plant height, and clusters per plant and fruit yield indicating the involvement of additive gene action for expression of these traits in crosses studied. Characters like fruits per plant, plant height; fruits per clusters and clusters per plant have shown the presence positive significant association with fruit yield among F_5 segregants implying that fruit yield *per* plant could be improved up on improving some of the traits like fruits per plant, plant height, fruits per clusters and clusters per plant.

Introduction

Tomato (*Solanum lycopersicum*), is one of important vegetable crop belonging to family *solanaceae* which is mainly grown in the world because of its high nutrient content and is an important source of sugars, vitamins, minerals and antioxidant compounds (Raiola *et al.*, 2014). Tomato stands third in priority after potato and onion in India but ranks second after potato in the world where India stands second in terms of area and production. Changing Climate worldwide is regarded as one of the greatest challenges for future food security. Further occurrence of drought in conjunction with high temperature and radiation acts as critical yield limiting factors of tomato. It is broadly accepted that breeding for drought tolerance has proven to be difficult due to very complex and till date sometimes poorly understood tolerance mechanisms (Van Bueren *et al.*, 2011). Crop productivity and water availability are interdependent when water becomes limiting, crop yields are also reduced. Global climate change is influencing rainfall patterns, plant transpiration rates, and agricultural productivity (Walthall *et al.*, 2012), (Foolad *et al.*, 2003; Nahar and Ullah, 2011, 2012).

Traits that accurately quantify and reflect a plant's ability to perform under water stress are essential for effective crop breeding efforts (Richards, 2006; Tuberosa, 2012). Water-use efficiency (WUE) determines plant growth habits in water-limiting environments (Comstock *et al.*, 2005; Xu *et al.*, 2008).

However, it is difficult to measure WUE rapidly therefore, surrogate traits are often taken into consideration which includes $\Delta^{13}C$, SPAD chlorophyll meter readings (SCMR) and Specific leaf area (SLA = leaf area/dry leaf mass) (Comstock *et al.*, 2005; Chen *et al.*, 2013; Martin *et al.*, 1999; Tuberosa, 2012). $\Delta^{13}C$ is negatively correlated with WUE (Farquhar and Richards, 1984). High SLA has been reported to be associated with water-hungry plant growth (Deines *et al.*, 2011). SPAD chlorophyll meter readings (SCMR) and Specific leaf area (SLA) and have early been reported as important surrogate traits for tolerance to drought in peanut and groundnut (Rao *et al.*, 2001; Leal-Bertioli *et al.*, 2012; Janila *et al.*, 2015, Xiong *et al.*, 2015).

Materials and Methods

To developing superior segregants for fruit yield with high water use efficiency traits F_5 segregants were developed from the inter-specific cross between EC 771612 (*Solanum lycopersicum*) which is a high fruit yielding with drought susceptible and LA 2657 (*Solanum penellii*) an accession line which is low yielding but drought tolerant. These two germplasm lines were selected from one hundred tomato germplasm accessions which were screened for drought stress in *rabi* 2015 in two separate experiments. One under well watered and second under water stress condition. Water stress was imposed at 60days after transplanting in stress plot for 20 days and the well water condition experiment was given drip irrigation twice a week.

As a procedure of plant to row progeny method 88 F_5 superior segregants along with parents and checks were sown during summer 2017 in augmented design. Entire design was divided into five blocks and in each blocks parents and checks were replicated thrice to minimize environmental error. All recommended agronomic practices and plant protection measures were followed during the crop growth period to ensure proper growth and good yield. The observations were recorded for all the plants.

Observations for individual plants was recorded for both WUE and fruit yield traits that includes Days to flowering (DFF), SPAD chlorophyll meter reading (SCMR), Specific leaf area (SLA), plant height (PH, cm), Branches *per* plant, flowers *per* cluster (FLPP), fruits *per* cluster (FRPP), clusters *per* plant (CPP), Average fruit weight (AFW, g), No. of fruits *per* plant (FRT No.) and fruit yield *per* plant (g).

The genotypic and phenotypic co-efficient of variations was computed as suggested by Robinson *et al.*, (1949). Heritability and genetic advance were worked out as per the method outlined by Hanson *et al.*, (1956).Correlation co-efficient of each character between two generations was found out by calculating the phenotypic correlation coefficient exactly as described under taking the same character in both the generations.

Results and Discussion

Analysis of variance in F_5 segregating population for the inter-specific cross EC 771612 × LA 2657 revealed significant differences (Table 1) among the lines for all the characters.

Table.1 Analysis of variance of yield and yield related traits in F_5 segregating population of the inter-specific cross EC-771612 x LA-2657 in Tomato

		Physiological		Morphological Parameters				Fruit Parameters				
Source of Variation	**DF**	**SCMR**	**SLA (cm^2g^1)**	**DFF**	**Plant Ht(cm)**	**Branches/ plant**	**Flowers/ cluster (FLPP)**	**Fruits /cluster (FRPP)**	**Clusters /plant (CPP)**	**Avg. Fruit weight (g) (AFW)**	**No. of Fruits/plant**	**Fruit Yield/ plant(g)**
Blocks	4	2.33	33.45**	0.45	32.45	0.256	9.63**	0.156	10.25	3.52	856.32	992.49
Entries	130	32.56**	1245.63**	13.52**	1245.69**	8.56*	10.22**	12.33**	452.36**	478.52	1545.32**	16992.35**
Checks	3	152.33**	1745.36**	63.52**	589.63**	7.45**	15.63**	21.33**	7856.23**	4552.36**	223458.80**	3254525.60**
Varieties	90	28.52**	745.63**	10.23**	1326.33**	8.55**	12.55**	10.25**	145.33**	9.52**	7452.33**	8862.544**
Checks vs. Varieties	1	263.45**	632.56**	174.52**	789.63**	52.36**	96.56**	78.55**	1789.56**	2456.32**	5.63	1.375
ERROR	12	1.55	2.78	0.66	20.14	0.17	0.14	0.145	11.23	2.56	796.33	847.711

Note: * Probability @ 0.05 ** Probability @0.01

Table.2 Estimation of genetic variability for yield and yield related traits in F_5 segregating population of the inter-specific cross EC-771612 x LA-2657 in Tomato

	Physiological		Morphological Parameters			Fruit Parameters					
	SCMR	**SLA (cm^2g^1)**	**DFF**	**Plant Ht(cm)**	**Branches/ plant**	**Flowers/ cluster (FLPP)**	**Fruits/ cluster (FRPP)**	**Clusters/ plant (CPP)**	**Avg. Fruit weight (g)(AFW)**	**No. of Fruits/plant**	**Fruit Yield/ plant(g)**
GCV	15.33	20.36	12.52	32.52	22.33	25.63	30.12	34.52	42.63	35.52	41.52
PCV	18.56	25.63	14.56	33.65	23.12	25.89	31.02	36.518	45.52	38.52	43.52
h^2_{bs} (%)	93.34	99.53	93.12	98.16	96.71	98.59	97.32	82.87	80.64	89.43	89.65
GAM	19.23	34.28	11.39	55.58	53.14	46.37	51.48	62.34	91.95	88.11	97.74

Table.3 Correlation coefficient for yield and yield related traits in F_5 segregating population of the inter-specific cross EC-771612 x LA-2657 in Tomato

	DFF	SCMR	SLA (cm^2g^{-1})	Plant height (cm)	Branches/plant	Flowers / cluster	Fruits/ cluster	Clusters / plant	Avg. Fruit weight (g)	No of Fruits/ plant	Fruit yield per plant (g)
DFF	1.00	0.12	-0.24*	0.35*	0.45**	0.32*	0.24*	-0.36*	0.23*	0.23*	0.22*
SCMR		1.00	-0.32*	0.44**	0.48**	0.56**	0.32*	0.25*	0.37*	0.42**	0.45**
SLA(cm^2g^{-1})			1.00	-0.25*	-0.23*	-0.32*	-0.24*	0.33*	-0.45**	0.35*	-0.52**
Plant height(cm)				1	0.88**	0.56**	0.68**	0.45**	0.33*	0.68**	0.65**
Branches/ plant					1	0.48**	0.56**	0.26*	0.28*	0.45**	0.74**
Flowers/cluster						1	0.79**	-0.26*	-0.33*	0.78**	0.69**
Fruits/cluster							1	-0.34*	-0.37*	0.82**	0.82**
Clusters/ plant								1	-0.78**	0.84**	0.75**
Avg. Fruit weight(g)									1	-0.65**	0.56**
No. of Fruits/plant										1	0.78**

Table.4 Comparison of correlation regression and heritability for traits related to fruit yield and WUE in F_4 segregating population of the inter-specific cross EC-771612 x LA-2657 in Tomato

Characters	Correlation (r-value)	Regression (b-value)	Heritability $h^2_{(bs)}$ (%)	Range
Days to flowering	0.22*	0.32	93.12	10.20
SCMR	0.45**	0.61	93.34	55.45
SLA (cm^2g^{-1})	-0.52**	-0.44	99.53	46.32
Plant height (cm)	0.65**	0.76	98.16	53.00
No Branches/ plant	0.74**	0.65	96.71	12.00
Flowers/ cluster	0.69**	0.57	98.59	9.00
Fruits/ clusters	0.82**	0.74	97.32	7.00
Clusters/plant	0.75**	0.66	82.87	46.00
Avg. Fruit weight(g)	0.56**	0.43	80.64	4.21
No. of Fruits/plant	0.78**	0.73	89.43	42.00
Fruit yield per plant (g)	-	0.88	89.65	530.5

Further, segregating progenies and checks also recorded presence of high variability for all the characters, which indicates the presence of enormous genetic variability and the choice of the material for the investigation is appropriate.

Genetic variability parameters

Data presented in the Table 2 indicates the presence of wider range which implies availability of a higher magnitude of variability among the segregating population which is further confirmed by the presence of high PCV and GCV for all the traits, therefore influence of environment on the expression of these characters is low.

High heritability coupled with high GAM was noticed for all the characters which imply the involvement of additive gene action on the expression of fruit yield and its attributes. So, individual plant selection for these traits could be practiced for selection of superior segregants from the F_5 generation.

Correlation of fruit yield per plant with growth parameters, traits related to WUE and yield component characters

Phenotypic correlation coefficients studies revealed that (Table 3) fruit yield per plant had strong positive correlation with fruits per plant, clusters per plant, fruits per cluster, plant height and SCMR, indicating that improvement of above mentioned traits indirectly leads to improvement in fruit yield coupled with water use efficiency. Significant negative association of fruit yield per plant with SLA was observed indicating that negative relationship of fruit yield per plant with SLA. Therefore selection plants which produce lower SLA and higher fruit yield would leads to development of superior segregants for high yielding and water use efficient in a single selection programme.

Comparison of correlation, regression and heritability among the F_5 segregants for traits related to fruit yield and WUE

Data presented in the Table 4 indicates the presence of significant positive correlation coupled with high positive regression of fruit yield per plant with plant height, SCMR, clusters per plant, fruits per clusters, fruits per plant and average fruit yield. High heritability with narrow range of above mentioned traits indicates the involvement of additive gene action on the expression of these traits. Further positive correlation coupled with high regression concludes the improvement of above mentioned traits would lead to improvement of fruit yield coupled with high water use efficiency. Hence these traits can be used as preferential criteria for selection of superior segregants for high fruit yield and high water use efficiency in a single breeding programme.

Selected superior segregants in F_5 segregating generations in the cross EC 771612 × LA 2657 of tomato

Top high fruit yielding progenies were selected from F_4 segregating population and they also recorded more number of fruits per plant, more number of clusters per plant, taller plant and higher SCMR value coupled with higher fruit yield over parents and checks. Further these selected superior progenies from F_4 generation are still segregating for many loci hence some more generation need to be selfed to achieve complete homozygosity for all loci before predicting their performance either for station trial or multi location trail.

References

Henareh, M., Dursun, A. and Mandoulakani, B.A., 2015, Genetic diversity in tomato landraces collected from turkey and Iran revealed by morphological characters.

Acta Sci. Pol. Hortorum Cultus, 14(2): 87-96.

Hu, X., Wang, H., Chen, J. and Yang, W., 2012, Genetic diversity of Argentina tomato varieties revealed by morphological traits, simple sequence repeat, and single nucleotide polymorphism markers. *Pak. J. Bot.*, 44(2): 485-492.

Janila, P., Manohar, S.S., Rathore, A. and Nigam, S.N., 2015, Inheritance of SPAD chlorophyll meter reading and specific leaf area in four crosses of groundnut (*Arachis hypogaea* L.). *Indian J. Genet.*, 75(3): 408-412.

Kalariya, K.A., Singh, A.L., Chakraborty, K., Ajay, B.C., Zala, P.V., Patel, C.B., Nakar, R.N., Goswami, N. and Mehta, D., 2015, SCMR: A more pertinent trait than SLA in peanut genotypes. *Proc. Natl. Acad. Sci., India, Sect. B Biol. Sci.,* pp: 1-11.

Kashiwagi, J., Upadhyaya, H.D. and Krishnamurthy, L., 2010, Significance and genetic diversity of SPAD chlorophyll meter reading in chickpea germplasm in the semi-arid environments. *J. Food Legumes*, 23(2): 99-105.

Kumar, R., Ram, C.N., Yadav, G.C., Deo, C., Vimal, S.C. and Bhartiya, H.D., 2014, Appraisal studies on variability, heritability and genetic advance in tomato (*Solanum lycopersicon* L.). *Plant Arch.*, 14(1): 367-371.

Lakshmamma, P., Prayaga, L. and Sarada, C., 2010, Evaluation of castor (*Ricinus communis* L.) germplasm for water use efficiency (WUE) and root characters. *Indian J. Plant Genet. Resour,* 23(3): 276-279.

Patel, M.S., Singh, N., Kumar, A., Singh, M.K., Yadav, G.C. and Ghuge, M.B., 2015, Genetic variability, heritability and genetic advance of growth and yield components of tomato (*Lycopersicon esculentum* M.). *Environ. Ecol.*, 33(3): 1034-1037.

Ramzan, A., Khan, T.N., Nawab, N.N., Hina, A., Noor, T. and Jillian, G., 2014, Estimation of genetic components in F_1 hybrids and their parents in determinate tomato (*Solanum lycopersicum* L.). *J. Agric. Res.*, 52(1): 65-75.

Saleem, M.Y., Iqbal, Q. and Asghar, M., 2013, Genetic variability, heritability, character association and path analysis in F_1 hybrids of tomato. *Pak. J. Agri. Sci.*, 50(4): 649-653.

Ullah, M.Z., Hassan, L., Shahid, S.B. and Patwary, A.K., 2015, Variability and inter relationship studies in tomato (*Solanum lycopersicum* L.). *J. Bangladesh Agril. Univ*., 13(1): 65-69.

How to cite this article:

Savithramma, D.L., Sritama Kundu, K. Mallikarjun and Madhu, S.V. 2018. Estimation of Genetic Parameters for Fruit Yield, Yield Related Traits and Traits Related to WUE in F_5 Generation of the Inter-Specific Cross between EC 771612 × LA 2657 in Tomato. *Int.J.Curr.Microbiol.App.Sci.* 7(01): 466-471. doi: https://doi.org/10.20546/ijcmas.2018.701.055