**A Seminar Paper On**

# Breeding Potential for Cherry Tomato Hybrids (*Solanum lycopersicum* var. *cerasiforme*)

**Course Title**: Seminar

**Course Code**: GPB 598

**SUBMITTED TO:**


**Course Instructors**

**Dr. A. K. M. Aminul Islam**
Professor,
Department of Genetics and Plant Breeding,
BSMRAU

**Dr. Satya Ranjan Saha**
Professor,
Department of Agroforestry and Environment,
BSMRAU

**Dr. Shaikh Shamim Hasan**
Professor,
Dept. of Agricultural Extension and Rural Development
BSMRAU

**Dr. Dinesh Chandra Shaha**
Associate Professor**,**
Department of Fisheries Management,
BSMRAU

**Major Professor**

**Dr. A. K. M. Aminul Islam**
Professor,
Department of Genetics and Plant Breeding
BSMRAU

**Submitted by:**
**Srabone Akter Dhulon**
Reg. No. 17-05-4187
MS Student
Term: Winter'22
Department of Genetics and Plant Breeding

**BANGABANDHU SHEIKH MUJIBUR RAHMAN AGRICULTURAL UNIVERSITY, GAZIPUR-1706**

**Breeding Potential for Cherry Tomato Hybrids (*Solanum lycopersicum* var. *cerasiforme*)[1]**

**Srabone Akter Dhulon[2]**

## Abstract

This review paper was prepared on breeding potential for cherry tomato hybrids. All data were collected from secondary sources. In this study combining ability were discussed for cluster per plant, fruits per cluster, fruits per plant, and fruit yield plant per kg and performance of cherry tomato hybrids were discussed for earliness, plant height, longer shelf life and quality content. For earliness, Petomech×Small Fry showed 83 days to maturity; for highest plant height hybrid EC-165690×VRT-02(515.11cm); crosses EC-914115 x VRT-02, WIR-5032 x EC-914115, TOCVAR-1×TOCVAR-3 and IIHR2754XIIHR-2860 were found to exhibit significant and desirable SCA effects for highest cluster per plant, fruits per cluster, fruits per plant and yield per plant in kg; for fruit size hybrids EC-165690xWIR– 3957(5.56g; FL 11.90cm; FD 13.70cm), Ch 3×Ch 8 (9.7g, FL 23.5cm, FD 23.6 cm) and TOCVAR-3×Cherry Round Yellow (9.87g, FL 23.13cm; FD 24.32cm) were found better. In case of longer shelf life, the cross P8 x P2 and P8×P3 recorded the highest shelf life (32.00 days). In case of quality, hybrid TOCVAR-1 × TOCVAR-6 was higher than other hybrids(TSS 8.2); hybrid EC-914097x VRT - 02 had highest total sugar%(5.74%) reducing sugar%(4.75%), hybrids EC-165690xVRT – 02, EC- 914092xWIR – 3957, EC-914092xEC-914097 had highest non reducing sugar% and hybrid Sun-cherry x EC – 520078 had highest juice to pulp ratio. The hybrids with earliness, higher yield, and quality can be used for further breeding programs to fulfil farmers and consumer demand.

**Keywords:** Cherry tomato, hybrids, Combining ability, Earliness, Yield, Shelf life, Quality.

---

[1] A seminar paper presented for seminar course GPB 598; winter'2022

[2] MS Student, Department of Genetics and Plant Breeding, BSMRAU, Gazipur 1706.

## TABLE OF CONTENTS

## LIST OF TABLES

# List of Figures

# CHAPTER I

## Introduction

Cherry tomato (*Solanum lycopersicum var. cerasiforme*, 2n=2x=24), one of the significant botanical varieties of the cultivated tomato (*Solanum lycopersicum* L.), belongs to the nightshade family "Solanaceae," which has 96 genera and more than 3000 species (Akhtar *et al*., 2013). It is referred regarded as a table tomato and has small, bright red fruits with a flavor that is similar to cherries (Charlo *et al*., 2007). Cherry tomatoes are grown for their edible fruits, which are usually spherical, mature red, little (less than 30g), longer than 1.5 cm but less than 3 cm in diameter (Kalloo, 1991 and Ranc *et al.*, 2008). It is used as a raw ingredient in processed foods such juice, ketchup, sauce, canned fruits, puree, and paste in addition to being eaten as a fresh vegetable. People are consuming more minimally processed meals, which has enhanced the appeal of the cherry tomato, a fruit rich in several organic and inorganic compounds (Wang *et al*., 2018). Fresh cherry tomatoes are the most popular type of consumption due to their high nutritional value, antioxidant properties, and flavor, and their commercial significance is constantly expanding (Kavitha *et al*., 2014; Prema *et al* 2011, and Renuka *et al.*, 2014). The wild cherry tomato originated in tropical and subtropical America before being spread to the tropics of Asia and Africa (Gharezi *et al*., 2012). Right now, cherry tomatoes are grown in large quantities throughout Central America and exported to Spain, Japan, Europe, Mexico, and Florida (Renuka *et al*., 2014).

When cultivated inside of enclosed structures, this warm-season crop is the most promising because it needs extended growing periods to provide several harvests (Vidyadhar *et al*., 2014). Due to the expanding popularity of hybrids and the considerably different consumer acceptance of them, it is imperative to develop high-yielding F1 hybrids with outstanding nutritional quality. The creation of improved F1 hybrids is the focus of numerous tomato breeding initiatives. Tomato hybrids are favoured over pure line types due to their improved disease resistance, earlier maturity, increased uniformity, and superior marketable fruit output and fruit quality (Shankara *et al*., 2005). Because it is cost-effective and profitable to cultivate hybrid varieties, they make up the majority of the tomato crop, particularly in greenhouses. The traits of the parent plants are combined in hybrid plants.

Small and marginal farmers may have opportunities to diversify their crop production and increase sales with open field crops. In order to find superior cherry tomato genotypes for further development in production, fruit quality, and disease tolerance qualities, advance breeding lines for desirable horticultural attributes must be evaluated. For high yield, nutritious properties, greater consumer acceptability, and to meet consumer demand across tropical and subtropical parts of the world, it is important to improve existing cultivars or generate novel hybrid combinations. Because of the high demand and the search for new hybrids that meet the requirements of the consumer market, breeding strategies consist of exploring important agronomic traits, allowing improvements in organoleptic and yield properties to favour both higher quality and production. In this sense, one of the main goals of cherry tomato breeding programs is to select hybrids that simultaneously promote high yield and good taste quality.

**Objectives of this study:**

1. To review the breeding potential of cherry tomato hybrids for improvement earliness, yield longer shelf life and fruit quality.
2. To evaluate the hybrids that can be used for further breeding program.

# CHAPTER II

## MATERIALS AND METHODS

This seminar paper's objective is to offer a review, and all of the data presented here was gathered from secondary sources. Books, journals, papers, internet searches, and library materials were among the sources used. Instructions from honourable course instructor and from major professor were followed. This seminar paper was written using the information gathered and was based on a range of books, journals, and websites.

# CHAPTER III

## REVIEW OF FINDINGS

### 3. Breeding Potential Traits of Cherry Tomato hybrids:

Breeding potential traits of cherry tomato are earliness, higher yield, fruit quality, longer shelf life etc under greenhouse and open field condition, under optimum and disease condition etc. The traits influencing breeding potential are discussed below:

### 3.1. Earliness:

Early fruit harvests throughout the early seasons tend to fetch the best prices on the fresh market, hence early maturity in tomato varieties is greatly desired (Effah et al, 2017). Early growth should be favored, especially in regions with lower seasonal rainfall (Ofori et al., 2005). Different definitions of earliness exist, but generally speaking, relative earliness (or lateness) is defined as the number of days between sowing and the first mature fruit. According to Day et al. (2008), selection for earliness reduces fruit size and has a positive association with the number of degree days to mature fruit. Delay in maturity was caused by selection for high fruit size. The level of genetic variability and the heritability of desired traits are key factors in crop improvement. Variety affects the days to maturity of tomatoes, but environmental factors like temperature and growing conditions also have an impact (Saleem et al., 2011).

Table 1. Maturation responses of cherry tomato

| Tomato genotype | Days to 1st flowering | Days to 50% flowering | Days to maturity |
|---|---|---|---|
| Petomech | 30 | 38 | 90 |
| Small Fry | 30 | 39 | 81 |
| Petomech×Small fry | 31 | 36 | 83 |
| F2 | 30 | 35 | 84 |
| BC1 | 30 | 36 | 88 |
| BC2 | 30 | 36 | 82 |
| MSU50-1 | 31 | 33 | |
| MSU50-6 | 36 | 40 | |

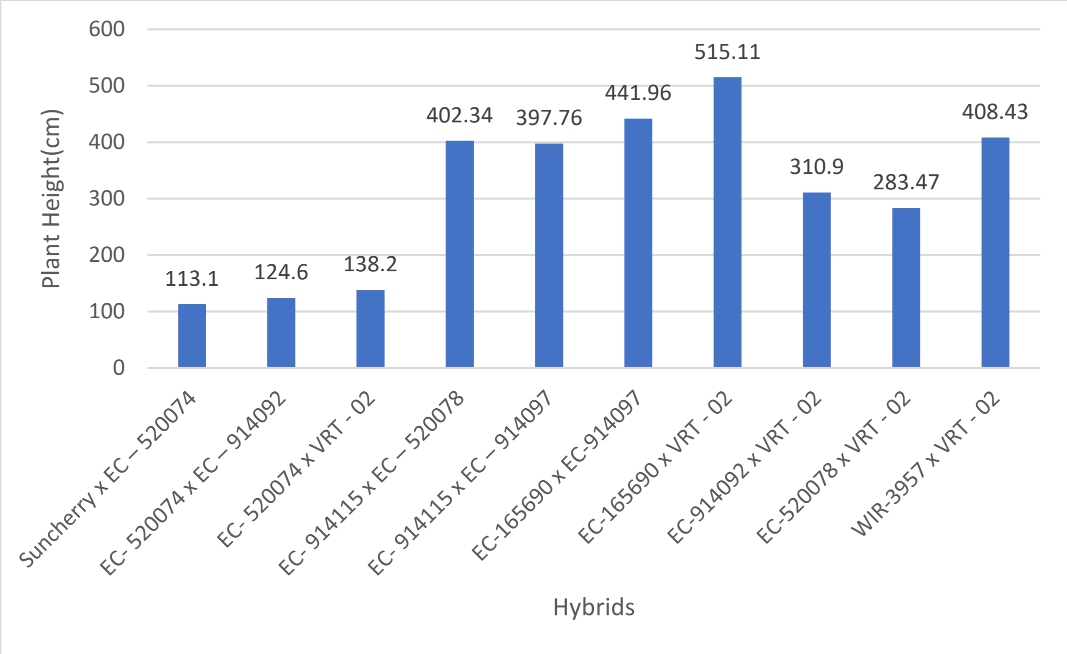
(Sources: Effah *et al.*, 2017; Pasorn *et al*., 2018)

The fruit maturation times of various tomato generations are shown in Table 1. The genotypes did not differ significantly ($P > 0.05$) in the number of days until the first blooming. At 50% flowering, there was a noticeable difference between the genotypes. For the two parental lines, the difference in days from anthesis to the breaker stage of fruit maturity was largest (8.9 days). The means of BC1 and Petomech were extremely similar. The F2 means were considerably biased towards the Small Fry mean. Tomato genotype, Small Fry and Petomech×Small Fry hybrid can be incorporated into other breeding programmes for early fruit maturation.

### 3.2. Yield Potential of Cherry tomato:

The most important selection factor for tomatoes is yield. The main factors affecting tomato yields include plant morphology, physiology, growth circumstances, genotype, and abiotic and biotic stresses (Causse et al., 2007). According to Sulaiman et al. (2013), dominance or overdominance was inherited by a plant's overall fruit yield. In hybrid breeding, output and fruit quality can be combined to enhance tomato performance (Hannan et al., 2007). For the purpose of choosing the best lines to create high-yield cultivars, inheritance of yield and its constituent parts may disclose important information. The most important characteristics that directly affect the amount of plant output are the yield components, specifically the number of fruits per plant and average fruit weight as well as their balance (Venkadeswaran et al., 2018; Sulaiman et al., 2013). Fruit yield is influenced by a variety of factors, including plant height, branching, cluster size, flower and fruit density, and the number of plants and clusters per plant. The yield components, particularly the number of fruits per plant and average fruit weight, as well as their balance, are the most significant features that have a direct relationship to the quantity of plant output (Venkadeswaran et al., 2018; Sulaiman et al., 2013). Fruit yield depends on the many parameters such as plant height, branching, cluster per plant, flowers per cluster, fruits per cluster, fruits per plant etc.

**3.2.1. Plant Height:** Plant height is one of the major contributing characters towards yield. More the height of plant, more the chance of having high branches.




(Source: Lone *et al*., 2022).

**Figure 1**. Average plant height of some cherry tomato hybrids.

From figure 1 we could see that the highest plant height was 515.11cm for the hybrid EC-165690×VRT-02 followed by EC-165690×EC-914097 having 441.96cm. The lowest plant height was 113.1cm for the hybrid Suncherry×EC-520074. Hybrid EC-165690×VRT-02 had the potential for vigorous growth that would ultimately increase yield. This suggests that the distribution of photosynthates and other compounds that aid in plant growth has shifted towards the shoot or increased in the above ground area. This could pave the way for the increase of plant yield (Di et al., 2018).

### 3.2.2. Cluster per plant, fruits per cluster, fruits per plant and fruit yield plant per kg:

The variation in the genetic makeup of the cultivars and their interaction with the environmental factors might explain the variation in yield and yield components characteristics of the studied cultivars (Ali et al., 2016).The factors that contribute most to determining yield are clusters per plant, fruits per cluster, and fruits per plant. A plant having higher cluster means it has the capacity to bear more fruits per cluster. In cherry tomatoes, it is particularly desired to have as many fruit-retaining bloom clusters as possible per plant (Ramya et al., 2016). The cherry tomato's potential yield varies depending on the hybrid and the parents. One of the most important and challenging responsibilities for the breeder in any crop development program is selecting the parents for hybridization (Lone et al, 2022). In addition to having characteristics that are economically desirable, cultivars and lines must also be able to produce high levels of heterosis in F1 crosses in order to be suitable for use as partners in hybrid combinations. The effectiveness of heterosis breeding is significantly influenced by this trait, known as "combining capacity."

The combining ability analysis has been used extensively to identify potential parents either to be used in the development of hybrids or recombinant breeding for getting elite pure parents. This analysis facilitates the partitioning of genotypic variation of crosses into variation due to GCA and SCA. GCA effects are the measure of additive gene action which represent the fixable components of genetic variance and are used to classify the parents for the breeding behavior in hybrid combinations. On the other hand, SCA effects are the measure of non-additive gene action which is related to non-fixable component of genetic variance (Griffing, 1956).

**3.2.2.1.General Combining Ability:** The estimates of GCA effects provides a measure of general combining ability of each genotype, thus aids in selection of superior ones as parental lines for hybridization programmes.

Table 2: General combining ability (GCA) effects for yield and yield attributing traits in cherry tomato

| Parents | Number of clusters plant$^{-1}$ | Number of fruits cluster$^{-1}$ | Number of fruits plant$^{-1}$ | Fruit yield plant$^{-1}$ (Kg) |
|---|---|---|---|---|
| EC – 914115 | 1.785 ** | 0.677 ** | 11.876 ** | -0.061 ** |
| EC – 165690 | -4.292 ** | -0.473 ** | -23.181 ** | 0.188 ** |
| EC – 914092 | -3.148 ** | -0.640 ** | -15.819 ** | 0.419 ** |
| EC – 914097 | -6.233 ** | -0.160 ** | -19.708 ** | 0.283 ** |
| EC-520078 | -0.629 ** | -0.057 ** | -8.746 ** | 0.058 ** |
| EC-520074 | -1.249 ** | 0.710 ** | 9.448 ** | -0.303 ** |
| WIR 5032 | 15.061 ** | 0.385 ** | 72.614 ** | -0.312 ** |
| WIR 3957 | - 2.575 ** | 0.057 ** | -12.495 ** | -0.118 ** |
| VRT-02 | -1.287** | -0.398 ** | -15.936 ** | 0.312 ** |

| Parents | Number of clusters plant$^{-1}$ | Number of fruits cluster$^{-1}$ | Number of fruits plant$^{-1}$ | Fruit yield plant$^{-1}$ (Kg) |
|---|---|---|---|---|
| TOCVAR-1 | 0.809 | 0.793* | 26.254* | 0.330* |
| TOCVAR-3 | −0.888 | 1.625* | 19.209* | 0.104* |
| TOCVAR-4 | 1.737 | −1.125* | −0.049 | 0.257* |
| TOCVAR-5 | 0.48 | −1.166* | −17.172* | -0.233* |
| TOCVAR-6 | −3.611 | 0.373 | −37.218* | -0.287* |
| Cherry-Round Yellow | 1.473 | −0.501* | 8.977* | -0.171* |
| IIHR-2754 | 3.10** | 0.52** | 49.90** | 0.11** |
| IIHR-2858 | 1.21** | 0.56** | 34.34** | |

*, ** Significant at 5 and 1 per cent levels, respectively

(Sources: Lone *et al*., 2022; Debmala *et al*., 2019; Renuka *et al*., 2015)

Parent WIR 5032 manifested significant highest positive GCA effects in terms of number of clusters plant-1. Parent TOCVAR-3 manifested significant positive GCA effects in terms of number of fruits cluster-1. Parent WIR 5032 manifested significant positive GCA effects in terms of number of fruits plant-1. Parent EC – 914092 manifested significant positive GCA effects in terms of fruit yield plant-1.Parents WIR-5032, TOCVAR-3 and EC – 914092 were found to exhibit significant and desirable GCA effects for most of the traits. Hence, these parents could be selected for use in future crop improvement programmes and direct selection for higher values of yield plant-1 can be made in the advanced generations of their heterotic crosses.

**3.2.2.2.Specific Combining Ability:** The specific combining ability reveals the best cross combination among the genotypes which can be useful for developing hybrids with high vigour for the traits.

Table 3: Specific combining ability (SCA) effects for yield and yield attributing traits in cherry tomato

| Crosses | Number of clusters plant$^{-1}$ | Number of fruits cluster$^{-1}$ | Number of fruits plant$^{-1}$ | Fruit yield plant$^{-1}$ (Kg) |
|---|---|---|---|---|
| EC- 520078 x VRT - 02 | -7.693 ** | 0.802 ** | -17.565 ** | 0.915 ** |
| EC- 914115 x VRT - 02 | 17.726 ** | 0.369 ** | 48.590 ** | 0.255 ** |
| WIR – 5032 x WIR – 3957 | 5.913 ** | -0.381 ** | 6.265 ** | 0.774 ** |
| EC-914115 x EC-914097 | 2.714 ** | 1.111 ** | 21.541 ** | -0.470 ** |
| WIR-5032 x EC-914115 | -0.272 ** | 9.550 ** | 1.486 ** | -0.558 ** |
| WIR-5032 x VRT-02 | -0.017 ** | 1.561 ** | 9.786 ** | -0.625 ** |
| TOCVAR-1×TOCVAR-3 | 2.47** | 0.585 | 49.247** | 0.646** |
| TOCVAR-1×TOCVAR-4 | -0.426 | 0.335 | -0.602 | 0.319** |
| TOCVAR-5×TOCVAR-6 | -0.963 | -1.544** | -25.76 | -0.093 |
| TOCVAR-1× Cherry-Round Yellow | 1.711** | -0.959 | 1.109 | -0.059 |
| TOCVAR-1×TOCVAR-5 | 1.158* | 0.706 | 37.068** | 0.270** |
| IIHR2754XIIHR-2860 | -0.38 | -0.56 ** | -31.87 ** | 1.19 ** |
| IIHR-2754XIIHR-2865 | -1.79 * | -0.15 | -24.24 ** | 0.77 ** |

*, ** Significant at 5 and 1 per cent levels, respectively

(Sources: Lone *et al*., 2022; Debmala *et al.*, 2019; Renuka *et al*., 2015)

Cross EC- 914115 x VRT – 02 manifested significant positive SCA effect in terms of number of clusters plant-1. Cross WIR-5032 x EC-914115 manifested significant positive SCA effects in terms of number of fruits cluster-1. Cross TOCVAR-1×TOCVAR-3 manifested significant positive SCA effects in terms of number of fruits plant-1. Cross IIHR2754XIIHR-2860 manifested significant positive SCA effects in terms of fruit yield plant-1.

It is concluded that crosses EC-914115 x VRT-02, WIR-5032 x EC-914115, TOCVAR-1×TOCVAR-3 and IIHR2754XIIHR-2860 were found to exhibit significant and desirable SCA effects for most of the traits. Hence, these crosses could be selected for exploitation of heterosis.

**3.3.Fruit Characteristics:** Cherry genotypes have relatively smaller weights per fruit with most lines weighing between 3.2 and 7.0 grams respectively, a direct product of fruit size. It might be due to the limited energy (source) in comparison with a high number of flowers and fruits (sinks) per plant. In a source-limited situation, carbohydrate content in the plants might be low as plants have sufficient sinks to utilize the produced assimilates. Subsequently, a low source/sink ratio negatively correlates with the potential fruit size (Vidyadhar et al., 2014). Similar results were obtained by (Li et al., 2015) who mentioned that increasing fruit number leads to decreasing average fruit weight. Moreover fruit length and fruit diameter also determines the fruit size.

Table 4: Fruit parameters of some parents of cherry tomato

| Parents | Fruit weight(g) | Fruit Length(cm) | Fruit Diameter (cm) |
|---|---|---|---|
| Ch 3 | 10.1 | 22.1 | 23.1 |
| Ch 8 | 12.7 | 24.5 | 26.1 |
| Ch 14 | 22.4 | 31.3 | 30.9 |
| Ch 16 | 12.2 | 24.5 | 25.5 |
| Ch 18 | 20.3 | 30.8 | 30.3 |
| Ch 21 | 21.7 | 43.9 | 28.9 |
| Ch 22 | 12.7 | 23.9 | 25.9 |
| Ch 25 | 12.4 | 24.4 | 25.4 |
| Tomato 139(P9) | 12.5 | 24.8 | 25.8 |
| TOCVAR-1 | 10.34 | 29.11 | 21.97 |
| TOCVAR-3 | 9.38 | 20.10 | 22.89 |
| TOCVAR-4 | 11.57 | 28.00 | 29.96 |
| TOCVAR-5 | 9.62 | 36.23 | 23.57 |
| TOCVAR-6 | 12.05 | 31.89 | 21.68 |
| Cherry Round Yellow | 7.98 | 17.96 | 17.96 |

| Parents | Fruit weight(g) | Fruit Length(cm) | Fruit Diameter (cm) |
|---|---|---|---|
| Sun-cherry | 14.99 | 15.70 | 15.70 |
| WIR - 5032 | 17.99 | 17.50 | 17.60 |
| EC- 520074 | 33.03 | 21.10 | 23.40 |
| EC- 914115 | 31.38 | 24.50 | 24.90 |
| EC-165690 | 6.04 | 10.30 | 10.20 |
| EC- 914092 | 19.54 | 18.20 | 18.30 |
| EC- 520078 | 16.29 | 16.40 | 16.60 |
| WIR- 3957 | 11.75 | 28.10 | 29.30 |
| EC- 914097 | 22.52 | 25.50 | 26.40 |
| VRT - 02 | 33.80 | 26.30 | 29.10 |

(Sources: Hamed., 2017; Debmala *et al*., 2019; Lone *et al*., 2020)

The highest fruit size was for the parent VRT – 02 having average fruit weight 33.80g, fruit length 26.30cm and fruit diameter 29.10 cm. The lowest fruit size was for the parent EC-165690 having fruit weight 6.04g, fruit length 10.30cm and fruit diameter 10.20cm, which is desired.

Table 5: Fruit parameters of some hybrids of cherry tomato

| Hybrid | Fruit weight(g) | Fruit Length(cm) (FL) | Fruit Diameter(FD) (cm) |
|---|---|---|---|
| Ch 3×Ch 8 | 9.7 | 23.5 | 23.6 |
| Ch 3×Ch 14 | 11.2 | 23.3 | 24.8 |
| Ch 3×Ch 16 | 9.9 | 23.2 | 24.2 |
| Ch 8×Ch 18 | 16.2 | 28.7 | 28.1 |
| Ch 8×Ch 21 | 14.1 | 26.1 | 26.8 |
| Ch 8×Ch 22 | 11.9 | 24.1 | 25.8 |
| Ch 14×Ch 18 | 17.4 | 27.9 | 27.3 |
| Ch 14×Ch 21 | 20.7 | 32.6 | 28.6 |
| Ch 16×Ch 25 | 11.5 | 23.6 | 24.8 |
| Ch 21×Ch 25 | 15.0 | 27.6 | 27.4 |
| TOCVAR-1×TOCVAR-3 | 11.03 | 30.30 | 26.16 |
| TOCVAR-1× TOCVAR-4 | 13.42 | 27.39 | 27.23 |

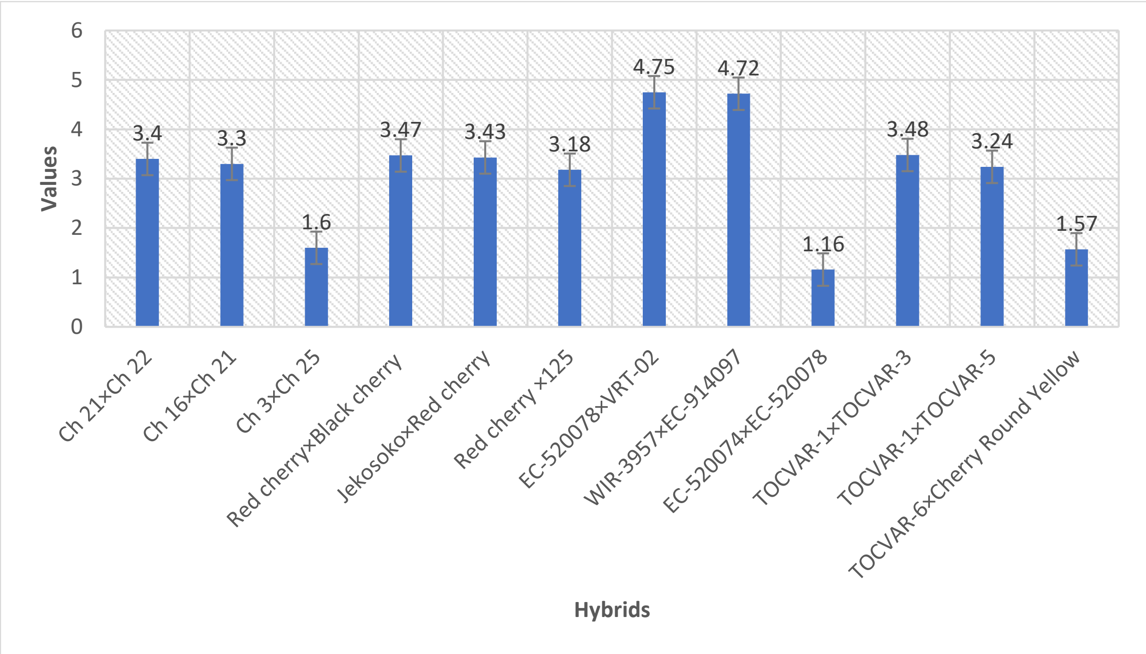
| Hybrid | Fruit weight(g) | Fruit Length(cm) | Fruit Diameter (cm) |
|---|---|---|---|
| TOCVAR-1× TOCVAR-5 | 10.38 | 32.43 | 22.89 |
| TOCVAR-1× TOCVAR-6 | 12.57 | 33.16 | 22.09 |
| TOCVAR-3 ×TOCVAR-5 | 11.06 | 28.45 | 26.25 |
| TOCVAR-3×Cherry Round Yellow | 9.87 | 23.13 | 24.32 |
| TOCVAR-4 × TOCVAR-5 | 11.92 | 26.15 | 26.17 |
| TOCVAR-4 × TOCVAR-6 | 12.52 | 27.46 | 23.44 |
| TOCVAR-6×Cherry Round Yellow | 10.89 | 17.55 | 16.94 |
| TOCVAR-5 × TOCVAR-6 | 12.76 | 22.48 | 13.37 |
| SuncherryxEC– 914115 | 28.83 | 21.00 | 21.20 |
| EC-914097 x VRT - 02 | 59.55 | 25.80 | 23.70 |
| WIR-3957x EC -914097 | 108.22 | 32.70 | 32.50 |
| EC-914092xWIR– 3957 | 50.17 | 23.40 | 24.70 |
| EC-165690xWIR– 3957 | 5.56 | 11.90 | 13.70 |
| EC-520074xEC-914115 | 50.52 | 23.90 | 25.60 |
| WIR – 5032 x VRT - 02 | 39.52 | 23.20 | 24.10 |
| WIR–5032xEC–914092 | 38.45 | 24.20 | 24.70 |
| WIR–5032xEC–520074 | 19.59 | 18.50 | 18.40 |
| SuncherryxEC– 520078 | 13.00 | 16.90 | 16.40 |

(Sources: Hamed, 2017; Debmala *et al.*, 2019; Lone *et al*., 2020)

The standard fruit was for the hybrids EC-165690xWIR– 3957(5.56g; FL 11.90cm; FD 13.70cm), Ch 3×Ch 8 (9.7g, FL 23.5cm, FD 23.6 cm) and TOCVAR-3×Cherry Round Yellow (9.87g, FL 23.13cm; FD 24.32cm) etc.

### 3.4. Shelf Life:

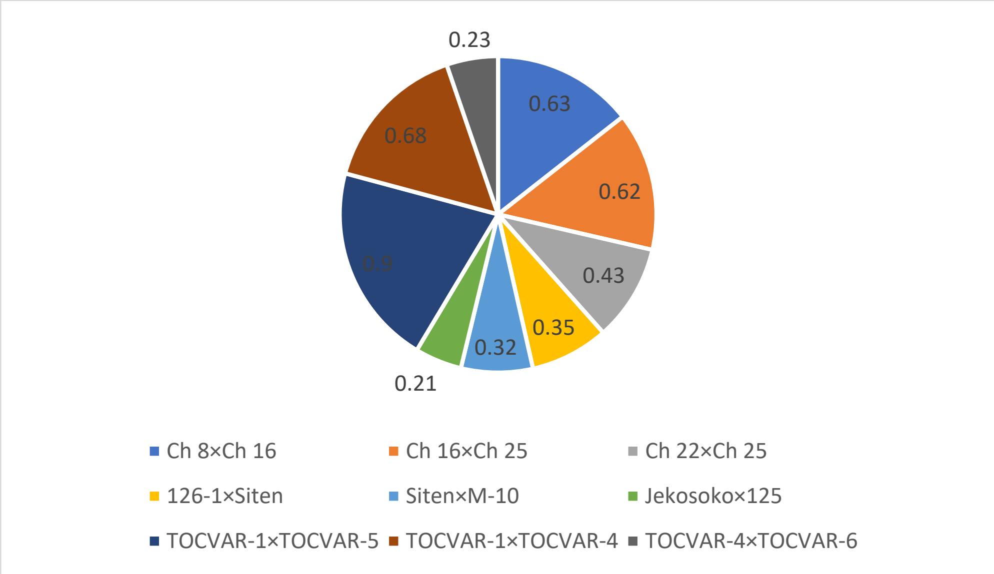
Fruits should be firm and smooth enough to endure shipping (Prema et al., 2011). Fruit firmness and form are determined by the thickness of the flesh. This is most likely because photo assimilates are diverted from the production of locule walls to the development of the pericarp, improving the firmness of the fruit in cherry tomato fruits (Prema et al., 2011). The shelf life of fruits with quality features may be extended with an increase in cherry tomato pericarp thickness. Tomatoes with a thicker pericarp would stand up to long distance transit and retain well. The pericarp thickness is a crucial factor for increased storability, which indirectly boosts market price (Bhutani and Kalloo, 1991). Prema et al. (2011), Renuka et al. (2014), and Ramya et al. (2016) all noted an increase in the pericarp thickness of cherry tomatoes. However, the genetic makeup of a certain genotype of small fruited tomato may be the cause of some genotypes' extremely low pericarp thickness (Kumar et al., 2014). Firmness in cherry tomato fruit is an indirect measure of keeping quality after harvest of fruits. Firm fruited types stay well for longer period and fruit firmness decreases as ripening progress. The firm fruited genotypes generally have longer shelf life due to thicker pericarp. Higher pericarp thickness and firmness also improve the shelf life of fruit (Prema et al., 2011).




(Source: Hamed., 2017, Eslamboly *et al.*,2014, Lone et al.,2022, Debmala *et al.*,2019)

Figure 2: Pericarp thickness for the hybrids of cherry tomato.

Pericarp thickness for the hybrids was shown in figure 2. Highest pericarp thickness was 4.75mm for the hybrid EC-520078×VRT-02(Lone et al., 2022). And the lowest pericarp thickness was 1.01mm for the hybrid Pant cherry tomato 1×IIHR 2753. However, the genetic makeup of a certain genotype of small fruited tomato may be the cause of some genotypes' extremely low pericarp thickness (Kumar et al., 2014).




(Source: Hamed, 2017, Eslamboly *et al.*, 2014, Debmala *et al.*, 2019)

Figure 3: Fruit firmness for the hybrids of cherry tomato.

Fruit firmness for the hybrids was shown in figure 3. Highest fruit firmness was 1.61 kg sq cm-2 for the hybrid Pant Cherry Tomato 1×LE 1223 (Venkadeswaran et al., 2021). And the lowest fruit firmness was 0.21 kg sq cm-2 for the hybrid Jekosoko×125 (Eslamboly et al., 2014).

Table 6: Parents showing fruit firmness, pericarp thickness and longer shelf life

| Parents | Fruit firmness (kg sq. cm-1) | Pericarp thickness (mm) | Shelf life of fruits (days) |
|---|---|---|---|
| P1 | 1.08 | 2.05 | 30.00 |
| P2 | 0.99 | 1.52 | 26.00 |
| P3 | 1.19 | 2.55 | 32.00 |
| P4 | 1.21 | 1.72 | 28.00 |
| P5 | 1.10 | 1.56 | 26.50 |
| P6 | 1.18 | 1.34 | 24.50 |
| P7 | 1.17 | 1.29 | 24.00 |
| P8 | 1.05 | 1.21 | 23.00 |

(Source:Venkadeswaran *et al*., 2018)

P1 : LE 13 P3 : LE 1223 P5 : IIHR 2753 P7 : Pant Cherry Tomato 1 P2 : LE 87 P4 : VGT 89 P6 : IIHR 2754 P8 : Pusa Cherry Tomato 1

Among the eight parents, P4 registered the highest fruit firmness (1.21 kg /sq. cm) and the least was recorded by P2 (0.99 kg/sq cm). The pericarp thickness was highest in parent P3 (2.55mm) and the least in P8 (1.21mm). The parent P3 remained fresh for most number of days (32.00) while P8 was found to have the least value for shelf life (23.00 days).

Table 7: Hybrids showing fruit firmness, pericarp thickness and longer shelf life

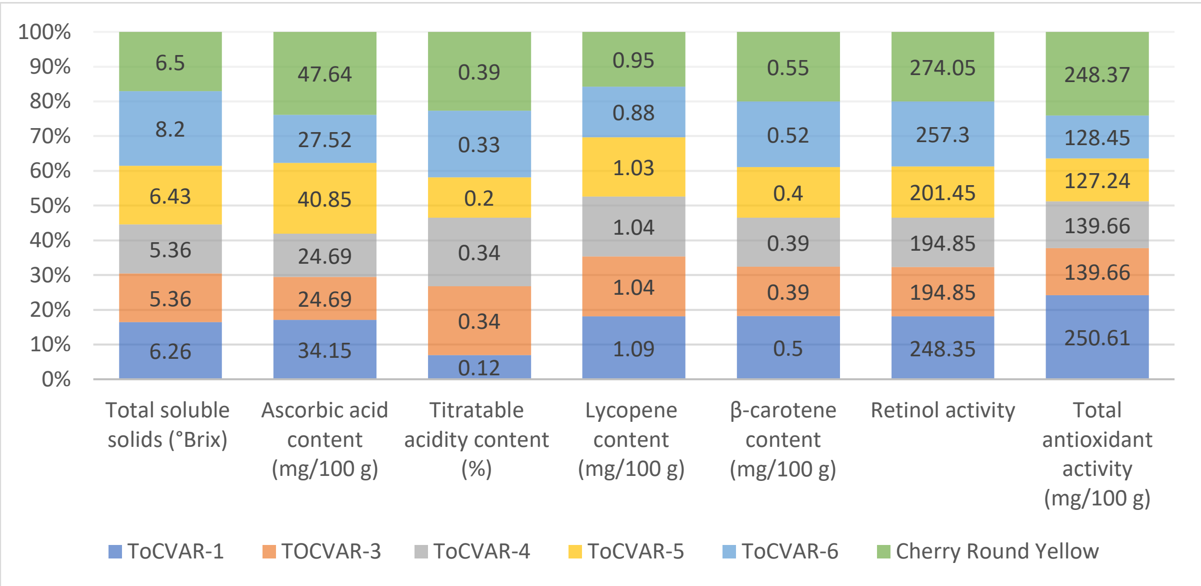
| Hybrids | Fruit firmness (kg sq. cm-1) | Pericarp thickness (mm) | Shelf life of fruits (days) |
|---|---|---|---|
| P1 x P2 | 0.92 | 1.39 | 25.00 |
| P1 x P5 | 0.90 | 2.08 | 30.00 |
| P1 x P7 | 0.87 | 1.62 | 27.00 |
| P2 x P7 | 0.75 | 1.28 | 23.50 |
| P3 x P4 | 0.96 | 2.14 | 30.50 |
| P3 x P7 | 1.01 | 1.61 | 27.50 |
| P4 x P3 | 0.94 | 2.40 | 31.50 |
| P5 x P2 | 0.86 | 1.47 | 25.50 |
| P5 x P4 | 0.87 | 1.62 | 27.00 |
| P6 x P3 | 1.00 | 2.11 | 30.00 |
| P6 x P8 | 1.12 | 1.36 | 24.50 |
| P7 x P3 | 1.61 | 1.30 | 24.00 |
| P7 x P6 | 1.33 | 1.16 | 22.50 |
| P7 x P8 | 1.11 | 0.98 | 21.50 |
| P8 x P2 | 1.20 | 2.51 | 32.00 |
| P8 x P3 | 1.09 | 2.54 | 32.00 |
| P8 x P4 | 1.29 | 2.43 | 31.50 |

(Source: Venkadeswaran *et al*., 2018)

P7 x P3 recorded the highest fruit firmness (1.61kg/sq cm) followed by P7 x P6 (1.33 kg/sq cm) and P8 x P4 (1.29kg/ sq cm). Among the hybrids developed, the cross P8 x P3 recorded the highest pericarp thickness (2.54mm) followed by P8 x P2 (2.51mm) and P8 x P4 (2.43mm). Among the hybrids, the cross P8 x P2 and P8×P3 recorded the highest shelf life (32.00 days) followed by P4 x P3 (31.50 days).The hybrids P7 x P3 (for fruit firmness), P8 x P3 (for pericarp thickness and shelf life) could be better utilized for further breeding programme for the improvement of cherry tomato.

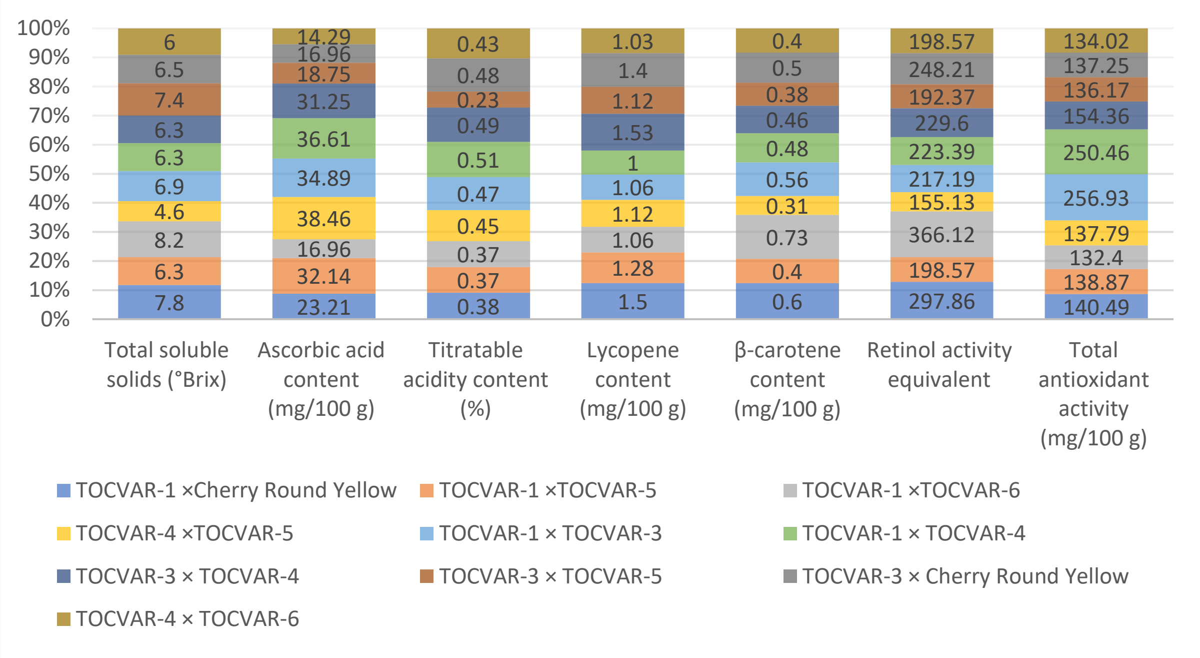
**3.5. Quality of cherry tomato:**

Cherry tomatoes have higher levels of antioxidants, carotenoids, ascorbic acid, phenolic compounds and sugar contents than large-fruited tomatoes. So, this type of tomato is preferred among consumers due to generally higher sugar content and concentrations of many health-promoting bio-actives(Kannaujia et al., 2020). Selection for sugar and acid content can be an efficient way to breed tastier cherry tomatoes (Casals et al., 2019). Cherry tomatoes have higher sugar and acid contents than the other tomato types. From the nutritional point of view, quality is considered to be as an important factor in any vegetable crop. Cherry tomato often called 'salad tomato' and being high content of antioxidant and phytochemical compounds, it is needless to emphasise the importance of quality parameter for fresh and processed produce. Quality parameters in cherry tomato emphasizes on attributes for fresh market and processing (Venkadeswaran et al., 2018). The cherry tomatoes developed for fresh market and processing should have distinct quality characteristics (Kumar et al., 2014). The main factor in processing cherry tomatoes is the total soluble solids concentration. The total soluble solids of the fruits affect cherry tomato products' flavor as well. For total soluble solids, genotypes varied greatly from one another (Venkadeswaran et al., 2018). With respect to environmental factors and genotypes, tomatoes' total soluble solids content varies (Gautier et al., 2005). Several hybrid quality traits were identified as being the average of the parents' quality attributes by Causse et al. (2002) after researching genetic differences in tomato quality attributes. Fruit weight and total soluble solid content are strongly and favorably associated (Casals et al., 2019). Total soluble solids content rose under various storage conditions (Kanski et al., 2020). Both breeders and consumers prefer cultivars with high TSS values. Ascorbic acid (Vitamin C) is an important anti-oxidant which is protective to most diseases produced by reactive oxygen such as superoxide (Rawal et al., 2016).The high amount of ascorbic acid and acidity might be due to result of most number of locules which were in agreement with the findings of Manna and Paul (2012) and Rathod (2014).




(Source: Debmala *et al.*, 2019)

Figure 4: Mean performance of cherry tomato parents for fruit quality attributes.




(Source:Debmala *et al.*, 2019)

Figure 5: Mean performance of cherry tomato hybrids for fruit quality attributes.

From figure 4 and 5, we can see that highest β-carotene content and retinol activity equivalent were in parents TOCVAR-1, TOCVAR-′ and TOCVAR-6, and were superior to other parents. For TSS, beta carotene and retinol activity hybrid TOCVAR-1 × TOCVAR-6 was higher than other hybrids. Highest lycopene content occurred when parent TOCVAR-1 was used to produce all hybrids. Desirable total soluble solids occurred when TOCVAR-6 was used to produce all hybrids. The highest ascorbic acid content and titratable acidity were in parent 'Cherry Round Yellow' when used to produce hybrid.

Table 8: Mean performance of parents for some quality traits in cherry tomato

| Parents | Dry matter content (%) | Total Soluble Solids (Brix) | Total sugars (%) | Reducing sugar (%) | Non reducing sugar (%) | Juice to pulp ratio |
|---|---|---|---|---|---|---|
| Suncherry | 9.12 | 10.00 | 4.33 | 3.72 | 0.61 | 2.34 |
| WIR - 5032 | 10.81 | 10.45 | 1.09 | 0.92 | 0.17 | 2.30 |
| EC- 520074 | 8.23 | 9.75 | 1.49 | 1.05 | 0.44 | 2.63 |
| EC- 914115 | 8.00 | 9.05 | 1.80 | 1.50 | 0.30 | 2.57 |
| EC-165690 | 15.05 | 10.45 | 3.39 | 2.84 | 0.55 | 2.11 |
| EC- 914092 | 9.53 | 8.05 | 4.37 | 3.68 | 0.69 | 1.59 |
| EC- 520078 | 7.90 | 10.15 | 5.73 | 4.75 | 0.98 | 1.75 |
| WIR- 3957 | 6.17 | 6.00 | 5.64 | 4.65 | 0.99 | 1.61 |
| EC- 914097 | 9.16 | 9.15 | 3.48 | 2.82 | 0.67 | 2.16 |
| VRT - 02 | 5.35 | 8.35 | 5.57 | 4.58 | 0.99 | 1.80 |

(Source: Lone *et al.*, 2021)

From table 8, parent EC-165690 had highest dry matter% and TSS, parent EC- 520078 had highest total sugar%, reducing sugar% and non-reducing sugar% and parent EC-520074 had highest juice to pulp ratio.

Table 9: Mean performance of hybrids for some quality traits in cherry tomato

| Hybrids | Dry matter content (%) | Total Soluble Solids ($^0$Brix) | Total Sugars (%) | Reducing sugar (%) | Non-reducing sugar (%) | Juice to pulp ratio |
|---|---|---|---|---|---|---|
| Suncherry x WIR - 5032 | 10.12 | 10.40 | 4.33 | 3.72 | 0.61 | 2.34 |
| Suncherry xEC – 520074 | 8.71 | 8.80 | 3.77 | 3.10 | 0.67 | 1.64 |
| Suncherry xEC – 520078 | 9.63 | 10.00 | 4.90 | 4.28 | 0.62 | 3.72 |
| WIR – 5032xEC – 520074 | 10.59 | 10.40 | 1.09 | 0.92 | 0.17 | 2.30 |
| WIR – 5032x EC – 914115 | 9.39 | 10.05 | 4.23 | 3.56 | 0.68 | 3.28 |
| EC- 520074 xEC – 914097 | 6.15 | 9.95 | 1.19 | 0.96 | 0.23 | 1.87 |
| EC-165690x VRT - 02 | 9.26 | 10.15 | 5.72 | 4.72 | 1.00 | 1.89 |
| EC-914092xEC-520078 | 3.53 | 8.95 | 5.72 | 4.74 | 0.98 | 1.74 |
| EC- 914092x WIR – 3957 | 5.03 | 8.15 | 5.73 | 4.73 | 1.00 | 1.57 |
| EC-914092xEC-914097 | 5.93 | 7.60 | 5.73 | 4.73 | 1.00 | 1.71 |
| WIR-3957xEC 914097 | 5.77 | 6.55 | 5.61 | 4.73 | 0.87 | 1.61 |
| WIR-395 xVRT - 02 | 5.55 | 8.40 | 5.06 | 4.12 | 0.94 | 1.81 |
| EC-914097x VRT - 02 | 4.55 | 7.55 | 5.74 | 4.75 | 0.99 | 1.78 |

(Source: Lone *et al.*, 2021)

From table 9, hybrid WIR – 5032xEC – 520074 had highest dry matter% and TSS, hubrid EC-914097x VRT - 02 had highest total sugar%, reducing sugar%, hybrids EC-165690xVRT – 02, EC- 914092xWIR – 3957, EC-914092xEC-914097 had highest non reducing sugar% and hybrid Sun-cherry x EC – 520078 had highest juice to pulp ratio.

# CHAPTER IV

## Conclusion

Hybrids combine the characters of the parent. For earliness, Petomech×Small Fry showed earliness that required 83 days for days to maturity. For higher yield, Cross IIHR2754XIIHR-2860 manifested significant positive SCA effects in terms of fruit yield plant-1. For fruit size hybrids EC-165690xWIR– 3957(5.56g; FL 11.90cm; FD 13.70cm) were found better. The cross P8 x P2 and P8×P3 recorded the highest shelf life (32.00 days). In case of nutritional quality, hybrid hybrid TOCVAR-1 × TOCVAR-6 was higher than other hybrids (TSS 8.2); hybrid EC-914097x VRT - 02 had highest total sugar% (5.74%) reducing sugar%(4.75%) performed best. These hybrids can be used for further breeding program for increasing yield and quality to fulfil farmers and consumer demand.

## References

Akhtar, S. and Hazra, P. 2013. Nature of gene action for fruit quality characters of tomato (Solanum lycopersicum). *African Journal of Biotechnology 12(20)*: 2869-2875.

Bhutani RD, Kalloo RK, 1991. Inheritance studies of locule numbers in tomato (Lycopersicon esculentum Mill). *Haryana J Hort. Sci; 20(1-2)*:119-124.

Brandt, S., A. Lugasi, E. Barna, Z.J. H ovari, Z. Pek, and L. Helyes. 2003. Effects of the growing methods and conditions on the lycopene content of tomato fruits. *Acta Aliment. 32(3)*: 269–278, doi: 10.1556/aalim.32.2003.3.6.

Casals, J., Rıvera, A., Sabate, J., Romero Del Castıllo, R., and Sımo, J. (2019). Cherry and fresh market tomatoes: differences in chemical, morphological, and sensory traits and their implications for consumer acceptance. *Agronomy, 9(1)*: 9

Causse, M., Chaib, J., Lecomte, L., Buret, M., and Hospital, F. (2007). Both additivity and epistasis control the genetic variation for fruit quality traits in tomato. TAG. Theoretical and Applied Genetics. *Theoretische und angewandte Genetik, 115*: 429–442.

Causse, M., Saliba Colombani, V., Lecomte, L., Duffe, P., Rouselle, P., and Buret, M. (2002). QTL analysis of fruit quality in fresh market tomato: a few chromosome region control the variation of sensory and instrumental traits. *Journal of Experimental Botany, 53(377)*: 2089–2098.

Charlo, H. C. O., Castoldi, R., Ito, L. A., Fernandes, C. and Braz, L. T. (2007). Productivity of cherry tomato under protected cultivation carried out with different type of pruning and spacing. *Acta Horticulturae. 761*:323-326.

Day, K., Lopez, G. and Dejong, T. 2008. Using growing degree hours accumulated 30 d after bloom to predict peach and nectarine harvest date. *Acta Horticulturae 803*:163- 166.

Debmala Mukherjee, Praveen Kumar Maurya, Swadesh Banerjee, Tridip Bhattacharjee, Subhrajyoti Chatterjee, Soumitra Chatterjee, Asit Kumar Mandal, Anirban Maji & Arup Chattopadhyay (2019): Breeding cherry tomato grown under open field conditions for simultaneous improvement in yield, nutritional quality, and leaf curl virus disease tolerance, International Journal of Vegetable Science.

Di Filippo-Herrera, D.A.; Muñoz-Ochoa,M.; Hernández-Herrera, R.M.; Hernández-Carmona, G. Biostimulant activity of individual and blended seaweed extracts on the germination and growth of the mung bean. *J. Appl. Phycol. 2018*, *33*, 1–13.

Effah, Zechariah & Osei, Michael & Akromah, Richard & Frimpong, Mathias. (2018). Hybridisation between cherry tomato (small fry) and Petomech for shortened fruit maturation, size and earliness. *African Crop Science Journal. Vol. 25, No. 1.*

El-Eslamboly, Ahmed & Mahmoud, A. (2014). Genetic Analysis to Find Suitable Parents for Development of Cherry Tomato Hybrids under Green House Conditions. *Egyptian Journal of Plant Breeding. 19.* 55-70. 10.12816/0011699.

Gautier, H., Rocci, A., Buret, M., Grasselly, D., Dumas, Y., and Causse, M (2005). Effect of photoselective filters on the physical and chemical traits of vineripened tomato fruits. *Canadian Journal of Plant Science, 85*: 439–446.

Gharezi, M., Joshi, N. and Indiresh, K.M. 2012. Physico-chemical and sensory characteristics of different cultivars of cherry tomato. *Mysore Journal of Agricultural Sciences. 46*: 610-613.

GRIFFING. B., 1956, Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Biol. Sci., 9*: 463-493.

Hamed, A. (2017). EXPLOITATION OF HYBRID VIGOUR IN CHERRY TOMATO. *Menoufia Journal of Plant Production. 2.* 291-303.

Hannan, M.M., Biswas, M.K., Ahmed, M.B., Hossain, M., and Islam, R. (2007). Combining ability analysis of yield and yield components in tomato (Lycopersicon esculentum mill.). *Turkish Journal of Botany, 31(6)*: 559–563.

Kabaş, Aylin & Ersoy, A. & Zengin, Sinan & Golukcu, M.. (2021). Assessment of quality attributes of hybrids developed from pure lines of cherry and cocktail-type tomatoes. *Acta Alimentaria. 50*. 65-73. 10.1556/066.2020.00135.

Kalloo, G. (1991). Genetic improvement of tomato. *Monographs on Theroretical and Applied Genetics vol14*. Springer-Verlag, New York, USA. 358 p.

Kannaujia, P.K., Patel, N., Asrey, R., Mahawar, M.K., Meena, V.S, Bibwe, B., Jalgaonkar, K., and Negi, N. (2020). Variability of bioactive properties and antioxidant activity in commercially grown cherry tomato (Solanum lycopersicum var. cerasiforme) cultivars grown in India. *Acta Alimentaria, 49*: 13–22.

Kanski, L., Naumann, M., and Pawelzik, E. (2020). Flavor-related quality attributes of ripe tomatoes are not significantly affected under two common household conditions. *Facial Plastic Surgery: FPS, 11, article 472.*

Kavitha, P., Shivashankara, K. S., Rao, V. K., Sadashiva, A. T., Ravishankar, K. V. and Sathish, G. J. (2014). Genotypic variability for antioxidant and quality parameters among tomato cultivars, hybrids, cherry tomatoes and wild species. *Journal of the Science of Food and Agriculture, 94*: 993-999.

Kumar K, Trivedi J, Sharma D, Nair SK. Evaluation for fruit production and quality of cherry tomato (Solanum lycopersicum L. var. cerasiforme). *Trends in Biosciences. 2014*; 7(24):4304-4307.

Li, T., Heuvelink, E., and Marcelis, L. F. M. (2015). Quantifying the source–sink balance and carbohydrate content in three tomato cultivars. *Frontiers in Plant Science, 6 (416)*: 1-10. [24] Saglam,

Lone, Sameena & Hussain, Khursheed & Malik, Ajaz A. & Masoodi, Khalid & Dar, zahoor ahmad & Nazir, Nageena & Zahed, Zahedullah & Ali, Gowhar. (2022). Combining ability studies in cherry tomato for yield and yield attributing traits in open and protected conditions.

Manna M, Paul A. Studies of genetic variability and character association of fruit quality parameters in tomato. *Hort. Flora. Res. Spectrum. 2012*; 1(2):110-116.

Ofori, K., Kumaga, F.K. and Tonyigah, A. 2005. Morphological characterisation and agronomic activity of tomatoes by increasing the total antioxidant. *Journal of Agriculture and Food Chemistry 145*: 23- 28.

Pasorn, P., Senakun, C., Saensouk, S., Sinsiri, W. and Somboonwattanakul, I. (2018). Evaluate Characteristics of new cherry tomato varieties of Mahasarakham University. *International Journal of Agricultural Technology 14(7)*:1583-1588.

Prema G, Indiresh KM, Santhosha HM. Evaluation of cherry tomato (Solanum lycopersicum var. cerasiforme) genotypes for growth, yield and quality traits. *The Asian Journal of Horticulture. 2011; 6(1)*:181-184.

Ramya R, Ananthan M, Krishnamoorth V. Evaluation of cherry tomato [Solanum lycopersicum L. var. cerasiforme (Dunnal) A. Gray] genotypes for yield and quality traits. *Asian J Hort. 2016; 11(2)*:329-334.

Ranc, N., S. Munos, S. Santoni andM. Causse (2008). A clarified position for Solanumlycopersicon var. cerasiforme in the evolutionary history of tomatoes (Solanaceae). *BMC Plant Biol. 8(130)*: 1-16.

Rathod HR. Genetic variability, correlation, path and D2 analysis in tomato (Lycopersicon esculentum Mill.). M.Sc. Thesis, Navsari Agricultural University, Navsari, 2014.

Rawal, Ranjana & Gautam, D.M. & Khadka, Ram & Gautam, Ishwori & Mishra, Khushali & Acedo, Antonio & Hanson, W & Easdown, J & Hughes, A & Keatinge, J. (2016). Fruit Quality Characters of Tomato (Solanum lycopersicum) Genotypes Differed by Maturity Stages. 10.17758/IAAST.A0416069.

Renuka, D.M., A.T. Sadashiva, B.T. Kavita, R.C. Vijendrakumar and M.R. Hanumanthiah (2014). Evaulation of cherry tomato lines (Solanumlycopersicum var. cerasiforme) for growth, yield and quality traits. *Plant Arch. 14 (1)*: 151-154.

Renuka D. M., T. H. Singh, Geeta S. V. and Sheela Malaghan (2015); Combining ability analysis of growth, yield and quality traits in cherry tomato (Solanum lycopersicum var. cersiforme) *Int. J. of Adv. Res. 3 (Jul)*. 319-325] (ISSN 2320-5407).

Saleem, M.Y., Akhtar, K.P., Asghar, M., Iqbal, Q. and Rehman, A. 2011. Genetic control of late blight, yield and some yield related traits in tomato (Solanum lycopersicum L.). *Pakistan Journal of Botany 43(5)*: 2601- 2605.

Shankara, N., V.D.J. Joep, D.G. Marja, H. Martin and V.D. Barbara.(2005). Cultivation of Tomato: Production Processing and Marketing. Agromisa Foundation, Wageningen, 63-64.

Sulaiman, S. M. and Arif, L. H. (2013). Response of some gynoecious cucumber varieties to different levels of phosphorus fertilization in plastic houses. *Journal of Koya University*, *26*: 317-333.

Venkadeswaran, E., Vethamoni, P.I., Arumugam, T., Manivannan, N., & Harish, S. (2018). Evaluating the yield and quality characters of cherry tomato [Solanum lycopersicum (L.) var. cerasiforme Mill.] genotypes. *International Journal of Chemical Studies 2018*; *6(3)*: 858-863.

Vidyadhar, B., Tomar, B.S. and Singh, B. 2014. Effect of truss retention and pruning of berry on seed yield and quality of cherry tomato (Solanum lycopersicum var. cerasiforme) grown under different polyhouse structures. *Indian Journal of Agricultural Sciences. 84*: 1335-1341.

Wang, S., Z. Chu, R. Jia, F. Dan, X. Shen, Y. Li, and X. Ding. 2018. Slmyb12 Regulates flavonol synthesis in three different cherry tomato varieties. *Sci. Rpt. 8*:1582.