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Prakash E
PG scholar, Department of
vegetable crops, HC & RI,
Coimbatore, TNAU,
Tamil Nadu, India

Premalakshmi V
Assistant professor
(Horticulture), HC & RI,
Coimbatore, TNAU,
Tamil Nadu, India

Arumugam T
Dean (Horti.), HC&RI,
Periyakulam, TNAU,
Tamil Nadu, India

Thiruvengadam V
Assistant Professors (Plant
breeding and genetics), CPBG,
Coimbatore, TNAU,
Tamil Nadu, India

Correspondence
Premalakshmi V
Assistant professor
(Horticulture), HC & RI,
Coimbatore, TNAU,
Tamil Nadu, India

Evaluation of indeterminate tomato hybrids (*Solanum lycopersicum*. L) for fruit quality and biochemical traits under polyhouse condition

Prakash E, Premalakshmi V, Arumugam T and Thiruvengadam V

Abstract

Protected cultivation offers higher production and productivity per unit area and better-quality products for year-round production gaining importance among the growers. The present investigation on evaluation of five promising indeterminate tomato hybrids and their parents with check hybrids namely Naveen and Savannah under polyhouse condition was undertaken during 2018 – 2019 at Department of Vegetable Crops, Horticultural College and Research Institute, TNAU, Coimbatore. The results reported that the hybrids Punjab Sartaj X EC163605 and Punjab Sartaj X IIVR BT-10 were recorded the highest values for fruit quality and biochemical traits viz., pericarp thickness (5.69 and 5.76 mm), fruit firmness (3.00 and 3.04 kgf/cm²), shelf life (45 and 40.8 days), ascorbic acid (14.75 and 13.90 mg/100g), titrable acidity (0.46 and 0.38 %), lycopene content (0.32 and 0.36 mg/100g) and β carotene content (0.44 and 0.46 mg/100g) compared to the check hybrids. This can be recommended for cultivation under polyhouse condition for fruit yield and quality.

Keywords: Indeterminate tomato hybrids (*Solanum lycopersicum*. L), fruit quality, biochemical traits

Introduction

Tomato (*Solanum lycopersicum*. L) is the most popular and the major vegetable under cultivation after potato. India ranks second in tomato production after China with 18.74 million tonnes accounting for worlds 10 per cent share in production of 170.75 million tonnes per annum (NHB, 2017). It considered as protective food which contains vitamin C and pigments like lycopene and β carotene for more health benefits. It was grown for fresh consumption and processing for various processed products. Recent years the protected cultivation gaining importance for vegetable cultivation which advances the production, increased yield and quality, higher productivity per unit area, healthy product, protection from pest and diseases. The area under protected cultivation of vegetable was 402, 981 ha in the world and in India 2000 hectares (Sabir and Singh. 2013) [14]. Even though protected cultivation is popular among the farmers there is no specific variety or hybrids specifically breed for polyhouse condition so far. The indeterminate type of tomato was better suitable under polyhouse cultivation for higher yield and long growing season. Considering these points, present investigation was carried out on evaluation of promising indeterminate F₁ hybrids in tomato for fruit quality and fruit biochemical traits under polyhouse cultivation.

Materials and methods

The study conducted during the 2018 – 2019 at Department of vegetable crops, Horticultural college and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The experimental materials comprised of five parents viz., EC 160885, Punjab Sartaj, IIHR 2042, EC 163605, IIVR BT 10 and five F₁ hybrids viz., EC 160885 X EC 163605, Punjab Sartaj X EC 163605, IIHR 2042 X EC 163605, Punjab Sartaj X IIVR BT-10, IIHR 2042 X IIVR BT-10 two commercial hybrids Naveen and Savannah as a check were evaluated under naturally ventilated polyhouse condition. The materials were evaluated under Randomized block design with three replications. The observations were recorded for fruit quality and fruit biochemical traits viz., fruit firmness (kgf/cm²), pericarp thickness (mm), number of locules per fruit, fruit shape index, shelf life (days), physiological loss in weight (%), total soluble solids ($^{\circ}$ Brix), ascorbic acid (mg/100g), titrable acidity (%), lycopene content (mg/100g) and β carotene content (mg/100g). The data were analysed by using the statistical package for social science (SPSS).

Result and discussion

The analysis of variation showed that the significance difference for all the fruit quality and biochemical traits indicated that wide range of variation present among the parents and hybrids under evaluation (Table 1).

The fruit firmness ranged from 1.39 (IIVR BT-10) to 2.99 kgf/cm² (Punjab Sartaj) among the parents. The highest fruit firmness was observed in Punjab Sartaj X IIVR BT-10 (3.04 kgf/cm²) followed by EC 160885 X EC 163605 (3.00 kgf/cm²) which was superior over the check Naveen (2.99 kgf/cm²). whereas, lowest fruit firmness was recorded for 2.25 kgf/cm² in IIHR 2042 X EC 163605. High pericarp thickness and less number of locules gives high firm fruit. The high fruit firmness influences the shipping ability and keeping quality. These results were consonance with Bharathkumar *et al.* (2017)^[1] and Farooq *et al.* (2013)^[5] for fruit firmness.

The parent's recorded pericarp thickness ranged from 4.69 (EC 163605) to 6.41 mm (Punjab Sartaj). The pericarp thickness was high in Punjab Sartaj X IIVR BT-10 (5.76 mm) followed by Punjab Sartaj X EC 163605 (5.69 mm) and IIHR 2042 X IIVR BT-10 (5.64 mm) which was higher than the check Naveen (5.50) and Savannah (5.42). The high pericarp thickness is due to the pericarp cells which contain a greater number of starch grains and the accumulation of assimilates is also more. Thick pericarp is suitable for canning and is a useful character in respect of post-harvest handling of fruit during transportation. Hazarika and Phookan (2005)^[7] and Farooq *et al.* (2013)^[5] demonstrated the utility of thick pericarp trait as one of the trait for selection.

Among the parents, number of locules per fruit ranged from 2.20 (Punjab Sartaj) to 3.66 (IIVR BT-10). Lower number of locules per fruit was observed in Punjab Sartaj X EC 163605 (2.60) followed by Punjab Sartaj X IIVR BT-10 (2.75) and EC 160885 X EC 163605 (3.00) whereas, the check Naveen (3.13) and Savannah (3.06) recorded the higher locule number. The fruits with less locule number are preferable as it gives better firmness and indirectly better storability. The higher number of locules was observed in IIHR 2042 X EC 163605 (3.40). The fruits containing higher number of locules were juicier and more suitable for table purpose. The results were confirming the findings of Kanwar (2011)^[10] and Sharma and Singh, (2015)^[17] under polyhouse condition.

The shape index among the parents ranged from 0.81 (Punjab Sartaj) to 0.91 (IIVR BT-10). The hybrid IIHR 2042 X EC 163605 registered high fruit shape index of 0.99 followed by Punjab Sartaj X IIVR BT-10 (0.98) and IIHR 2042 X IIVR BT-10 (0.98) whereas, low fruit shape index was registered in EC 160885 X EC 163605 (0.92). The shape index was statistically on par with check Naveen (0.98) whereas, Savannah recorded the shape index of 1.07. The spherical fruit shape was observed in the hybrids as it recorded the shape index (0.86 – 0.99). Variation in fruit size (fruit length and diameter) is associated with genetic makeup and governed by cell size and intercellular space of the flesh, as was observed by Regassa *et al.* (2012)^[16] and Jindal *et al.* (2015)^[8].

The shelf life of parents ranged from 32 (EC 163605) to 41.00 days (EC 160885). Whereas, the hybrid Punjab Sartaj X EC 163605 recorded the highest shelf life of 45.00 days followed by IIHR 2042 X EC 163605 (43.00 days) and IIHR 2042 X IIVR BT-10 (42.00 days). Whereas, the check Naveen (38 days) and Savannah (39 days) recorded the lower shelf life when compared to the hybrids. The lowest shelf life was observed in EC 160885 X EC 163605 (38.00 days). The

parents recorded physiological loss in weight ranged from 23.30 (EC 160885) to 75.50 per cent (EC 163605). Physiological loss in weight was low in Punjab Sartaj X EC 163605 (40.09 %) followed by Punjab Sartaj X EC 163605 (40.28 %) and IIHR 2042 X IIVR BT-10 (42.46 %) Whereas, the check Naveen (50.57 %) and Savannah (51.90 %) registered the high physiological loss in weight. whereas, high physiological loss in weight was observed in EC 160885 X EC 163605 (55.26). The variation in shelf life and physiological weight in loss might be due to the respiration and transpiration and also the nutritional factors and harvested stage. The fruits having low water content will exhibit long shelf life. The difference in shelf life because of ripening gene mutants may be present in certain hybrids which participate in ethylene independent signalling and imparts the delayed ripening in tomato as was observed in the studies of Regassa *et al.* (2012)^[16], Chibi *et al.* (2015) and Kumar and Gowda (2016)^[11].

The total soluble solids ranged from 5.27 (EC 163605) to 6.43 ° Brix (IIHR 2042) among the parents. High total soluble solids were recorded in IIHR 2042 X IIVR BT-10 (6.54 ° Brix) followed by Punjab Sartaj X IIVR BT-10 (6.39 ° Brix) and IIHR 2042 X EC 163605 (6.14 ° Brix) which was higher when compared to the check Naveen (6.20 ° Brix) and (6.08 ° Brix). High TSS and low acidity are the major factors considered for fruit processing products. The one per cent increase in TSS results in 20 per cent increases in recovery of processed products. High TSS due to the enhanced deposition of solids and more conversion of organic acids to sugars. About 50 to 65% of TSS would be sugars as glucose and fructose and their amount and proportion influenced the organoleptic quality of tomato. This is in close agreement with the results obtained by Chapagain *et al.* (2014), Gupta *et al.* (2017)^[6] and Omprasad *et al.* (2018)^[13]. The total soluble solids were low in EC 160885 X EC 163605 (5.41 ° Brix)

Among the parents, ascorbic acid ranged from 12.15 (IIVR BT-10) to 14.84 mg/100g (EC 160885). High ascorbic acid content was registered in EC 160885 X EC 163605 (17.03 mg/100g) followed by Punjab Sartaj X EC 163605 (14.90 mg/100g) and IIHR 2042 X EC 163605 (14.75 mg/100g). These hybrids were recorded higher ascorbic acid when compare to check Naveen (12.17 mg/100g) and Savannah (13.63 mg/100g). Whereas, low ascorbic acid was recorded in Punjab Sartaj X IIVR BT-10 (13.90 mg/100g). The higher ascorbic acid is primarily due the genetic potential of the hybrids which can be used for nutritional perspective to prevent the scurvy and maintenance of skin and blood vessels. Hazarika and Phookan (2005)^[7], Cheema *et al.* (2013)^[3] and Lekshmi and Celine (2015)^[12] observed variation for ascorbic acid content among tomato hybrids.

The acidity among the parents ranged from 0.28 (Punjab Sartaj) to 0.50 per cent (IIVR BT-10). The titrable acidity was high in IIHR 2042 X IIVR BT-10 (0.53%) followed by Punjab Sartaj X EC 163605 (0.46 %) and Punjab Sartaj X IIVR BT-10 (0.38 %) which was higher than the check Naveen (0.48 %) but Savannah recorded the fruit acidity of 0.60 per cent. Higher fruit acidity lowers the incidence of fungal infection in tomato (Mohammed *et al.*, 1999). Low acidity of 0.32 per cent was recorded in IIHR 2042 X EC 163605. Lower acidity might due to rapid utilization of organic acids in respiration during maturity. This is in accordance with the Cheema *et al.* (2014)^[4], Singh *et al.* (2014)^[15] and Omprasad *et al.* (2018)^[13].

The lycopene content ranged from 0.23 (IIHR 2042) to 0.69 mg/100g (IIVR BT-10) among the parents. The hybrid IIHR

2042 X IIVR BT-10 recorded the high lycopene content of 0.46 mg/100g followed by IHR 2042 X EC 163605 (0.38 mg/100g) and Punjab Sartaj X IIVR BT-10 (0.36 mg/100g). The hybrid Naveen (0.27 mg/100g) and Savannah (0.30 mg/100g) recorded low lycopene content when compared to the hybrids. The lycopene content was low in Punjab Sartaj X EC 163605 (0.32 mg/100g). Among the parents, β -carotene content ranged from 0.30 (EC 163605) to 0.87 mg/100g (IIVR BT-10). Highest β -carotene content was recorded in IHR 2042 X EC 163605 (0.49 mg/100g) followed by IHR 2042 X IIVR BT-10 (0.48 mg/100g) and Punjab Sartaj X IIVR BT-10 (0.46 mg/100g) whereas, the hybrid EC 160885 X EC 163605 recorded the low β -carotene content of 0.40

mg/100g. These hybrids were recorded the highest carotene content than the check Naveen (0.32 mg/100g) and Savannah (0.38 mg/100g). The variation in lycopene and β carotene content might be due to the genetic makeup of the hybrids and also the favourable environmental condition inside the polyhouse. Both the pigments are the potential antioxidants which scavenge the free radicals in human body. The deep red colour associates with lycopene while orange colour is associated with high β carotene. Cheema *et al.* (2013) ^[3], Lekshmi and Celine (2015) ^[12] and Omprasad *et al* (2018) ^[13] reported the similar results as observed in the present study for lycopene and β carotene content.

Table 1: Mean performance of parents and hybrids of indeterminate tomato hybrids under polyhouse condition for fruit quality and biochemical traits.

Parents and hybrids	Fruit firmness (kgf/cm ²)	Pericarp thickness (mm)	Number of locules per fruit	Shape index	Shelf life (days)	Physiological loss in weight (%)	Total soluble solids (° Brix)	Ascorbic acid (mg/100g)	Acidity (%)	Lycopene content (mg/100g)	β -carotene (mg/100g)
EC 160885	2.86	6.19	2.93	0.88	41.00	23.30	5.30	14.84	0.40	0.41	0.40
Punjab Sartaj	2.99	6.41	2.20	0.81	40.00	40.30	6.32	13.21	0.28	0.25	0.33
IHR 2042	2.19	5.28	2.73	0.90	36.00	70.16	6.43	14.18	0.30	0.23	0.38
EC 163605	2.39	4.69	2.33	0.89	32.00	75.50	5.27	13.58	0.42	0.39	0.30
IIVR BT- 10	1.39	5.68	3.66	0.91	35.00	61.23	6.39	12.15	0.50	0.69	0.87
EC 160885 X EC 163605	2.61	5.19	3.00	0.92	38.00	55.26	5.41	17.03	0.37	0.34	0.40
Punjab Sartaj X EC 163605	3.00	5.69	2.60	0.94	45.00	40.28	5.82	14.75	0.46	0.32	0.44
IHR 2042 X EC 163605	2.25	5.52	3.40	0.99	43.00	40.09	6.39	14.90	0.32	0.38	0.49
Punjab Sartaj X IIVR BT- 10	3.04	5.76	2.75	0.98	40.80	50.01	6.14	13.90	0.38	0.36	0.46
IHR 2042 X IIVR BT- 10	2.29	5.64	3.33	0.98	42.00	42.46	6.54	14.53	0.53	0.46	0.48
Naveen (Check)	2.99	5.50	3.13	0.98	38.00	50.57	6.20	12.17	0.48	0.27	0.32
Savannah (Check)	3.66	5.42	3.06	1.07	39.00	51.90	6.08	13.62	0.60	0.30	0.38
SEd	0.12	0.27	0.14	0.04	1.91	2.64	0.29	0.70	0.01	0.01	0.02
CD (p = 0.05)	0.26	0.56	0.29	0.09	3.96	5.48	0.61	1.46	0.04	0.03	0.04

Conclusion

The present study revealed that the hybrid Punjab Sartaj X EC163605 was recorded the highest performance in fruit quality and biochemical traits *viz.*, high fruit firmness, high pericarp thickness, less number of locules per fruit, more shelf life, minimum physiological loss in weight, ascorbic acid and titrable acidity followed by the hybrid Punjab Sartaj X IIVR BT-10 recorded for the traits *viz.*, fruit firmness, pericarp thickness, number of locules per fruit, total soluble solids, titrable acidity, lycopene and β carotene content. Based on the finding, it can be concluded that the hybrids Punjab Sartaj X EC163605 and Punjab Sartaj X IIVR BT-10 were performed well for the fruit quality and biochemical traits. This can be recommended for cultivation under polyhouse condition.

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