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Evaluation of cherry tomato genotypes for tribal livelihood improvement

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Abstract

In the captivating cold desert terrain of Ladakh, nestled beyond the towering Himalayas, the harsh climatic conditions confine the agricultural window to a brief 5-6 months annually for open cultivation. Within this limited timeframe, while cool-season vegetables manage to thrive in open fields, the cultivation of warm-season crops, which demand a higher temperature, necessitates the adoption of protected cultivation methods. In response to these challenges, tomatoes, a warm-season crop, have been successfully cultivated within protective structures such as greenhouses, trenches, and walk-in tunnels, which are instrumental in providing the necessary temperature conditions to achieve optimal yields. Cherry tomatoes have emerged as a novel and sought-after crop, primarily driven by the burgeoning tourism industry in Leh Ladakh, which has spiked the demand for these tomatoes. However, the widespread cultivation of cherry tomatoes at the farm level is hindered by a lack of knowledge regarding appropriate cultivation techniques and the identification of suitable varieties. To address this gap, a pivotal study was conducted at KVK-Leh during the Kharif season of 2023-24, focusing on the evaluation of three cherry tomato genotypes under protected cultivation conditions. The study utilized a basic local structure for protection, affordable for the majority of local farmers. Among the genotypes tested, 'Cherry Red Gold' stood out, yielding an impressive 61.44 tons per hectare and featuring a tangy sweet flavor profile with a Total Soluble Solids (TSS) content of 11°Brix. The spherical fruit shape of 'Cherry Red Gold' was preferred over the oblong and oval shapes of the 'Sheeja' and 'Tutim Racha' varieties, respectively. 'Cherry Red Gold' also excelled in the number of fruits per bunch, although 'Tutim Racha' led in bunch weight due to its larger fruit size. In terms of plant height, 'Tutim Racha' was the tallest, followed by 'Cherry Red Gold', with 'Sheeja' being the shortest at 171.40 cm. This study marks a significant step toward identifying a cherry tomato variety that is well-suited for successful cultivation under protected conditions in Ladakh, potentially transforming local agriculture and contributing to the region's economic growth

Keywords: Cherry tomatoes, cold desert, Ladakh, local greenhouse, temperature and trans-Himalayas

Introduction

The cultivation of cherry tomatoes (*Solanum lycopersicum* var. *cerasiforme*) represents a significant segment of the horticultural industry, driven by consumer demand for flavorful and nutritious produce. Cherry tomatoes, characterized by their small size, vibrant colors, and sweet flavor profile, have gained widespread popularity among consumers worldwide. The fruits of cherry tomato plants have pleasing appearances and a delicious taste, and are well accepted by consumers. Cherry tomatoes have determinate, semi-determinate, and indeterminate growth habits with long racemes and many fruits of intense color and flavor weighing between 10 and 30 g (Prema *et al.* 2011) [10]. Cherry tomatoes are resistant to diseases and tolerant to high relative humidity, have high nutritional value because of high vitamin C content and present a highly variable number of fruits per cluster (15-50). Lycopene content of cherry tomato exceeds fresh weight which is considered as high. Cherry tomato fruits are consumed more as a fruit rather than as a vegetable (Omprasad *et al.*, 2016) [8]. Cherry tomato is a very new introduction in Ladakh and only few know about the crop. When taken as a salad dressing, it offers extra charm to the plate and looks very attractive. Ladakh being a cold arid region, open conditions do not support its survival and production (Fig 1). Protected cultivation, particularly through greenhouse farming, is highly advantageous during the summer months, especially under the unique conditions of Ladakh. This method provides a controlled environment that is essential for maximizing production potential. Key benefits of greenhouse cultivation include an extended growing season, safeguarding crops from unpredictable weather, and maintaining optimal temperature conditions. The average temperature inside a greenhouse remains favorable, thereby supporting robust plant growth. These advantages make greenhouse cultivation an appealing choice for both commercial growers and small-scale producers in Ladakh (Fig. 2). To fully capitalize on the

benefits of cultivating cherry tomatoes under greenhouse conditions in regions such as Ladakh, it is imperative to select genotypes that not only offer high yields but also demonstrate strong adaptability to the local growing conditions. In this context, an experiment was conducted to evaluate the performance of three different cherry tomato cultivars under passive solar greenhouse conditions. The study particularly focused on assessing the cultivars in terms of taste, yield, and overall acceptability. This methodological approach ensures that the selected cherry tomato genotypes are well-suited for the specific environmental conditions of Ladakh, potentially leading to improved agricultural productivity. Passive solar greenhouses in Ladakh are the most affordable structures for crop cultivation with zero energy investment as this arid region gets around an average of 300 cloud-free sunny days in a year (Lamo *et al.*, 2020) [7]. The average temperature inside the protected structure from April to October prevails in the best range for tomato cultivation (Fig. 2). In this paper, we delve into selecting the best varieties of cherry tomato for cultivation within passive greenhouse settings under cold arid Ladakh conditions. The findings would provide growers with valuable information to make informed decisions regarding genotype selection for protected cherry tomato production.

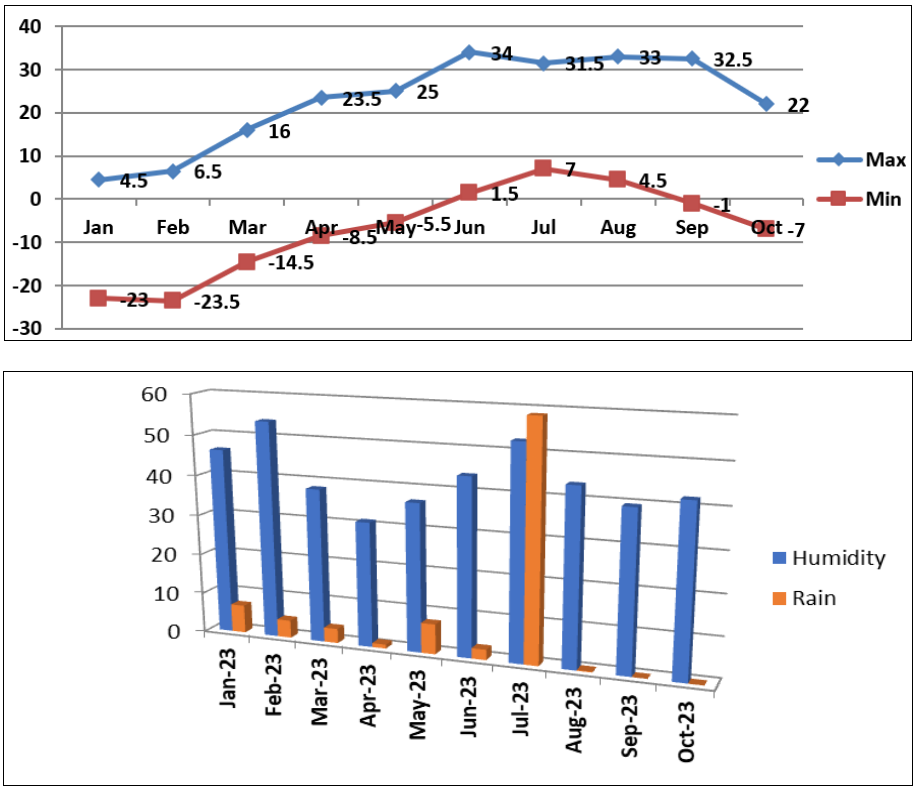
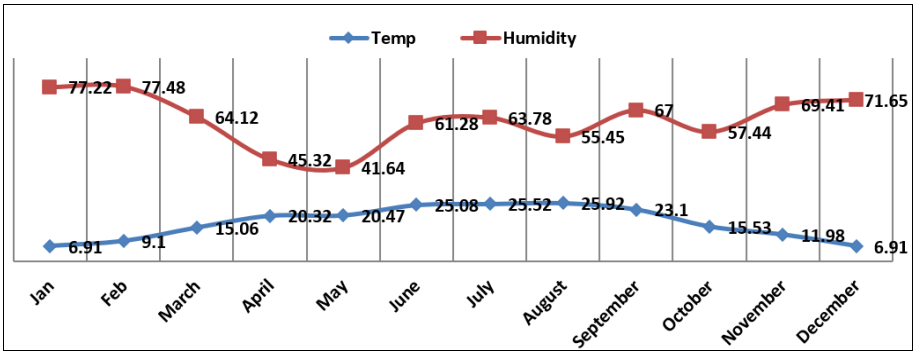


Fig 1: Leh Agormetero data under open conditions from Jan to Oct 2023 (source AMFU-Leh)



***Source*:** Easy Log Digi-logger

Fig 2: Av. temp data inside Local greenhouse 2023

Materials and methods

A field experiment was conducted at Krishi Vigyan Kendra-Leh, under the auspices of Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K), positioned at an elevation of 3305 meters above sea level (latitude 33.975383, longitude 77.699674), from May to October 2023. This study aimed to evaluate the performance of three hybrid cherry tomato varieties (*Solanum lycopersicum* L. var. *cerasiforme*) within a local greenhouse, embodying a commitment to sustainable agricultural practices through the use of indigenous materials such as bricks, stones, clay, and willow sticks. The

structure, measured 32x16 square feet and the cladding material used was a UV stabilized polythene sheet to optimize growing conditions. The experiment used a randomized block design, incorporating three replications. The cherry tomato genotypes selected for this study-Sheeja, Cherry Red Gold and Tutim Racha-are characterized by their semi-indeterminate growth habit, allowing for prolonged fruiting periods conducive to the region's dry temperate climate. The experimental setup consisted of nine plots, each hosting six plants spaced at 100cm x 60cm between rows and individual plants, respectively. Cultural practices tailored to tomato cultivation were meticulously adhered to, following the transplantation of 35-day-old seedlings in the month of May. The plants were trained along plastic twines. Growth and yield characters were recorded from five plants in each replicated entry selected randomly and were tagged. Data on growth and yield characters were recorded on plant height (cm), fruit TSS, number of fruits per bunch, average fruit weight, fruit length, fruit width, fruit shape, fruit yield per plant and fruit yield per hectare. Multiple manual harvesting of fruit was done at 4-5 days interval. Mean across three replications were calculated for each trait and the mean performance is assessed (Fig. 3). The recorded data were statistically analyzed at 1% and 5% level of significance following the standard process using WASP (Web Agri Stat Package-ICAR) data analysis package.

Results and Discussion

The evaluation of cherry tomato genotypes under the unique climatic conditions of Ladakh offers significant insights into optimizing agricultural practices for tribal livelihoods in cold desert regions. This study's findings highlight the considerable genetic variability among cherry tomato genotypes, particularly in terms of growth, yield, and fruit quality attributes. The performance of 'Cherry Red Gold,' 'Sheeja,' and 'Tutim Racha' under passive solar greenhouse conditions revealed distinct advantages and limitations, underscoring the importance of genotype selection for successful cultivation. Analysis of variance (ANOVA) was carried out for three genotypes under Local greenhouse in Ladakh for growth and yield attributes presented in Table 1. The differences among the genotypes were significant for all the characters (Table 1).

The maximum plant height was observed in Tutim Racha (241.80 cm) followed by cherry Red Gold (228.60). Sheeja recorded minimum plant height among the three genotypes (171.40 cm). The differences in plant height may have been influenced by a combination of genetic traits, acclimatization and adaption, light availability, pruning and training. Similar findings confirmed with the results reported by Ramya *et al*. (2016) [12], Yimchunger *et al.* (2018) [16] and Ramesh *et al*. (2022) [11] in cherry tomato. The results also coincide with the findings of Haque *et al.* (1988) [5] who evaluated tomato lines and reported that the tallness, shortness and other morphological differences are varietal characteristics, which are controlled and expressed by certain genes. Fruit length was recorded maximum in Sheeja (4.43 cm) which is significantly at par with Tutim Racha (4.17 cm) and the minimum in recorded in Cherry Red Gold (3.43 cm). Similarly Fruit width was maximum (3.37 cm) in Cheery Red Gold and minimum was recorded in Sheeja (2.83 cm) which is statistically at par with Tutim Racha (2.90 cm). The findings explain the shape of the fruits and the reason behind the round shape of Cherry Red Gold and Elongated/ oval shape of Sheeja and Tutim Racha. Sheeja is little longer than Tutim Racha. The differences in Fruit shape are entirely genetic and the response of these genotypes to acclimatize to the greenhouse conditions. Similar results were also reported by Prema *et al*., (2011) [10] in cherry tomato. TSS affect over all taste and flavour of a product. This defines sweetness and consumer preferences. The evaluated genotypes reported significant differences with respect to total soluble solids (TSS). Maximum TSS was recorded in Sheeja (11.48 º Brix) followed by Cherry Red Gold (11.00 º Brix). The minimum was recorded in Tutim Racha (10.57 º Brix). Higher TSS might be due to the enhanced deposition of solids and more conversion of organic acids to sugars. Similar studies were conducted by the earlier workers Sumathi *et al*. (2013) [15] in tomato under poly house and Prema *et al.* (2011) [10] and Islam *et al.* (2012) [6] in cherry tomato. Notably, the study's outcomes regarding TSS levels contribute to a broader understanding of how Ladakh's intense solar radiation and unique geographic location affect fruit quality. The high TSS values recorded across genotypes may reflect an enhanced conversion of organic acids to sugars, a phenomenon previously observed in other high-altitude crops exposed to elevated UV radiation levels (Sumathi *et al*., 2013; Cervantes *et al*., 2019) [15, 2]. Significant differences were recorded among the cherry tomato genotypes for number of fruits / bunch. Maximum no. of fruits/bunch was recorded in Cherry Red Gold (14.50) which was significantly at par with Tutim Racha (13.73). This may be due to more number of flowers per cluster, fruiting clusters, fruit set and genetic potential of the genotype. Similar results in cherry tomato have also been reported by Cheena *et al.* (2018) [3], Chouhan *et al*. (2018) [4] and Yimchunger *et al.* (2018) [16]. The genotypes showed significant differences for bunch weight. Maximum bunch weight was recorded in Tutim Racha (132.10) followed by Cherry Red Gold (127.40 g). Though the number of fruits per bunch are significantly similar. The reason for more bunch weight in Tutim Racha might be the bigger size of fruits compared to Cherry red Gold. Minimum bunch weight was recorded in Sheeja (75.67 g) which could be attributed to less number of fruits per bunch and also Sheeja fruits were lighter in weight compared to the other two genotypes. Average fruit weight showed significant differences among the three genotypes with Tutim Racha recording maximum average fruit weight of 9.63 g which is significantly at par with Cherry Red Gold (8.81 g). This variation in average fruit weight might be due to inverse relationship existing between average fruit weight, and number of fruits per cluster. This was conformity with the findings of Prema *et al*., (2011) [10], Islam *et al.*, (2012) [6]. The lowest average fruit weight in Sheeja (7.73 g) might be due to lower fruit dry matter content despite less number of fruits per cluster which is potentially a genetic trait. The data on Fruit yield per plant and fruit yield per ha showed significant variation among the genotypes. The highest yield per plant and per hectare was recorded in Cherry Red Gold (3.39 kg, 61.44 t) followed by Tutim Racha (2.84 kg, 47.27t). The lowest yield per plant and per hectare was recorded in Sheeja (1.94

kg, 32.28t). The highest fruit yield per plant and per hectare in Cherry Red Gold is attributed to better vegetative growth, robust flowering, higher fruit set percentage, more no. of fruits per cluster, good average fruit weight, and taller plants. This may be due to the inherent ability of the hybrid and their better response to controlled environmental conditions. Similar reports of better performance of hybrids due to genetic makeup have been reported by Singh *et al.*, (2013) [14] in tomato under protected conditions and Prema *et al*., (2011) [10], Aguirre and Cabrera (2012) [1] and Razzak *et al.*, (2013) [13] in cherry tomato.

Fig 3: Different cherry tomato hybrids and their performance under local greenhouse at KVK-Leh (3305 m amsl)

Table 1: Performance of cherry tomato genotypes under Local Greenhouse for growth and yield parameters in Ladakh

SI. No.	Genotype	Plant height (cm)	Fruit length (cm)	Fruit width (cm)	TSS (^{0} brix)	No. of fruits/bunch	Bunch weight (g)	Average Fruit wt (g)	Yield/plant (kg)	Yield/ha(t)	Fruit Shape and colour
1	Sheeja	171.40	4.43	2.83	11.48	9.80	75.67	7.73	1.94	32.28	Yellow and oblong
2	Cherry Red Gold	228.60	3.43	3.37	11.00	14.50	127.40	8.81	3.69	61.44	Cherry red and spherical
3	Tutim Racha	241.80	4.17	2.90	10.57	13.73	132.10	9.63	2.84	47.27	Red and oval
	F-test	**	**	**	**	**	**	**	**	**	
	CD at 0.05	4.76	0.56	0.35	0.36	1.50	3.83	1.00	0.17	2.87	
	CV	0.98	6.16	5.14	1.42	5.24	1.51	5.08	2.70	2.69	

** Significant at 1% level of significance

Conclusion

Among the trio of genotypes evaluated, Cherry Red Gold emerged as the superior variety, excelling in yield, flavor profile, and overall acceptability. It produced an impressive yield of 61.44 tons per hectare, with a total soluble solids (TSS) content of 11^0 Brix, a rich tangy-sweet taste, complemented by its appealing spherical shape. These findings suggest that Cherry Red Gold is exceptionally well-suited for cultivation during the summer months in Ladakh within the confines of an affordable and sustainable local greenhouse.

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Conflict of Interest

On behalf of all authors, the corresponding author declares that there is no conflict of interest involved. No external funding was received for the research conducted, and there are no financial or non-financial interests to disclose.

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