

Assessment of Tomato Cultivars for its Growth, Yield and Keeping Quality under Open Field and Tunnel Condition in Mid-hills of Bagmati Pradesh, Nepal,

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Abstract

Tomato seedlings of nine tomato cultivars with Pusa Ruby and Srijana as check were transplanted on March second week, 2021 at Khumaltar with the spacing of 70X60 cm in three replications and fertilized with 150:120:100 NPK kg + 20-ton FYM per hectare. The main objective of this study was to evaluate and select high yielding, good keeping quality with preferred characters under open field and plastic tunnel conditions for Bagmati province's mid-hills. Observation was recorded on vegetative, insect pest and disease, reproductive characters, yield parameter and keeping quality. Tomato crops under plastic tunnel were vigorous, taller, less infected with insect pest and disease, earlier; flowering and fruit set, higher number of fruits and flowers per cluster, fruits yield in number and weight, and longer period keeping quality as compared to open field condition. Among the tested cultivars 13X7 showed superior performance that was late blight resistant (2.3), early days to flowering (26), higher number of fruits per plant (6.3), superior yield (99.95 t/ha) and 5171 gm per plant and medium in fruit size. It had good keeping quality; least shrinkage (1.8), significantly higher marketable fruit weight remain percentage (78.3), less rotten percent (18.8) and physiological weight loss percent (18.8) at 30 days after room storage (DARS). The next superior cultivar was Srijana which had late blight (3.5), days to flowering (27), higher number of fruits per cluster (6.5), superior yield (100 t/ha) and 5624 gm per plant, medium fruit size, and superior keeping quality; less shrinkage (2.3), higher marketable fruit weight remain percent (60.2) and less rotten percent (7.8) at 30 DARS. These two cultivars are recommended for cultivation in mid-hills of Bagmati Pradesh. If only keeping quality is concerned; 3961D was the best cultivar which had no any rotten, significantly least shrinkage and weight loss even after 30 DARS.

Keywords: Cultivar, disease, high yielding, keeping quality, open pollinated

Introduction

Tomato the most popular home garden and the world's second most consumed vegetable after potato (Ebert, 2020). It known as the

world's most widely grown and processed (FAOSTAT, 2017). Tomato is the third largest vegetable crop in Nepal in terms of production. The area under tomato cultivation is around 21,981 ha with a total production of 410,721

mt and an average yield of 19 mt/ha (MoALD, 2019). Any change in the amount or quality of any after-harvest product that prevents or reduces the intended consumption of the product or decreases its value is a post-harvest loss (Kiaya, 2014). After, production, management, collection, storage, packaging, transport, and marketing are of the post-harvest activities (Mrema & Rolle, 2002). Acceleration of deterioration can be due to high, temperature, low humidity, incorrect atmosphere, and physical damage in the transportation process as well as in storage (Gorny, 2001). Fresh fruits and vegetables, including tomatoes, are projected to have postharvest losses of 5 to 25 percent in developed countries and 20-50% in developing countries (Kader et al., 1985). Around 20-50% of tomato fruit harvested for consumption has been estimated to be wasted due to microbial spoilage and other damage incurred during transit by volatile stresses, rough loading, and unloading (Aworth, 1985). It is very difficult to increase a 10% yield but easy to reduce 10% loss without bringing additional land for production (Gautam & Bhattarai, 2006).

Tomato crops in open field at mid-hills have peak harvesting period before monsoon when price is very low but later after initiation of monsoon prices increases tremendously. If peak time harvested tomato could be stored for longer period, it extends the use and fetches the good price.

The main objective of this study was to evaluate and select high yielding, good keeping quality with preferred characters under open field and plastic tunnel conditions for Bagmati province's mid-hills.

Materials and Methods

Twenty days old seedlings of eleven tomato genotypes were transplanted in the open field with a spacing of 60 x 60 cm in 3 replications. The standard recommended dose of fertilizers

(150:120:100 NPK kg/ha + 15-ton (FYM/ha) was applied and fungicide was sprayed as it required. Observation on vegetative, insect pest and disease, keeping quality, Ascorbic acid content and yield attributing parameters were recorded. Uniform fruits having same physiological stage were harvested at second harvesting time and kept on plastic container in ordinary room from July 4 to August 2 (30 days) and evaluated keeping quality where every 5 days rotten fruits were collected, counted, weighted and removed. The average minimum temperature, maximum and relative humidity in the room during storage period was 18°C, 26.10°C and 77.2 percent.

Rotten (%)

Fruits were evaluated visually for symptoms of rotten at the end of each storage interval. Samples having diseased symptoms were counted.

$$\text{Rotten (\%)} = \frac{\text{Number of rotten fruits}}{\text{Number of total fruits}} \times 100$$

Ascorbic acid

The ascorbic acid of ripe fruits was measured by volumetric method as per the reference from Sadasivsm and Manickam (1991). Following formula was used to calculate the ascorbic acid content.

$$\begin{aligned} \text{Amount of ascorbic acid (mg/100 g sample)} \\ = \frac{0.5 \text{ mg} \times V_2 \text{ mL} \times 12 \text{ mL} \times 100}{V_1 \text{ mL} \times 5 \text{ mL} \times \text{wt. of sample}} \end{aligned}$$

Where, V₁ = amount of dye consumed during the titration

V₂ = amount of dye consumed when the supernatant was titrated with 4% oxalic acid

Shrinkage

Shrinkage of the fruit was measured using 1 to 5 hedonic scales, 1 for no shrinkage and 5 for highly shrinkage fruits. The panelist of 10 scientist and technical officer was involved in scoring the shrinkage of the fruit on the last

day of storage.

Freshness

Fruits were evaluated visually for freshness at the end of each storage interval. Samples having less freshness were counted.

$$\text{Freshness (\%)} = \frac{\text{Number of fresh fruits}}{\text{Number of total fruits}} \times 100$$

Results and Discussion:

Vegetative growth parameter

All the tested genotypes had very good (4) to excellent (5) plant uniformity under both the growing condition, however, plant uniformity was better under tunnel growing condition. Varietal difference among the genotypes on plant uniformity was not significant (Table 1).

Result showed that among the tested cultivars 9331 had good plant uniformity (4.8). Plant vigor was significantly different among the cultivars in both the growing conditions. The most vigorous (5.0) plants were observed in Cv. 13X7, 9331 and 1455. In open field condition, CL1131 was also most vigorous. Most of the cultivars were more vigorous under tunnel condition as compared to open field. Varietal difference on plant height was significant under both the growing conditions. Most of the plants were taller under tunnel condition as compared to open field growing plants (Table 1). The cumulative mean of plant height was highest in 1455 (151.8 cm) followed by 13X7 (150.8 cm) and Srijana (149.6 cm) respectively (Table 1).

Table 1. Vegetative growth of tomato genotypes at Khumaltar under open field and screen house condition in 2021

S.N.	Cultivars	Plant uniformity			Plant vigor			Plant height (cm)		
		open	tunnel	Mean	open	tunnel	Mean	open	tunnel	Mean
1	13X7	4.3	4.3	4.3	5.0	5.0	5.0 a	140	161.7	150.8a
2	1418	3.7	4.3	4.0	3.7	4.0	3.8cd	56	71.6	63.8c
3	9708	3.7	4.7	4.2	3.7	4.3	4.0bcd	60	74.7	67.3c
4	9331	4.7	5.0	4.8	5.0	5.0	5.0a	130	171.3	150.6a
5	1455	4.0	4.7	4.3	5.0	5.0	5.0a	128	175.7	151.8a
6	3961C	3.7	3.7	3.7	3.3	3.7	3.5d	65	83.7	74.3c
7	3961D	3.3	3.7	3.5	3.3	4.0	3.6d	70	84.6	77.3c
8	CL1131(ch)	4.3	4.0	4.1	5.0	4.7	4.8ab	130	163.7	146.8ab
9	Pusa Ruby	4.3	4.0	4.1	4.3	5.0	4.6bcd	97	153.7	125.3b
10	Srijana(ch)	4.7	4.3	4.5	4.7	5.0	4.8ab	130	169.3	149.6a
11	CL2037	3.7	-	-	4.7	-	-	132	-	-
12	Choto cross	-	5.0	-	-	4.0	-	-	69.8	-
	GM	4.03	4.3	4.17	4.33	4.51	4.27	103.6	125.4	115.8
	F-test	ns	ns	ns	**	**	**	**	**	**
	LSD (0.05)	-	.978	-	0.816	.478	0.651	23.30	38.3	24.59
	CV%	17.11	13.26	8.07	11.07	6.22	6.75	13.21	17.93	9.39

Uniformity and vigor: 1: poor, 5: excellent

Insect and Disease Parameter

Varietal differences on late blight disease appearance was significant under open field and tunnel growing conditions. Late blight infestation was significantly higher in open field condition however it was appeared in both the conditions. The cumulative mean of late blight infestation was significantly lower in 13X7 (2.3) as

compared to the rest cultivars followed by 1455 and Srijana (3.5), and 1418 (3.7) respectively (Table 2). Early blight disease was appeared in both the growing conditions however it was lower infection under tunnel growing condition (Table 2). Similarly, leaf minor damage was less under tunnel condition even though seen under both the growing conditions but not significant different among the cultivars (Table 2).

Table 2. Insect and disease parameter of tomato genotypes at Khumaltar under open field and tunnel house condition in 2021

S.N.	Cultivars	Late blight(1-9)			Early blight			Insect		
		Open	Tunnel	Mean	Open	Tunnel	Mean	Open	Tunnel	Mean
1	13X7	3.7	1.0	2.3c	3.0	1.3	2.1	2.0	2	2.0
2	1418	4.7	2.7	3.7ab	3.0	1.0	2.0	2.0	2.3	2.1
3	9708	5.3	2.7	4.0ab	3.0	1.0	2.0	2.7	2	2.3
4	9331	5.3	2.7	4.0ab	3.7	1.7	2.7	2.3	2	2.1
5	1455	4.7	2.3	3.5b	3.0	1.7	2.3	2.0	2	2.0
6	3961C	5.7	2.3	4.0ab	3.3	1.0	2.1	2.7	2	2.3
7	3961D	5.0	2.7	3.8ab	3.7	1.3	2.5	2.7	2	2.3
8	CL1131(ch)	6.0	2.7	4.3a	3.7	2.0	2.8	2.7	2	2.3
9	Pusa Ruby	5.7	3.0	4.3a	3.3	2.0	2.6	3.0	2	2.5
10	Srijana(ch)	5.0	2.0	3.5b	3.3	1.0	2.1	2.5	2	2.2
11	CL2037	5.3	-	-	2.7	-	-	2.7	-	-
12	Choto cross	-	3.0	-	-	2.0	-	-	2	-
	GM	5.21	24.5	3.76	3.24	1.45	2.35	2.45	2.03	2.25
	F-test	**	**	**	ns	**	ns	ns	ns	ns
	LSD (0.05)	0.726	.806	.694	-	.599	-	-	-	-
	CV%	8.18	19.2	8.17	18.49	24.23	11.87	18.49	16.40	13.03

Disease: 1:none, 9:dead

Reproductive characteristics

Varietal difference on days to flowering was not significant under both the growing conditions however it took higher days for flowering under open field condition as compared to tunnel growing tomato plants. The cumulative mean days was earliest on 3961D (25.8 days after transplanting) followed by 13X7 (26.5 days) and 3961C (26.8 days) respectively. The latest days to flowering (30.8) was on 1418 and Srijana. It

is little bit earlier than the result of Gautam et al. (2013) who had found earliest flowering variety KashiVishes (44 days) in Madhya Pradesh, India. Varietal difference on number of flowers per inflorescence was significant under both the growing condition. The cumulative mean of number of flowers per inflorescence was significantly higher on 13X7 (7.2), CL1131 & Srijana (7.0) as compared to the rest of the cultivars. Most of the cultivars grown under

tunnel condition had higher number of flowers per inflorescence except Srijana (Table 3). Likewise, the number of fruits per cluster was also significant among the cultivars under both the growing condition however it was higher in tunnel in all the cultivars except Srijana (Table 3). Cumulative mean number of fruits per cluster was significantly higher in 13X7 (6.3), CL1131 (6.3) and Srijana (6.5) as compared to the rest of the cultivars. The least number of fruits per cluster was recorded in 1418 and 3961C (3.7) followed by 3961D (4.0) respectively (Table 3). Gemechu et al. (2019) had also reported

minimum number of fruits per cluster (3.1) in cv. Monica to Barun (7.3) in varietal evaluation trial at Ethiopia. It had also reflected on the fruit yield as higher the number of fruits per cluster had higher the number of fruits per plant in Srijana and 13X7 but in CL1131 average fruit size was small and the higher yield could not be obtained even though the higher number of fruits per plant. Days to fruit set was significant in open field condition where it was significantly earliest in 1418 (41.7 days) followed by CL2037 (44), 3961C (44.3), Srijana (44.3) as compared to Pusa Ruby (Table 4).

Table 3. Reproductive characteristics of tomato genotypes at Khumaltar under open field and tunnel house condition in 2021

S.N.	Cultivars	Days to Flowering			No. of Flowers / Inflorescence			No. of Fruits /Cluster		
		Open	Tunnel	Mean	Open	Tunnel	Mean	Open	Tunnel	Mean
1	13X7	29	24	26.5	6.6	7.6	7.2a	5.5	7.1	6.3a
2	1418	32	29.7	30.8	3.9	5.0	4.4c	3.1	4.4	3.7c
3	9708	35	23.3	29.1	4.3	5.2	4.7c	3.7	4.5	4.1c
4	9331	36	22.3	29.1	5.3	6.2	5.7b	4.7	5.7	5.7b
5	1455	32	22.3	27.1	5.5	6.0	5.7b	4.7	5.6	5.1b
6	3961C	31	22.7	26.8	4.1	5.1	4.6c	3.2	4.3	3.7c
7	3961D	30	21.7	25.8	4.9	5.1	5.0bc	3.5	4.5	4.0c
8	CL1131(ch)	35	24.7	29.8	6.3	7.7	7.0a	5.6	7.1	6.3a
9	Pusa Ruby	33	23.7	28.3	4.5	5.5	5.0bc	3.9	5.1	4.5bc
10	Srijana(ch)	35	26.7	30.8	7.3	6.8	7.0a	6.7	6.4	6.5a
11	CL2037	27	-	-	8.1	-	-	7.2	-	-
12	Choto cross	-	23	-	-	6.3	-	-	5.6	-
	GM	32.1	24	28.45	5.62	6.07	5.64	4.8	5.48	4.96
	F-test	ns	ns	ns	**	**	**	**	**	**
	LSD (0.05)	-	6.079	-	1.366	1.033	.876	1.210	1.047	.840
	CV%	14.18	14.88	7.99	14.26	10.0	6.87	14.81	11.21	7.49

Yield Attributing Characters

Fruit yield different was significant among the cultivars in both the growing condition where fruit yield was higher in tunnel condition (77% yield increment). The cumulative highest fruit

yield was obtained from Srijana (100 t/ha) followed by 13X7 (99.95 t/ha) and 9331 (68.0 t/ha) whereas the least yield was recorded from 3961D (29.28 t/ha). The highest yield in open field was produced by 13X7 (64.01t/ha) followed

by Srijana (61.15 t/ha) and CL2037 (58.53 t/ha) respectively whereas the least fruit yield (19.34 t/ha) was recorded in 3961D. But, under tunnel grown tomato, the highest yield (138.86 t/ha) was given by Srijana followed by 13X7 (135.89 t/ha) and 1455 (89.88 t/ha) and 9331 (89.46 t/ha) respectively (Table 4). In the same line, Parmao et al. (2018) had also reported variation in fruit yield from 33.7 t/ha (Best of all) to Red Gold (143.7 t/ha) at Kulu, Himanchal Pradesh, India. Significant differences were observed among the studied tomato cultivars indicating genetic variability among selected genotypes. This result was in conformity with the results found by Enujike and Emuh (2015)

and Atugwn and Unguru (2011) who reported that differences in growth and yield characters could be attributed to variation in genetic constitution that they expressed. Fruits yield in number and weight was significantly varied among the cultivars. Effect of cultivars on its number of fruits per plant was significant on both the growing condition. Number of fruits per plant was higher in tunnel was doubled (106% higher) as compared to open field tomato. In open field, the number of fruits per plant was highest in CL2037 (84) followed by Srijana (75) and 13X7 (71) respectively whereas in tunnel condition, the highest number of fruits per plant was in Srijana (175) followed by 13X7 (167) and CL1131 (160) respectively (Table 4).

Table 4. Yield parameter of tomato genotypes at Khumaltar under open field and tunnel house condition in 2021

S.N.	Cultivars	Days to fruit set			Yield (t/ha)			Fruits/Plant (#)		
		Open	Tunnel	Mean	open	Tunnel	Mean	Open	Tunnel	Mean
1	13X7	45.3	35.3	40.3	64.01	135.89	99.95a	71	167	119a
2	1418	41.7	38	39.8	24.06	46.56	35.31b	19	59	39bcd
3	9708	45.3	34.3	39.8	24.33	38.85	31.59b	22	26	24cd
4	9331	47.0	34	40.5	46.55	89.46	68.00ab	51	116	83 abc
5	1455	46.3	32	40.1	42.92	89.88	66.40ab	53	125	89ab
6	3961C	44.3	32.3	39.1	27.89	43.18	35.53b	18	36	27bcd
7	3961D	45.0	32.3	39.5	19.34	39.23	29.28b	14	22	18d
8	CL1131(ch)	45.3	34	39.6	39.77	72.84	56.30b	68	160	114a
9	Pusa Ruby	49.3	33	41.1	29.03	35.81	32.42b	45	51	48bcd
10	Srijana(ch)	44.3	34.7	39.5	61.15	138.86	100.00a	75	175	125a
11	CL2037	44.0	-	-	58.53	-	-	84	134	-
12	Choto cross	-	29.7	-	-	43.81	-	-	-	-
	GM	45.3	33.6	39.95	39.78	70.39	55.476	47.19	97.27	68.6
	F-test	*	ns	ns	**	**	**	**	**	*
	LSD (0.05)	3.50	5.917		19.40	31.54	39.09	25.0	71.63	63.15
	CV%	4.54	12.15	5.61	28.64	26.30	31.15	31.1	43.25	40.67

The same trend was also noticed on fruit yield per plant where Srijana gave the highest fruit yield (2442 g) followed by 13X7 (2255 g) and CL2037 (2107 g) respectively in open field, and in tunnel condition; Srijana gave highest yield (5624 g) followed by 13X7 (5171 g) and 1455

(3640 g) respectively. However, generally yield per plant had been increased by 94 percent in tunnel condition (Table 5). It should be due to no stress of rain fall, longer period of growing and low insect pest and disease infestation under tunnel condition.

Table 5. Yield parameter of tomato genotypes at Khumaltar under open field and tunnel house condition in 2021

S.N.	Cultivars	Fruit wt.g /Plant		
		Open	Tunnel	Mean
1	13X7	2255	5171	3713ab
2	1418	866	1886	1376c
3	9708	876	1574	1211c
4	9331	1600	3623	2611abc
5	1455	1545	3640	2592abc
6	3961C	1004	1749	1376c
7	3961D	696	1589	1142c
8	CL1131(ch)	1432	2950	2191bc
9	Pusa Ruby	1146	1450	1298c
10	Srijana(ch)	2442	5624	40.33a
11	CL2037	2107	-	-
12	Choto cross	-	1775	-
	GM	1452	2820.8	2154.6
	F-test	**	**	*
	LSD (0.05)	701.6	1220	1576
	CV%	28.38	25.40	32.33

Keeping Quality

Remain fresh fruit weight (%) among the tunnel grown cultivars were significant where the highest marketable fresh fruits after 30 days storage was recorded on 3961D (89.1%) followed by 1455 & 9331 (75.1%) and choto cross (71.8%) respectively whereas in open field tomato; the highest fresh fruit remain was on 13X7 (45.8%)

followed by Srijana (43.1%). As far as shrinkage is concerned, varietal response was significant in both of the growing condition. In open field tomatoes; the least shrinkage was observed on 13X7 (2.0) followed by 3961D (2.1) and 3961C & Srijana (2.3) respectively. Similarly, among the tunnel tomatoes; the least shrinkage was observed on 3961C and 3961D (1.3) followed

by 13X7 (1.6), Choto cross (2.3) and Srijana (2.6) respectively (Table 6). Pusa Ruby and CL1131 had higher shrinkage. Physiological

weight loss was lower on 3961C (10.1%) and 3961D (10.9%) followed by 9331 (12.1%) and 13X7 (13.2%) respectively.

Table 6. Keeping quality parameter of tomato genotypes at Khumaltar under open field and tunnel house condition in 2021

S.N.	Cultivars	Remain Fresh Fruit % wt (30DAS)			Shrinkage (1-5) ^x (30DAS)			PWL%
		Open	Tunnel	Mean	Open	Tunnel	Mean	Tunnel
1	13X7	45.8	68.0	56.9a	2.0	1.6	1.8b	13.2
2	1418	18.2	61.8	40.0ab	2.6	3.3	2.9ab	14.4
3	9708	14.3	67.2	40.75ab	3.3	1.6	2.4ab	20.2
4	9331	21.3	75.1	48.2ab	3.0	3.0	3.0ab	12.1
5	1455	26.3	75.1	50.7ab	3.3	3.6	3.4a	16.7
6	3961C	19.7	60.5	40.1ab	2.3	1.3	1.8b	10.1
7	3961D	29.8	89.1	59.45a	2.1	1.3	1.7b	10.9
8	CL1131(ch)	12.7	61.9	37.3ab	4.0	3.0	3.5a	15.5
9	Pusa Ruby	22.7	22.2	22.45b	3.0	4.3	3.6a	16.4
10	Srijana(ch)	43.1	77.3	60.2a	2.3	2.6	2.4ab	19.9
11	CL2037	6.0	-	-	3.3	-	-	-
12	Choto cross	-	71.8	-	-	2.3	-	15.8
	GM	23.6	66.37	45.6	2.8	2.57	2.67	14.57
	F-test	ns	**	ns	ns	**	*	Ns
	LSD (0.05)	-	22.67	-	0.222	1.064	1.463	8.459
	CV%	41.48	18.78	27.8	25.21	22.72	24.16	31.9

The number of marketable fresh fruit remain after 30 days storage was significant among the cultivars in both the growing condition. However, tomato fruits harvested from tunnel had longer keeping quality as compared to open field tomato. Cv. 3961D had best keeping quality (100%) followed by 13X7 (50.9%) and Srijana (47.4%) respectively in open field tomato. Cultivar Pusa Ruby had least remain fresh fruit (33.3%) in tunnel tomato. Similarly, the effect of cultivars on rotten % by number and weight was significant in both the grown condition. Rotten

fruits were higher in open field stored tomatoes in number and weight. 3961D had no any rotten fruits even after 30 days in both the growing condition. In open field tomatoes; the least rotten number (%) was recorded on 13X7 (49.1%) after 3961D whereas in tunnel grown tomatoes; 3961D was followed by Srijana (10%), 1455 (11.4%) and choto cross (12.1%) respectively. Likewise, rotten fruits were minimum on Srijana (7.8%) after 3961D followed by 1455 (8.1%) and choto cross (12.4%) respectively (Table 7).

Table 7. Keeping quality parameter of tomato genotypes at Khumaltar under open field and screen house condition in 2021

S.N.	Cultivars	Remain Fresh Fruit % # (30DAS)			Rot no. % (30DAS)			Rot wt. % (30DAS)		
		Open	Tunnel	Mean	Open	Tunnel	Mean	Open	Tunnel	Mean
1	13X7	50.9	78.3	64.6abc	49.1	19.2	34.1bc	42.7	18.8	30.7bc
2	1418	18.8	68.7	43.07bc	81.1	31.2	56.1ab	72.4	23.8	48.1ab
3	9708	16.4	87.7	52.0bc	83.6	12.2	47.9ab	75.2	12.6	43.9ab
4	9331	23.7	86.2	54.9bc	76.2	13.7	44.9ab	67.6	12.8	40.2ab
5	1455	30.6	86.6	58.6bc	69.3	11.4	40.3ab	60.1	8.1	34.1ab
6	3961C	32.8	68.5	50.6bc	67.1	34.7	50.9ab	63.3	29.4	46.3ab
7	3961D	100	100	100a	0	0	0c	0	0	0c
8	CL1131(ch)	14.8	73.1	43.9bc	86.6	26.8	56.7ab	68.4	22.6	45.5ab
9	Pusa Ruby	22.8	33.3	28.0c	77.1	66.6	71.8a	67.9	61.3	64.6a
10	Srijana(ch)	47.4	89.9	68.6ab	52.6	10.0	31.3bc	49.4	7.8	28.6bc
11	CL2037	6.5	-	-	93.4	-	-	82.8	-	-
12	Choto cross	38	91.2	-	62.0	12.1	-	54.5	12.41	-
	GM	24.09	78.54	56.52	76.04	21.66	43.4	66.86	19.05	38.2
	F-test	**	**	ns	**	**	ns	**	**	Ns
	LSD (0.05)	21.55	26.42	36.97	21.53	28.07	37.36	21.82	23.05	33.32
	CV%	49.16	18.49	28.92	15.56	71.2	38.0	17.95	66.51	38.55

Fruit Characteristics

The average fruit weight, fruit length and fruit width was higher in tunnel grown tomatoes as compared to open field grown. In open field tomatoes. 3961D had bigger size fruits (73.6 g) whereas 3961C had bigger size fruits (119.6 g) in tunnel condition (Fig. 1). Similarly, longest fruit length (51.6 mm) was found in 3961D in open field tomatoes and on 3961C (54.1 mm) in tunnel (Fig. 2). Widest fruit was recorded on 3961D (56.1 mm) in open field and 3961C (61.8 mm) in tunnel (Fig. 3). Cultivar 13X7 had the greatest Pericarp thickness (5.5 mm) in open field and 3961C (6.6 mm) in tunnel grown tomatoes (Fig. 4). TSS was ranged from

4.2 (3961C) to 4.9 (1455) in open field and 3.6 (3961C) to 5.4 (1418) in tunnel tomato (Fig. 5). The titratable acidity ratio was ranged from 0.9 (CL1131) to 1.9 (1455) (Fig. 6). Ascorbic acid content was ranged from 56.2 mg/100 g (Choto cross) to 89.1 mg/100 g (9331) in open field tomato whereas 47.3 mg/100g (Choto cross) to 102.8 mg/100 g (3961D in tunnel tomato (Fig. 7). The highest firmness (1.4 kg/cm²) was measured on 3961C and the lowest on 1455 (0.4) in tunnel tomato whereas ranged from 0.5 kg/cm² (Choto cross) to 0.9 kg/cm² (9708) (Fig. 8). The highest number of seeds (190) content in a fruit was counted on 3961C and the least (76) in 9708 (Fig. 9).

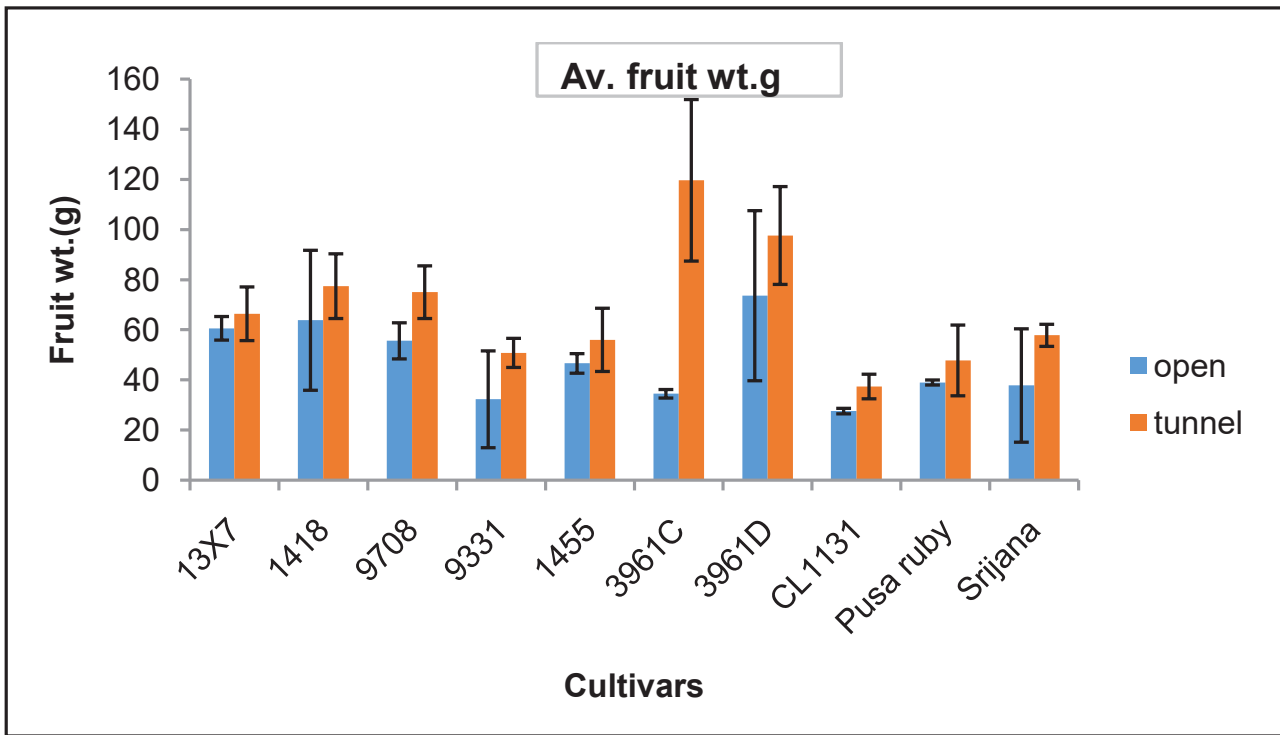


Fig. 1. Average fruit weight (g) of open and tunnel tomato

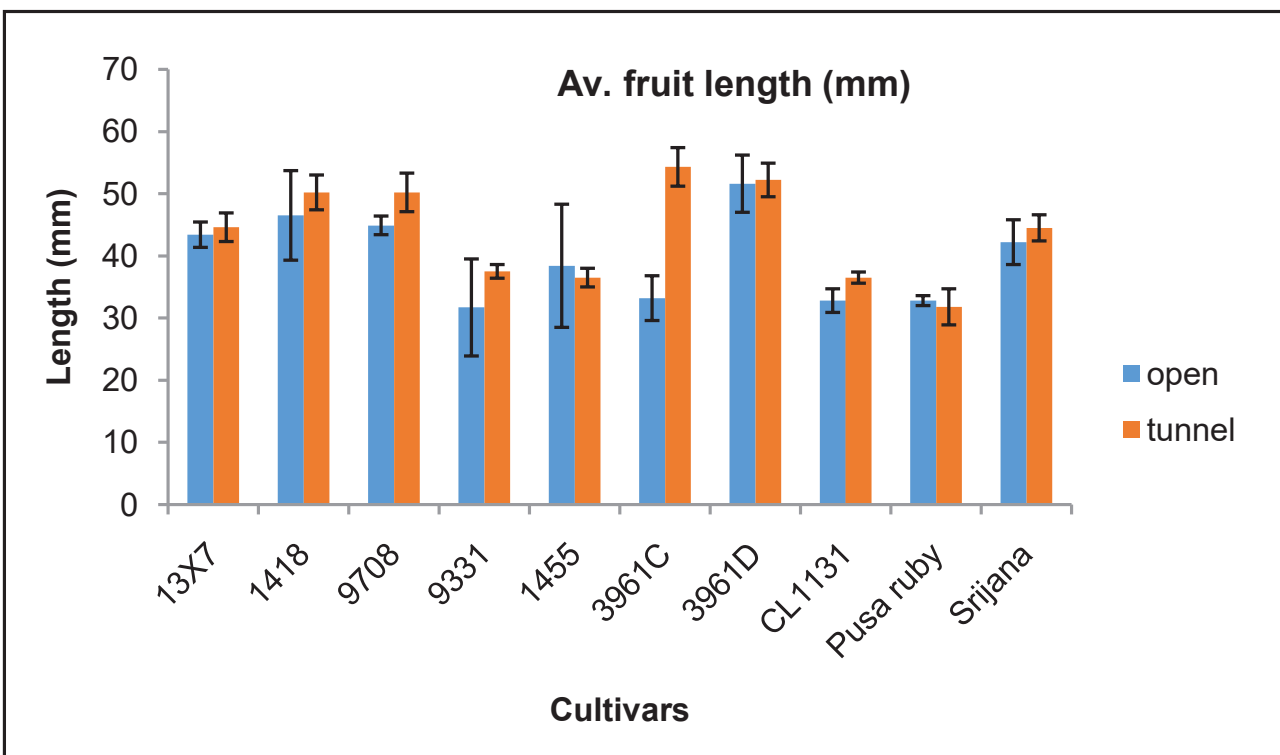


Fig. 2. Average fruit length (mm) of open and tunnel tomato

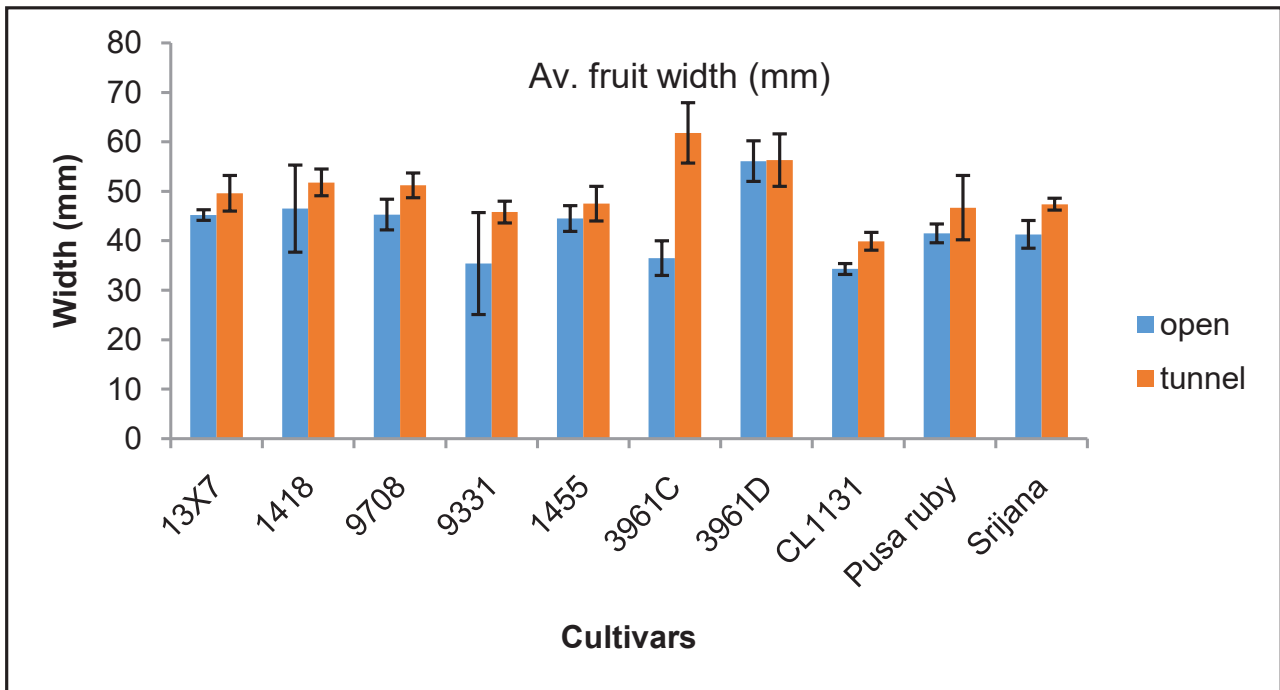


Fig. 3. Average fruit width (mm) of open and tunnel tomato

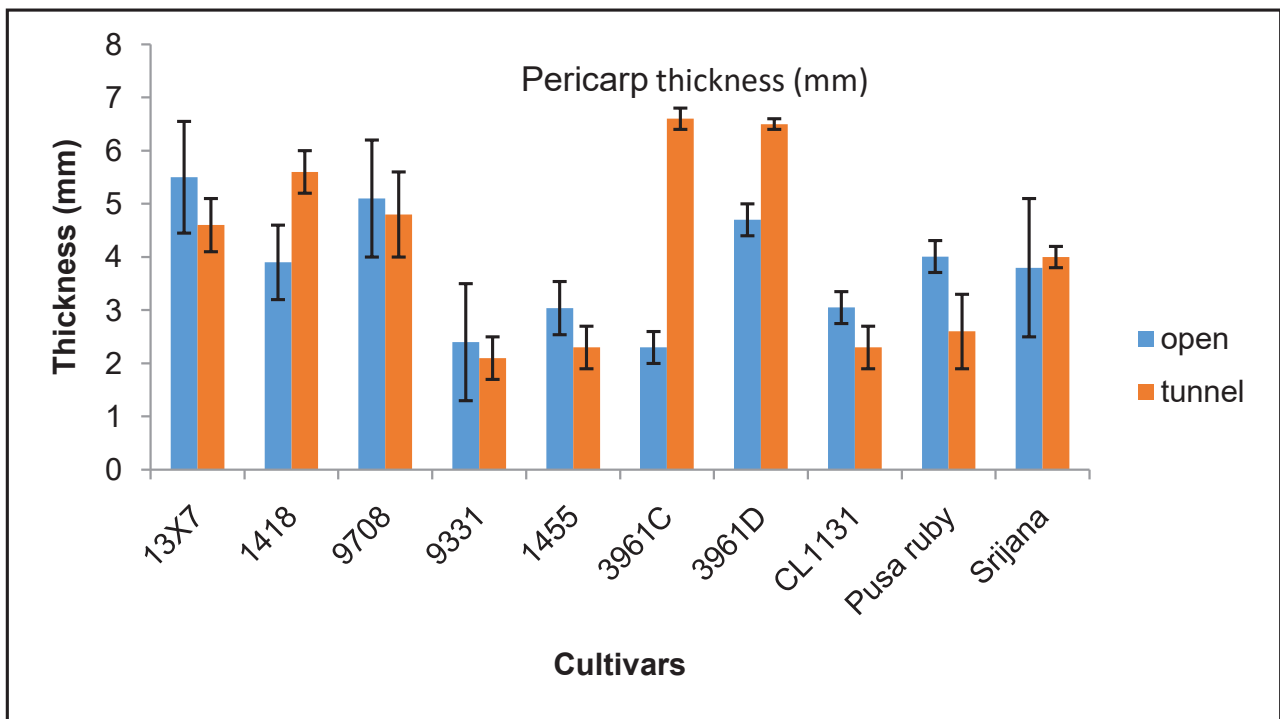


Fig. 4. Pericarp thickness (mm) of open and tunnel tomato

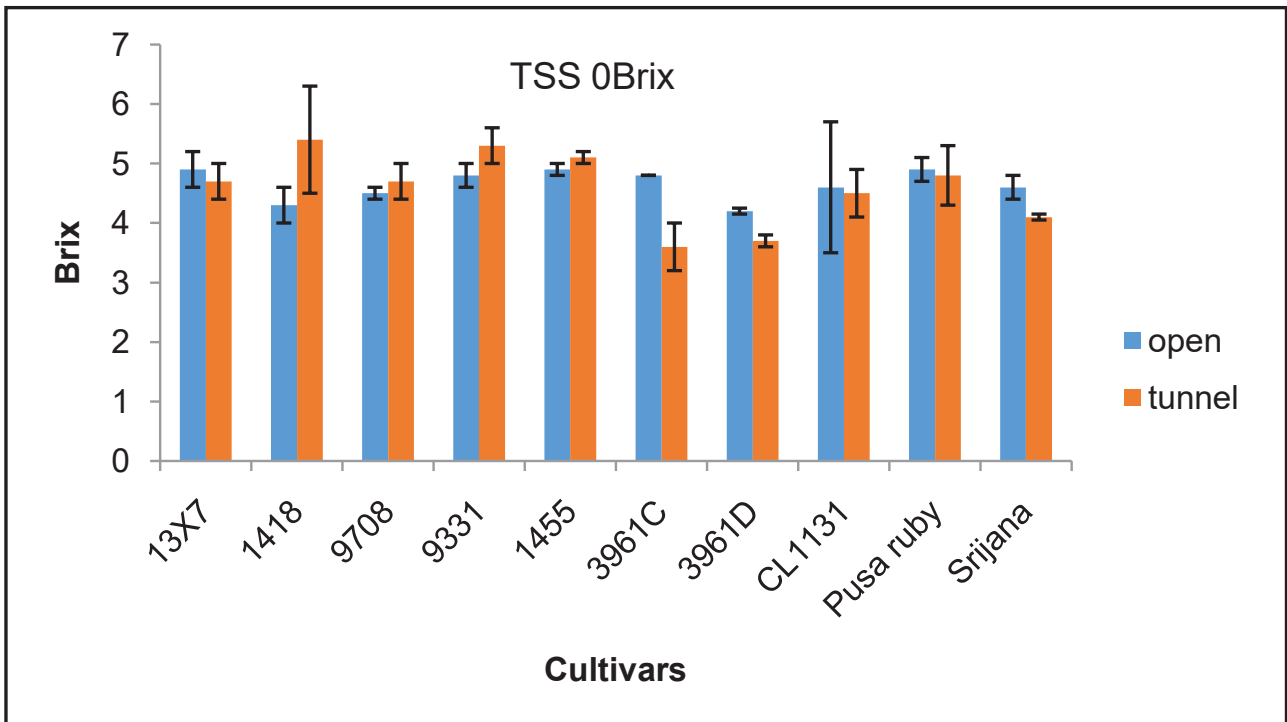


Fig. 5. TSS (0Brix) of open and tunnel tomato

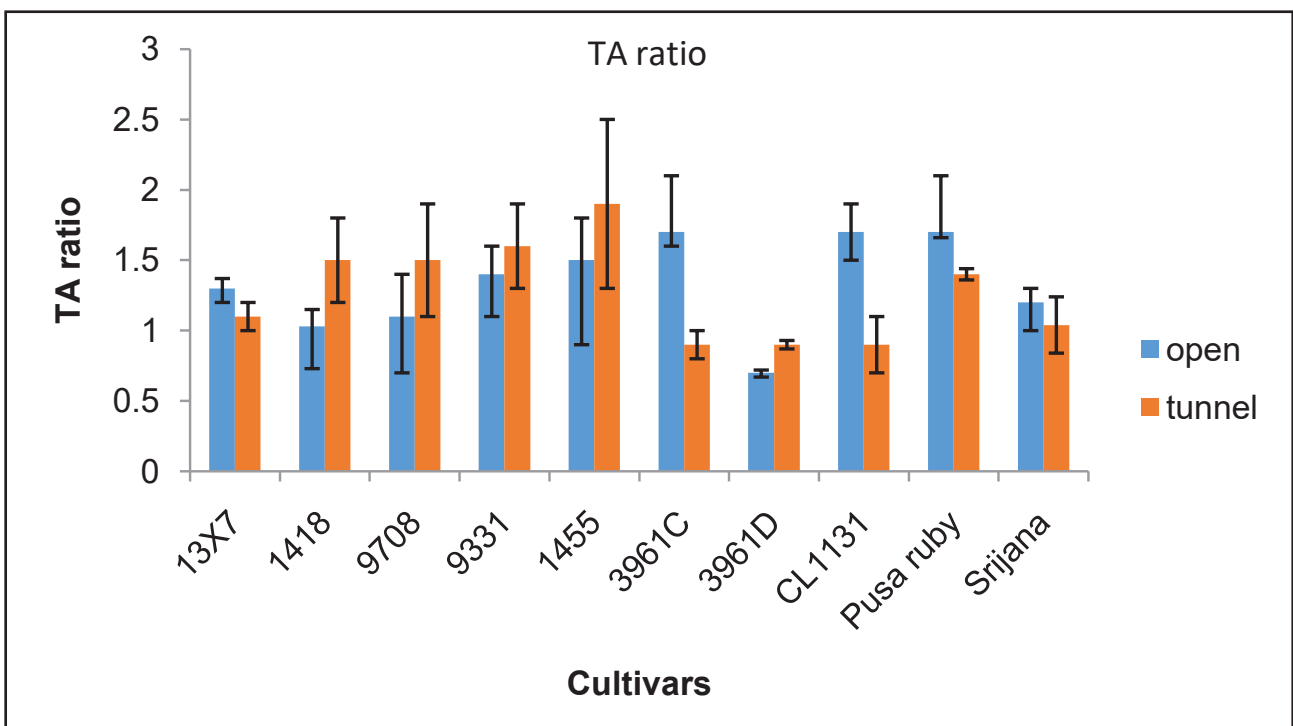


Fig. 6. TA ratio of open and tunnel tomato

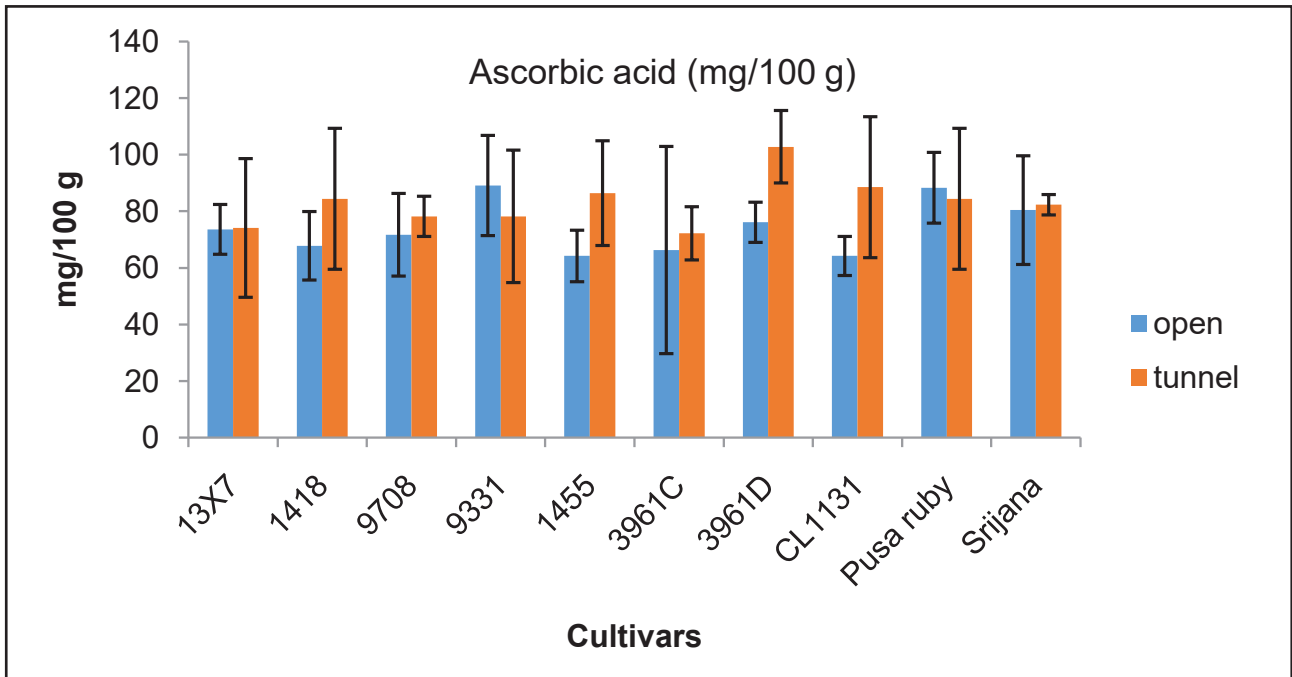


Fig. 7. Ascorbic acid (mg/100 g fruit) of open and tunnel tomato

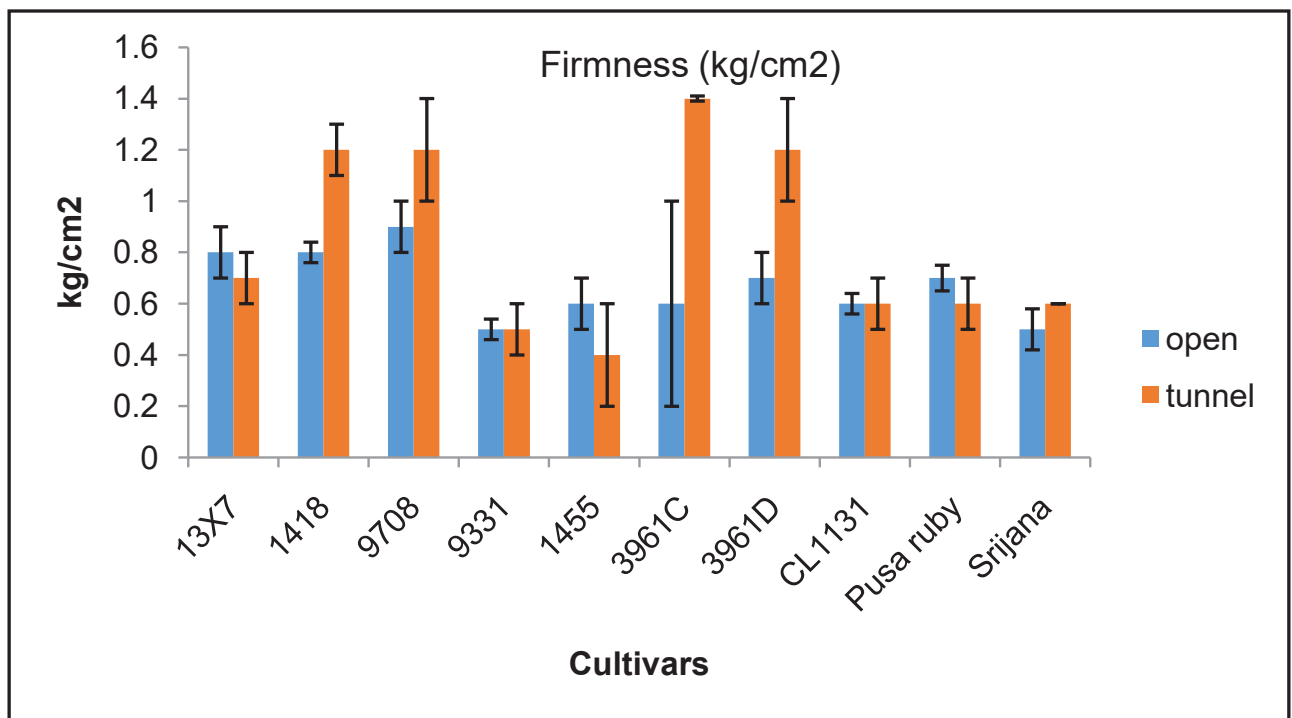


Fig. 8. Firmness (kg/cm2) of open and tunnel tomato

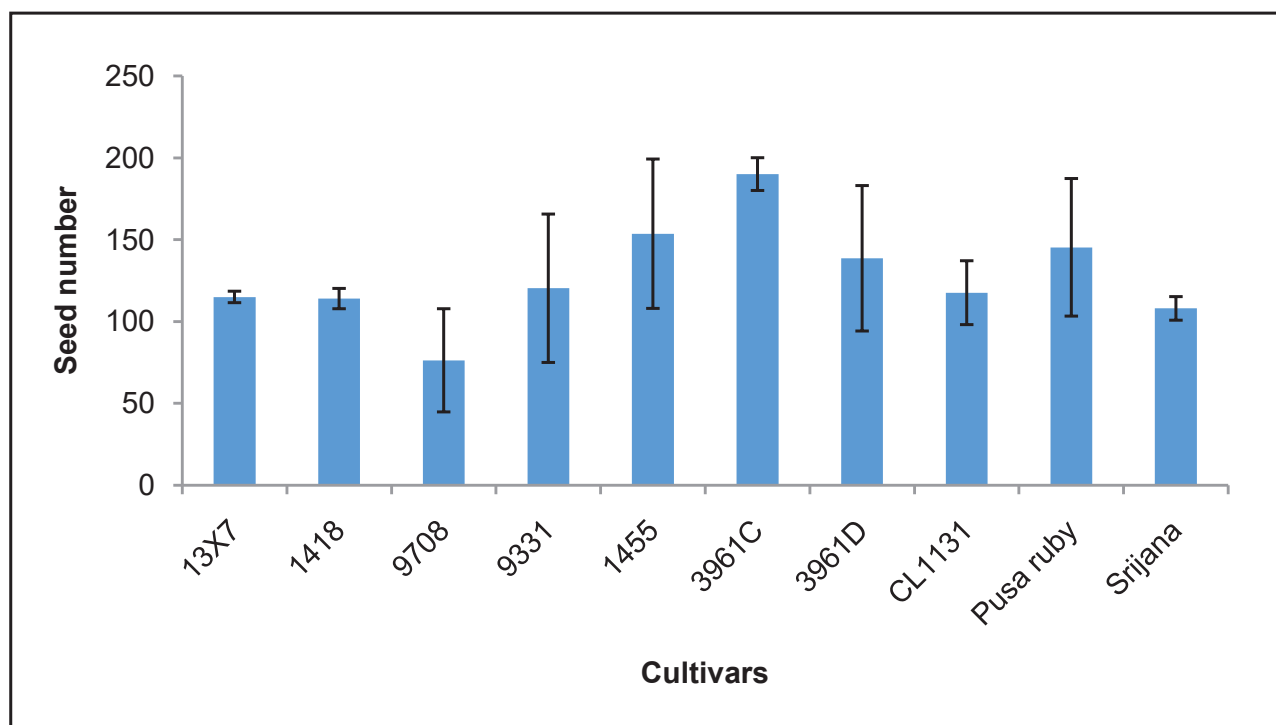


Fig. 9. Av. seed content (number) per fruit tomato

Conclusion and Recommendation

On the basis of overall characteristics under open field and tunnel growing condition; among the tested cultivars 13X7 showed superior performance that was late blight resistant (2.3), early days to flowering (26), higher number of fruits per plant (6.3), superior yield (99.95 t/ha) and 5171 gm per plant and medium in fruit size. It had good keeping quality; least shrinkage (1.8), significantly higher marketable fruit weight remain percentage (78.3), less rotten percent (18.8) and physiological weight loss percent (18.8) at 30 days after room storage (DARS). The next superior cultivar was Srijana which had late blight (3.5), days to flowering (27), higher number of fruits per cluster (6.5), superior yield (100 t/ha) and 5624 gm per plant, medium fruit size, and superior keeping quality; less shrinkage (2.3), higher marketable fruit weight remain percent (60.2) and less rotten percent (7.8) at 30 DARS. These two cultivars are recommended for cultivation in mid-hills of Bagmati Pradesh. If only keeping quality is concerned; 3961D was the best cultivar which had no any rotten, significantly least shrinkage

and weight loss even after 30 DARS.

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