AATCC Review

22 January 2025: Received
26 March 2025: Revised
23 April 2025: Accepted
27 April 2025: Available Online

https://aatcc.peerjournals.net/

Original Research Article

Open Access

Performance of some Apricot (Prunus armeniaca L.) Germplasm Accessions for Morphological and Physiological Characters under Cold Dry Temperate Conditions of Lahaul and Spiti valley

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ABSTRACT

Apricot (Prunus armeniaca L.) is a deciduous fruit tree of the family Rosaceae and sub family Prunoideae mostly grown in mid-hills and dry temperate regions of the country. In the cold temperate region of Lahaul and Spiti Valley, the productivity of this crop is quite low as compared to other apricot growing countries. The main reason for its low productivity and fruit quality is due to its suitability to particular agro-climatic regions. Therefore, it is need of the hour to identify the variety best suited to a particular agro-ecological condition. In this regard, the performance study was carried out to evaluate the apricot varieties like New Castle, Kaisha, Charmagaz, Suffiada, Nari, and Lari Selection. On the basis of evaluation studies results revealed that the maximum leaf-length (3.60 cm), leaf width (3.51cm), leaf area (36.25cm^2), and petiole length (29.00 mm) was found maximum in cultivar Lari Selection and minimum leaf-length (2.19 cm), leaf width (2.35 cm), leaf area (29.58 cm^2) and petiole length (25.97cm). The maximum fruit length (44.97 mm) was observed in cultivar Lari Selection and minimum (28.32 mm) in cultivar New Castle, fruit width (44.72 mm) was found maximum in cultivar Charmagaz and minimum (26.28 mm) in cultivar New Castle whereas fruit weight (43.94 g) was recorded maximum in cultivar Lari Selection, fruit firmness (6.02 kg/cm^2) in cultivar Charmagaz and minimum fruit weight (28.18 g) and fruit firmness (5.31 kg/cm^2) in cultivar Nari. Whereas, the maximum stone weight (2.71g) was recorded in cultivar Lari Selection and the minimum (1.32g) in cultivar New Castle. The highest fruits (36.11 kg/tree) and productivity (24.37 t/hac) were recorded in cultivar Suffaida while, minimum fruits (16.47 kg/tree) and productivity (10.01 t/hac) was recorded in cultivar Lari Selection. Total soluble solids (TSS) were recorded maximum in cultivar Charmagaz (18.03°B) and minimum (15.67°B) in cultivar New Castle. Acidity in fruit was recorded highest in Nari (1.50 %) and minimum in Kaisha (1.03 %). Total sugars in fruit were recorded highest in Charmagaz (14.13%) and minimum in New Castle (9.06 %), highest reducing sugars were observed in Charmagaz (3.11 %) with minimum recorded in Nari (1.70 %) and non-reducing sugars recorded maximum in Charmagaz (9.93 %) and minimum was recorded in cultivar Nari (5.11%).

Keywords: *Apricot, Charmagaz, Cultivar, Lahaul and Spiti valley, Lari Selection, Suffaida, Yield.*

INTRODUCTION

In Himachal Pradesh, the dry temperate climate of is ideal for growing a variety of temperate fruits [11]. Temperate fruit significantly contributes a major role in boosting the economy of the farmers or growers. Temperate fruit cultivation has completely transformed or uplifted the socio-economic conditions of the rural farmers or growers in the High Hills zone of the [15]. Apricot (*Prunus armeniaca* L.) is species of Prunus that belongs to the family Rosaceae and is grown worldwide in mild temperate to extremely cold regions. The heart disease prevention properties of apricots may be due to their β-carotene and lycopene content. It is also a good source of fiber, which is beneficial to health in that it can help avoid diverticulitis and other digestive disorders, fruits have antipyretic, antiseptic, emetic, and ophthalmic properties [13]. Turkey is by far the world's largest apricot producer with 730,000 tonnes per year [2], harvesting over three-quarters of a million tons each year. In India, Ladakh is the largest apricot producer with a total production of 15,789 tonnes, accounting for nearly 62 per-cent of the country's total production (Anonymous, 2023b**.** In Himachal Pradesh, it is being grown in the mid hills and dry temperate regions occupying an area of 3343 ha with a production of 5134 MT [1]. Apricots are enjoyed as a fresh fruit but are also used as dried and processed forms. In the Lahaul and Spiti districts of Himachal Pradesh, which has a dry climate, fresh and wild apricot trees are growing in most of the villages in abundance. The apricot has great significance to tribal people because the fruits have multi-purpose uses like table purpose, extraction of liquor, feed to animals, preparation of chutney, jam, squash etc, The quality of fruit is better due to dry temperate climate. Due to high sugar and low acidity, the apricot varieties grown in high hills and valley areas are more suitable for drying [16]. It has generated a good amount of variability and some trees produce fruits as good as comparable to the commercial cultivars. Production of temperate fruits like apples and apricots has increased gradually, but in the absence of export quality produce and overall productivity status, the production of quality fruits (apples, apricots, and pear) is still a major concern for the farming community of this district and state in the coming years. Keeping in view the importance of this fruit in hilly areas of India, particularly in Lahaul and Spiti Valley the present studies were undertaken to mark trees that produce good quality apricot fruits.

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DOI: https://doi.org/10.21276/AATCCReview.2025.13.02.375

There are certain apricot cultivars such as New Castle, Suffaida, Nari, Kaisha and Lari Selection etc. which have better Fruit physical, yield, and quality characteristics. In higher hills, the organically produced fresh and dried apricots from this region can compete with International standards. The fruits produced from this region are the last to reach the market, when the production glut from lower altitude areas is over and, as a result, growers receive good prices. Considering the excellent quality of the fruit, more emphasis is being given to the introduction and popularization of drying-type cultivars of apricot fruits and each and every part of the wild apricot is being used, the oil extracted from the kernel is edible while the pulp is consumed as fresh or dried and nutshells are used as fuel.

MATERIAL AND METHODS

This study was conducted at Krishi Vigyan Kendra, Tabo, Lahaul and Spiti-II of Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, H.P. for two years from 2019 to 2021. Spiti valley located in the western Himalayan region in India, it is an integral part of Indian cold deserts. It lies between $31^0$42' to $32^0$58' N latitude and $77^0$21' to $78^0$35' E longitude and occupies an area of 5,582 km^2. It is bounded by Tibet in the north-east, Kinnaur in the south-east, Kullu in the west and Ladakh in north, with an average elevation of 4000 m. Being a part of cold deserts, the area is characterized by harsh climatic conditions i.e. dry and cold weather, low temperature, heavy snowfall and low annual rainfall. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The apricot varieties budded/grafted on seedling rootstocks and planted in 2003 at a spacing of 4m × 4 m were used as study material. Six varieties or genotypes of apricot New Castle, Kaisha, Charmagaz, Suffiada, Nari and Lari Selection were evaluated for physical, yield and quality parameters. The plants were trained on a modified central leader system and applied uniform recommended cultural practices to all the trees under study. The orchard portrays the true dry temperate climate of the northwest Himalayas. The summer is very dry and short, while winter is long cold and freezing. The fruit's quantitative traits such as fruit weight, dimension and fruit firmness in fruit were determined at the time of harvest. TSS was determined with the help of a hand refractometer. The titratable acidity expressed in terms of the percentage of citric acid was recorded by titrating 2 ml of juice against N/10 sodium hydroxide using phenolphthalein as an indicator. The total and reducing sugars of fruit were estimated by Lane and Eynon following the volumetric method [4] by titrating the sample against Fehling's solutions. The pooled data of two years were subjected to the statistical analysis.

RESULTS AND DISCUSSION

The variation in leaf characters are considered as distinguishing feature for the description and identification of fruit species and cultivars [18]. However, in the present study (Table 1). The leaf length (3.60 cm), leaf width (3.51 cm) leaf area (36.25 cm^2) and petiole length (29.00 mm) was found maximum in cultivar Lari Selection and minimum leaf length (2.19 cm), leaf width (2.35 cm), leaf area (29.58 cm^2) and petiole length (25.97 mm) was found in cultivar Nari while, no marked variation was observed in leaf surface and margins. The color of mature leaves was green in all the cultivars/genotypes. Similar results pertaining to foliage characters were reported by various workers [14] [7] [8] and [17]. Table 1: Foliage parameters of apricot varieties under cold dry temperate conditions of Lahaul and Spiti valley, Himachal Pradesh. (Pooled data of 2019 and 2020)

Name of cultivar	Leaf Length (cm)	Leaf Width (cm)	Leaf area (cm^2)	Petiole length (mm)	Leaf surface	Leaf margin	Leaf color
New Castle	2.68	2.78	30.39	26.36	Smooth	Serrated	Green
Kaisha	2.56	2.69	32.26	27.96	Smooth	Serrated	Green
Charmagaz	2.47	2.44	34.59	28.59	Smooth	Serrated	Green
Suffaida	2.36	2.67	30.23	27.23	Smooth	Serrated	Green
Nari	2.19	2.35	29.58	25.97	Smooth	Serrated	Green
Lari Selection	3.60	3.51	36.25	29.00	Smooth	Serrated	Green
$CD_{0.05}$	0.12	0.13	2.17	1.33			

The morphological traits showed significant variation (Table 2) among the selected cultivars indicating the presence of adequate variations. Among six varieties studied, the maximum fruit length (44.97 mm), fruit weight (43.94 g), and stone weight (2.71g) was recorded in cultivar Lari Selection whereas, the maximum fruit width (44.72 mm) and fruit firmness (6.02 kg/cm^2) was found in cultivar Charmagaz while, the minimum fruit length (28.32 mm), fruit width (26.28 mm) and stone weight (1.32 g) was recorded in cultivar New Castle while, minimum fruit weight (28.18 g) and fruit firmness (5.31 kg/cm^2) were recorded in cultivar Nari. The highest fruits (36.11 kg/tree) and productivity (24.37 t/hac) was recorded
in cultivar Suffaida while, minimum fruits (16.47 kg/tree) and productivity (10.01 t/hac) was recorded in
cultivar Lari Selection. All the cultivars have cling/freestone while, stone size varies from medium to large and kernel taste was found bitter to sweet. The variation with respect to fruit physical characteristics is due to the effect of genotypic differences among the cultivars and differential utilization of resources from the soil. Such factors are known to cause morphological and genetic evolutionary divergences among the population. In general domestic market has a likeness toward apricot fruits which are large in size, sweet in taste, less acidic, and juicy flesh is easily separable from stone. Several workers have worked on the physical aspects of apricot [10] [5] [12] and [6] in the past and have reported considerable variation in fruits of different apricot cultivars.
Data relating to various qualitative characters on six cultivars (Table 3) showed that aroma was recorded high in cultivar New Castle, Kaisha, Charmagaz, Suffaida, and Nari and Medium in
cultivar Lari Selection, pulp color was observed deep orange in all the cultivars expect Nari and Lari Selection which is Yellow, pulp firmness was recorded firm in all the cultivars except medium in cultivar Lari Selection fruit taste was observed sweet to very sweet in nature whereas fruit over-color was observed yellow to orange-yellow in all the cultivars. These results showed their diverse nature represented by most of the descriptor states [9].

Table 2: Fruiting parameters of apricot varieties under cold dry temperate conditions of Lahaul and Spiti valley, Himachal Pradesh. (Pooled data of 2019 and 2020)

Name of cultivar	Fruit Length (mm)	Fruit Width (mm)	Fruit Weight (g)	Fruit firmness (kg/cm²)	Stone Weight (g)	Fruit yield (kg/tree)	Fruit productivity (t^{-hac})	Cling/free stone	Stone size	Kernel taste
New Castle	28.32	26.28	31.12	5.98	1.32	25.36	15.62	Free stone	Medium	Bitter
Kaisha	35.29	41.94	35.82	5.81	2.58	23.14	14.37	Free stone	Medium	Bitter
Charmagaz	36.28	36.90	33.28	5.46	2.36	32.05	20.00	Free stone	Medium	Sweet
Suffaida	41.25	44.72	42.02	6.02	1.45	36.11	24.37	Free stone	Medium	Sweet
Nari	36.29	35.03	28.18	5.31	2.09	23.12	14.42	Free stone	Medium	Sweet
Lari Selection	44.97	42.28	43.94	5.83	2.71	16.47	10.01	Free stone	Large	Bitter
$CD_{0.05}$	1.16	0.61	1.96	0.35	0.09	1.20	1.09			

Table 3: Imported qualitative characteristics of apricot varieties under cold dry temperate conditions of Lahaul and Spiti Valley, Himachal Pradesh

Name of cultivar	Aroma	Pulp color	Pulp firmness	Fruit taste	Fruit over color
New Castle	High	Deep orange	Firm	Very sweet	Deep Orange
Kaisha	High	Deep orange	Firm	Very sweet	Orange yellow
Charmagaz	High	Deep orange	Firm	Very sweet	Orange yellow
Suffaida	High	Deep orange	Firm	Very sweet	Orange yellow with red tinge
Nari	High	Yellow	Firm	Very sweet	Yellow
Lari Selection	Medium	Yellow	Medium	Sweet	Yellow

The observations recorded on total soluble solids in different apricot cultivars and hybrids presented in Table 4 clearly indicates that the maximum fruit TSS (18.03 °Brix), total sugars (14.13 %), reducing sugars (3.11 %) and non-reducing sugars (9.93 %) was recorded in cultivar Charmagaz whereas, maximum titratable acidity (1.50 %) was found in cultivar Nari while, the minimum TSS (15.67 °Brix) and total sugars (9.06 %) was recorded in cultivar New Castle while, minimum titratable acidity (1.03 %) was recorded in cultivar Kaisha and reducing sugars (1.70 %) and non reducing sugars (5.11 %) was recorded in cultivar Nari. Total Soluble Solids content in fruit juice are regarded as one of the most important components to assess the quality of fruits. The levels of total soluble solids keep on increasing as the fruit matures and are considered as one of the most important components for assessing the fruit quality. The appreciable differences with respect to T.S.S. In different apricot cultivars may be explained on the basis of leaf-fruit ratio and subsequently on the synthesis of more photosynthesis and their further breakdown into simple metabolites.

Table 4: Fruit chemical parameters of apricot varieties under cold dry temperate conditions of Lahaul and Spiti valley, Himachal Pradesh. (Pooled data of 2019 and 2020)

Name of cultivar	TSS (^{0}Brix)	Titratable Acidity (%)	Total Sugars (%)	Reducing Sugars (%)	Non-Reducing Sugars (%)
New Castle	15.67	1.25	9.06	1.79	6.01
Kaisha	17.62	1.03	9.31	2.12	7.42
Charmagaz	18.03	1.20	14.13	3.11	9.93
Suffaida	17.05	1.12	12.44	1.92	6.78
Nari	16.50	1.50	11.78	1.70	5.11
Lari Selection	16.37	1.18	10.42	2.00	9.57
$CD_{0.05}$	0.80	0.44	0.47	0.12	0.31

SCOPE OF THE STUDY

Apricot is supposed to fetch higher price with its wide market potential after processing. Dry apricot marketed at small scale, needs further multiplication with variation in the processed products. Apricot has great potential of marketing in wider area, which is supposed to be achieved through intervention of suitable post harvest technologies. Apricot farmers may fetch higher price through variation in the processed products with increased shelf-life. The income of apricot farmers can further be increased through utilizing the family labourers for different unit operations. Therefore, there is greater opportunity for adoption of apricot cultivation in Himachal Pradesh speciically in Lahaul and Spiti valley, where the agroecological situations are quite variable and extreme. Adoption of alien recommendations without rational exegesis may prove perilous leading to escalation in proportion of debit laden growers in the region.

Conlict of interest

The authors declare no potential conlicts of interest concerning the research, authorship, and/or publication of this research article.

Acknowledgment

The authors would like to thank Krishi Vigyan Kendra, Tabo, Lahaul, and Spiti-II, Himachal Pradesh for providing an opportunity to carry out this research work under their supervision and technical support.

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