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Evaluation of different genotypes of cherry tomato (*Solanum lycopersicum var. cerasiforme*) under foothill condition of Nagaland

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ABSTRACT

Six cherry tomato genotypes viz., 2015/TOCV AR-1, 2015/TOCV AR-2, 2015/TOCV AR-3, 2015/TOCV AR-5, 2015/TOCV AR-6 and Swarna Ratan were evaluated at horticultural experimental farm, SASRD, Nagaland University, Medziphema during the period of September 2015 to March 2016 following randomized block design with four replications. Results revealed that the genotype 2015/TOCV AR-3 manifested the maximum plant height (152.4 cm) coupled with maximum crop duration (136.9 days). The maximum number of branches plant^{-1} (61.5), number of leaves plant^{-1} (540.85), less duration from fruit set ripening (63.35 days) and number of fruit plant^{-1} (482.6) were recorded in genotype 2015/TOCV AR-2 while the shortest crop duration (125.7 days) was recorded in genotype 2015/TOCV AR-1. The genotype 2015/TOCV AR-1 exhibited the highest fruit volume (10.85cm^2). The maximum number of locules fruit^{-1} (3.25) and fresh weight (15g) were documented in genotype 2015/TOCV AR-3. The minimum number of seeds fruit^{-1} (35.50) and longest shelf life (13 days) were observed in genotype 2015/TOCV AR-5.The maximum yield plant^{-1} (1.35 kg), yield plot^{-1} (16.15 kg) and projected yield ha^{-1} (498.43q) were manifested by genotype Swarna Ratan. The genotype 2015/TOCV AR-3 recorded the highest vitamin C content (47.71 mg 100^{-1} g pulp) while the maximum lycopene content (3.35 mg 100g^{-1} of pulp) was recorded in Swarna Ratan. The TSS (8.64°Brix) and reducing sugar (8.91%) was obtained maximum in genotype 2015/TOCV AR-5, while the maximum total sugar (10.26%) and acid content (1.34%) were recorded in genotype 2015/TOCV AR-1. The yield plant^{-1} showed a significantly positive correlation with number of fruit plant^{-1}, number of leaves plant^{-1} and number of branches plant^{-1}. Based on the results, the genotype Swarna Ratan was proved to be the potential yielder under foothill condition of Nagaland.

Keywords: Cherry tomato, genotype, genetic variability, quality, yield.

INTRODUCTION

Among different forms of tomato, cherry tomatoes (*Solanum lycopersicum var. cerasiforme*) belong to the family Solanaceae with chromosome number 2n=24, multi-seeded berry and considered a native of Peruvian or Mexican region. It has gained popularity among consumers because they can be eaten without being cut, deep red in colour due to lycopene, its pleasant and intense flavor. Cherry tomatoes are numerous small round to oblong in size fruits borne in clusters along stem and branches of the plants. It is an important protective food due to its well balanced nutrition consisting of minerals (K, Mn, P, Cu, Ca, Fe, Zn), Vitamins (A, B_1, B_2, C, E, K, etc), dietary fibre, citric acid and high antioxidant property (Thapa *et al.,* 2014). At present, the growing as well as consumption demand of cherry tomato is increasing sternly day by day among the urban and rural people. But wide adaption to a particular environment and consistent performance of recommended genotypes is the key question for its commercialization. Although a number of varieties for cultivation of only tomato have been recommended so far but the information on the stability is still far behind for the agro-climatic condition. Therefore, a pertinent need was felt initially to evaluate and screen the potential genotypes of cherry tomato with consistent performance on the basis of stability, growth, yield and quality among the different genotypes and to recommend the cultivars best suited for foothill condition of Nagaland.

MATERIALS AND METHODS

The experiment was conducted at the Experimental Farm, Department of Horticulture, SASRD, Nagaland University, Medziphema Campus during September, 2015 to February, 2016. The research field was situated at an altitude of 310 meters above mean sea level in the foothill of Nagaland with geographical location of 25˚ 45' N latitude and 93˚ 53' E longitude. The site has a sub-tropical and sub-humid condition prevailing temperature variation within 7 ^{0}C (minimum) to 31 ^{0}C (maximum), average annual rainfall ranges from 150 cm to

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200 cm and relative humidity varies in 65% to 85%. The soil of the experimental site was sandy-loam and slightly acidic in nature with soil pH 6.6 with moderate water holding capacity. Before commencement of experiments, soil samples were collected randomly from the different spots of the experimental plot at a depth of 0 to 12 cm for physico-chemical analysis. It was laid out in randomized block design with six treatments (genotypes) and four replications. The treatments details were T_1: 2015/TOCV AR-1, T_2: 2015/TOCV AR-2, T_3: 2015/TOCV AR-3, T_4: 2015/TOCV AR-5, T_5: 2015/TOCV AR-6 and T_6: *Swarna Ratan*. The seeds of cherry tomato genotypes were collected for varietal evaluation from Indian Institute of Vegetable Research (IIVR), Varanasi, Uttar Pradesh. The seeds were sown after seed treatments in a line with 8 cm distance at a depth of 1 cm. Sowing of seeds was done on 12th September, 2015. The seeds were germinated after seven days of sowing. Seedlings were ready for transplanting after 30 days of sowing when they attained the height of 12 cm. The size of each plot was 1.8 m x 1.8 m maintaining at 60 cm x 45 cm distance by altogether 24 plots. Nitrogen, phosphorous and potassium in the form of urea, single superphosphate and muriate of potash were used as a source of fertilizer @ 120 kg, 60 kg, and 60 kg ha^{-1}, respectively and applied as per schedule. Right after transplanting management of partial shade, irrigation, staking and other cultural practices like weeding, earthing-up and plant protection measures were followed at required manners. Fruits were harvested at 7-10 intervals at colour break stage that were duly tagged. The parameters like growth (plant height and number of branches plant^{-1}), days taken from flowering and fruit ripening, number of fruits plant^{-1}, average fruit weight (fresh and dry weight) and fruit yield were recorded. Biochemical attributes like TSS, total sugar, reducing sugar, acidity, Vit-C and lycopene content of fruits were determined. Total soluble solids (TSS) were determined with the help of hand refractometer calibrated in ^{0}Brix at 20 ^{0}C with necessary correction factor. Total and reducing sugars were estimated by standard procedure of A.O.A.C. (1984) using Fehling's A and B reagents with methylene blue as an indicator through copper reduction method. Total titratable acidity was determined by titrating the extracted juice against N/10 NaOH using phenolphthalein as indicator and 2, 6-dichlorophenol indophenol dye titration method was used to estimate the ascorbic acid content of the fruit. Lycopene content of pulp was estimated by optical density at 503 nm using spectrophotometer. Petroleum ether was used as blank.

RESULTS AND DISCUSSION

Growth parameters

The wide variation among the different genotypes in regard to plant height, branches and leaves may be due to genetic constitution of different genotypes. The exponential growth over time and the variation in height of different genotypes of cherry tomato was found to vary from 109.15 cm to 152.40 cm at 105 days after transplanting (DAT). The maximum height was recorded in genotype 2015/TOCV AR-3 (50.45 cm, 77.29 cm, 121.30 cm, 142.20 cm, 147.30 cm and 152.40 cm at 30, 45, 60, 75, 90 and 105 days after transplanting (DAT) respectively) while minimum plant height (75.65 cm, 89.82 cm, 96.70 cm, 104.59 cm, 107.40 cm and 109.15 cm with advancement of days after transplanting respectively) was recorded in genotype 2015/TOCV AR-1 (Table 1). These results were supported by the findings of Swaroop and Suryanarayan (2005) who found the significant variation on plant growth and yield in all different 24 lines of tomato (*Lycopersicon esculentum* Mill) lines.

The organogenesis by sequential growth and development of primary and secondary branches was found to vary significantly in the different genotypes in perusal. The number of branches plant^{-1} in different genotypes at final stage (105 DAT) was found to vary from 24.15 to 38.90. Though, the maximum number of branches was recorded in genotype 2015/TOCV AR-2 by 16.70, 29.15, 35.75, 45.05, 55.00 and 61.50 branches plant^{-1} sequentially with the advancement of 30 days after transplanting (DAT), 45 DAT, 60 DAT, 75 DAT, 90 DAT and 105 DAT respectively (Table 1). Singh *et al.* (2012) also noticed the overall performance of 74 different genotypes of tomato and they observed variation among the different traits in flowering, number of branches, plant height, clustering of fruit and physical properties of fruits and fruit yield.

Table 1: Number of days taken during flowering, ripening, cumulative crop duration and growth parameters in different genotypes of cherry tomato

Treatment	Plant height (cm) (105 DAT)	No. of branches Plant^{-1} (105 DAT)	Days taken for flowering	Days taken for ripening	Crop duration (days from transplanting to last harvesting)
2015/TOCV AR-1	109.15	27.90	31.50	66.35	125.70
2015/TOCV AR-2	117.35	61.50	25.15	63.35	132.10
2015/TOCV AR-3	152.40	24.15	40.20	91.10	136.90
2015/TOCV AR-5	113.80	24.60	29.70	76.70	132.90
2015/TOCV AR-6	137.00	38.90	29.25	73.50	129.40
Swarna Ratan	125.94	38.70	29.05	66.00	128.80
SEm±	3.42	3.34	1.21	2.23	1.05
CD (P= 0.05)	10.31	10.06	3.66	6.72	3.15

Days for flower initiation among the different genotypes differed from 25.15 to 40.20 days after transplanting to main field. The minimum number of days to flowering and days taken for early ripening of fruit (25.15 and 63.35 days after transplanting respectively) was observed in genotype 2015/TOCV AR-2 (Table 1). The total crop duration from transplanting to last harvesting varied from 125.70 to 136.90 days. The wide variation among the genotype with respect to the number of days taken to fruit ripening may be due to genetic makeup and environmental condition. Similar findings have been reported by Garg *et al.* (2007).

Table 2: Fruit length and diameter in different genotypes of cherry tomato

Treatment	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (cm^2)	Fruit shape	Fruit colour	Shelf life (number of days)
2015/TOCV AR-1	3.7	2.38	8.81	Oblong	Yellow	9.00
2015/TOCV AR-2	2.1	2.26	4.74	Round	Red	10.50
2015/TOCV AR-3	3.2	3.39	10.38	Round	Pink	12.00
2015/TOCV AR-5	3.6	2.66	9.57	Heart shape	Red	13.00
2015/TOCV AR-6	2.8	2.96	8.2	Round	Red	10.75
Swarna Ratan	2.5	2.64	6.6	Round	Orange	9.75
SEm±	0.05	0.04	-	-	-	0.91
CD (P= 0.05)	0.15	0.13	-	-	-	2.75

Yield and yield attributes

The length of fruit was found to vary in between 2.1 and 3.7 cm and the fruit diameter in between 2.26 and 3.39 cm. Above all, the maximum fruit volume (10.38 cm^2) was recorded in genoptype 2015/TOCV AR-3 followed by 2015/TOCV AR-5 (9.57 cm^2) and minimum in *Swarna Ratan* (6.6 cm^2). The variation in fruit shape among the taits like round, oblong and heart shape were noticed in different genotypes along with variation in fruit colours like yellow (2015/TOCV AR-1), red (2015/TOCV AR-2, 2015/TOCV AR-5 and 2015/TOCV AR-6), pink (2015/TOCV AR-3) and orange (*Swarna Ratan*). The genotypes viz. 2015/TOCV AR-2, 2015/TOCV AR-3, 2015/TOCV AR-6 and *Swarna Ratan* were looked round in shape while the genotype 2015/TOCV AR-1 showed oblong and 2015/TOCV AR-5 in heart shape (Table 3). The variations in different shape of fruit are influenced by the genetic makeup of the genotype. Regarding the shelf life of different genotypes of cherry tomato, it was found to vary from 9.00 to 13.00 days after harvest under room and ambient temperature. Prema *et al.* (2011) also noticed in six genotypes of cherry tomato about the growth habits of the plants (extremely semi-determinate to indeterminate). They found that the per cent fruit set was maximum in genotype EC-1 followed by Stupice Harry and the maximum fruit weight and mean yield plant^{-1} was recorded in Podland Pink. The number of fruits plant^{-1} of cluster bearing cherry tomato was found to vary from 78.15 to 482.60. The genotypes 2015/TOCV AR-2 recorded the maximum number of fruits plant^{-1} (482.60 fruits) followed by the genotype 2015/TOCV AR-6

(260.40 fruits) fruits plant^{-1} throughout of its life cycle. The local genotype *Swarna Ratan* recorded the highest fruit yield plant^{-1} (1.35 kg) whereas the lowest yield was noticed in 2015/TOCV AR-1. Said *et al.* (2014) also observed the significant variations on yield and yield attributing characters in different accessions of cherry tomato with CHT1050SC, CHT1050SB, CHT1050SG and CHT1050SA. The genotype 2015/TOCV AR-3 recorded the maximum fresh weight (15.00 g), dry weight (2.00 g) of fruit, maximum number of seeds (82.00 seeds) and number of locules (3.25) fruit^{-1}. Although this genotype produced very less number of fruits (78.15 fruits) plant^{-1} (Table 3). The number of locules fruit^{-1} differed significantly by genetic makeup. Similar results have been obtained by Dar *et al.* (2012) who observed the highest value of the phenotypic coefficient of variation for yield, number of locules fruit^{-1} and pericarp thickness in 60 diverse genotypes of tomato.

Table 3: Yield and yield attributing characters in different genotypes of cherry tomato

Treatment	No. of fruits plant^{-1}	Yield plant^{-1} (kg)	Fresh weight (g) of fruit	Dry weight (g) of fruit	No. of seeds fruit^{-1}	No. of locules fruit^{-1}
2015/TOCV AR-1	110.50	0.62	12.00	1.75	38.50	2.50
2015/TOCV AR-2	482.60	1.31	5.50	1.25	61.00	2.00
2015/TOCV AR-3	78.15	0.80	15.00	2.00	82.00	3.25
2015/TOCV AR-5	167.00	1.15	13.75	2.00	35.50	2.75
2015/TOCV AR-6	260.40	1.27	12.25	1.25	55.50	2.00
Swarna Ratan	251.75	1.35	10.00	1.50	77.50	2.25
S.Em ±	27.49	0.13	0.74	0.19	7.83	0.37
CD (P= 0.05)	82.81	0.39	2.23	0.57	23.60	1.10

Bio-chemical attributes

The variation in TSS content in different genotypes of cherry tomato was noticed from 5.25 ^{0}B to 8.68 ^{0}B. The maximum TSS content (8.68 °Brix) was recorded in genotype 2015/TOCV AR-5 which was significantly superior to other genotypes. The genotype 2015/TOCV AR-6 with 8.23 °Brix was statistically at par with 2015/TOCV AR-5. The minimum TSS was recorded in check variety *Swarna Ratan* with 5.25°Brix (Table 4).

Table 4: Bio-chemical compositions of ripen fruits in different genotypes of cherry tomato

Treatment	TSS (◦Brix)	Total sugar (% fresh wt.)	Reducing sugar (% fresh wt.)	Vitamin C (mg 100 g^{-1} of pulp)	Acidity (% of fresh wt.)	Lycopene (mg 100 g^{-1} of pulp)
2015/TOCV AR-1	7.46	10.26	6.00	32.94	1.34	3.35
2015/TOCV AR-2	7.13	9.25	6.78	27.83	1.30	3.10
2015/TOCV AR-3	7.08	9.29	6.52	47.71	1.10	0.54
2015/TOCV AR-5	8.68	9.47	8.91	36.35	1.16	3.18
2015/TOCV AR-6	8.23	9.00	7.13	34.08	1.15	2.89
Swarna Ratan	5.25	5.58	5.13	31.24	1.27	3.42
SEm±	0.46	0.85	0.54	3.05	0.04	0.29
CD(P= 0.05)	1.38	2.57	1.61	9.20	NS	0.89

Figas *et al.* (2015) reported similar results. The highest total sugar (10.26%) content in fruit was noted in Genotype 2015/TOCV-1 whereas, the highest reducing sugar (8.91%) along with medium total sugar content (9.47) was recorded in genotype 2015/TOCV AR-5. The Vit-C content in different genotypes of cherry tomato was found to vary from 27.83 mg to 47.71 mg 100 g^{-1} of pulp. The highest vitamin C content was recorded in the genotype 2015/TOCV AR-3 (47.71 mg 100 g^{-1} of pulp). In cherry tomato, the moderate acid content in fruit was noticed and found to vary from 1.10 to 1.34% of fresh weight basis. The local genotype *Swarna Ratan* recorded the highest lycopene content of 3.42 mg 100 g^{-1} of fruit pulp followed by 2015/TOCV AR-1 with 3.35 mg 100 g^{-1} of fruit pulp while the lowest was recorded in genotype

2015/TOCV AR-3 with 2.54 mg 100 g^{-1} of fruit pulp (Table 4). This statement was in line with the conclusion drawn by Papoutsis *et al.* (2016) Kanaujia *et al.* (2017). It was envisaged that the attractive yellow fruit colour might be due to presence of β-carotene and the red colour of the fruit due to lycopene which act as an anti-oxidant. Bhandari *et al.* (2016) evaluated 119 cherry and non-cherry tomato genotypes (16 commercial cultivars and 103 germplasm lines) for the development of tomato cultivars with high antioxidant contents. One cherry tomato line, TG-110, and 3 non-cherry tomato germplasm lines, IT237605, IT237703, and IT237706, had much higher lycopene contents (> 1930 mg kg^{-1}).

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