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Evaluation of Apricot Cultivars and their Hybrids under Mid Hill Conditions of Garhwal Himalaya

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ABSTRACT

The present investigation was carried out at Horticultural Research Block, G.B. Pant University of Agriculture and Technology, Hill Campus, Ranichauri, Tehri Garhwal, Uttarakhand, India. Three cultivars and four hybrids of apricot growing in Horticultural Research Block were analyzed for their physical and bio-chemical properties. All the cultivars and hybrids show significant differences among various physical and bio-chemical characters of apricot fruit. Among different cultivars, New Large Early showed the best result in respect to the physical properties of apricot fruits. In respect to the different hybrid studied, treatment T_5 (New Large Early×New Castle) showed superiority in physical characters over all other hybrids. In relation to the bio-chemical characters of the different cultivars and hybrids, there was no definite pattern was observed during the investigation.

Key words: *Hill, Biochemical, Cultivars, Hybrids.*

INTRODUCTION

Apricot is a deciduous fruit tree of the family Rosaceae and rank next to peach and plum in economic importance among the temperate stone fruits. It is grown all over the world and the highest percentage of world's production comes from the countries around the Mediterranean region, i.e. Turkey, Spain, Italy, France and Greece[9]. Apricot (*Prunus armeniaca* L.) is a native to China and Central Asia. It is considered as one of the most delicious temperate fruit[4]. It is a rich source of carbohydrates and minerals besides having attractive color and typical flavor[12]. The major sugar likes glucose, fructose, sucrose, sorbitol and malic acid and citric acid are the principal constituents present in it[18]. It is a good source of mineral such as potassium, sodium and iron but deficient in protein and fat[13]. The fruits are rich source of vitamin A and also contain more carbohydrates, protein, phosphorus and niacin than majority of other common fruits. Nutritive value of fruits as reported includes carotene (617 mg/100g), carbohydrates (73.61%) and vitamin A 3600 IU[39].

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Apricot has a small tree, 8-12 m tall with a trunk up to 40 cm diameter and a dense spreading canopy. The leaves are ovate, 5-9 cm long and 4-8 cm wide with rounded base and pointed tip. The flowers are 2- 4.5 cm in diameter with 5 white to pinkish petals which are produced singly or in pairs in early spring. Apricot is classified among the stone fruits because of one hard seed often called a stone[40]. Apricot is a cultivated type of Zardalu (Wild apricot), which is produced by domestication. It plays an important role in human nutrition, the fruits are highly versatile and can be consumed as fresh, dried or processed such as frozen apricot, jam, jelly, marmalade, pulp juice nectar and apricot kernels are used in production of oils, cosmetics, active carbon and aroma perfumes[23]. The apricot plants start bearing at the age of 4-5 years and the productive life of the tree is about 25-30 years. The blooming and its duration vary from cultivar to cultivar depending upon age and vigour of the tree and the weather conditions prevailing in a particular agro-climatic zone. Under Indian conditions flowering period varies from 11-14 days in New Castle cultivar of apricot[38]. Similarly, the fruit set and physico-chemical composition of fruits are also influenced by the prevailing weather conditions as well as nitrogen supply. For commercial cultivation, the selection of cultivars for a particular site is very crucial because any one cultivar has only limited climatic adaptability and it can't be grown on a large tract in the hills which have highly variable climatic conditions. There are certain apricot cultivars, which have better fruit quality and are grown in higher hills, but under mid hill conditions, where these cultivars don't perform better, the cultivar like New Castle, Shipley's Early etc. Information on the genetic variability of apricot is limited. Apricot breeding programmes are under way in many countries, where specific attention is being focused on high quality fruits, resistant to winter and late spring and adaptability to different environmental conditions[22]. We need to produce good quality fruits in order to achieve these objectives. We have suitable lands, traditional varieties with good quality parameters and suitable climatic conditions. We only can fulfill the varying consumer demand if we continuously improve our production with the generation of new hybrids. The present study entitled "Evaluation of Apricot Cultivars and their Hybrids under Mid Hill Conditions of Garhwal Himalaya" was hence proposed to undertake the preliminary work on evaluation and selection of some apricot hybrids.

MATERIAL AND METHODS

Detail of Experiment

The present investigation entitled "Evaluation of Apricot (*Prunus armeniaca* L.) Cultivars and their Hybrids under Mid Hill Conditions of Garhwal Himalaya" was undertaken at Horticultural Research Block of G.B. Pant University of Agriculture and Technology, Hill Campus, Ranichauri (Tehri Garhwal), Uttarakhand during February, 2012 to June, 2012. The experiment was conducted on three apricot cultivars (parent) and their four hybrids. Trees of parent cultivars were 30-35 years old, whereas the hybrids were of only 23-24 years. All the hybrids were developed at Horticultural Research Block, GBPUA&T Hill Campus, Ranichauri (Tehri Garhwal) during the year 1987-1988. Uniform orchard management practices were employed for all the parent plant and their hybrids.

Treatments

Notation	Treatments
	Cultivars
T_1	New Castle
T_2	New Large Early
T_3	Charmagz
	Hybrids
T_4	New Large Early x Safeda
T_5	New Large Early x New Castle
T_6	Charmagz x New Castle
T_7	Charmagz x Safeda
Experimental design	Randomized Block Design
Number of replications per treatment	04 (One tree under each replication)

Observation Recorded

(A) Fruit physical parameters

1. **Fruit size (mm)-** Fruit size, in terms of length, from fruit apex to stem end, and diameter at the broadest end were measured by 'Vernier Callipers' and the mean size of ten fruits were calculated both for length and diameter.
2. **Fruit weight (g) and volume (ml)-** Fruit weight was recorded by weighing it on 'Electronic Balance' and the mean weight of ten fruits were computed. Fruit volume was determined by employing 'water displacement method'. For this fruits were submerged in a graduated cylinder, containing water. The initial and final volume of fruit was calculated by subtracting initial volume from final volume.
3. **Stone and kernel weight (g)-** Stones of ten randomly selected fruits at peak harvesting stage, having uniform maturity were cleaned, washed and shade dried. Pit and kernel weight was calculated by weighing them on 'Electronic Balance' and mean was worked out.
4. **Pulp:Stone ratio-** The pulp and stone of fruit were separated with the help of knife and finally weighed separately. In order to determined pulp: stone ratio, the pulp weight of a fruit was divided by corresponding stone weight.

(B) Fruit bio-chemical parameters

1. **Total soluble solids (^{0}Brix)-** Total soluble solids (T.S.S.) present in fruit pulp was recorded at room temperature by using Hand Refractrometer and expressed in terms of degree Brix (^{o}Brix). Three observations were taken for each sample and their mean values were computed.
2. **Ascorbic acid (mg/100g)-** Ascorbic acid content was estimated by using 2, 6-Dichlorophenolindophinol (DCPIP) visual titration method[28]. Ascorbic acid in terms of mg/100g pulp weight was calculated using the following formula,

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Titre} \times \text{Dye factor} \times \text{Volume made up} \times 100}{\text{Aliquot of extract taken for estimation} \times \text{Weight of sample taken for estimation}}$$

1. **Titrable acidity (%)-**The acidity of fruit was estimated by titrating the fruit pulp extract with 0.5 N NaOH using phenolphthalein as indicator[28]. This was expressed in terms of percentage malic acid using the formula given in following pages:
2. **Sugar content (%)-**Total and reducing sugars in the pulp of apricot fruit were determined by Lane and Eynon method[28], by using following formula.

$$\textbf{Total sugars (\% invert sugar)} = \frac{\text{Factor x Dilution} \times 100}{\text{Titre value *} \times \text{Weight or volume of sample taken} \times 100}$$

$$\textbf{Reducing sugar (\%)} = \frac{\text{Factor} \times \text{Dilution} \times 100}{\text{Titre value *} \times \text{Weight or volume of sample taken} \times 100}$$

$$\textbf{Non-reducing sugars (\%)} = (\text{Total sugar} - \text{Reducing sugar}) \times 0.95$$

Statistical Analysis

The experimental data were analyzed statistically as per the method described by Cochran and Cox[7]. for R.B.D. The interpretation of results based on 'F' test and for comparing means, critical difference (C.D.) at 0.05 level of probability was marked out. The results obtained during the investigation are presented in the form of tables, graphs and photographs at appropriate places.

RESULT AND DISCUSSION

Fruit Physical Characteristics

Data pertinent to fruit size have been presented in table 1. It is clearly indicated that among all the cultivars studied New Large Early produced the biggest fruits having 36.80 mm length followed by Charmagz which produced fruit length of 36.08 mm and New Castle (29.25 mm). Both the cultivars showed significant superiority over New Castle, while New Large Early Vs Charmagz remained at par to each other. Out of four hybrids studied the maximum fruit length was recorded in New Large Early x New Castle (42.98 mm), thereafter Charmagz x Safeda (38.12 mm), Charmagz x New Castle (37.27 mm) and the minimum fruit length was recorded in New Large Early x Safeda (35.54 mm). Data in respect to fruit width presented in table 1 significantly differed to each other. The maximum fruit width was recorded in New Large Early (43.28 mm) preceded by the Cv Charmagz (36.84 mm) and New Castle (27.62 mm) which was the lowest fruit width. Among the hybrids studied the minimum fruit width was estimated in Charmagz x New Castle i.e.; 37.27 mm, succeeded by Charmagz x Safeda (38.71 mm) and New Large Early x Safeda (39.56 mm). The maximum fruit width was noticed in New Large x New Castle (43.69 mm). The observations are in accordance with results reported by Prakash[26], who reported the average fruit length and diameter for New Castle as 25.3 x 35.8 mm^2 at the time of picking maturity. Sharma[30]. also noticed the same results with respect of fruit size in New Castle as 31.4 x 31.7 mm^2. A similar work was carried out by Dwivedi *et al.*[10]. while studying genetic divergence among apricot genotypes of Kargil. They reported fruit length of 26.30 mm (Afghani), 41.5 mm (Astralian), 34.4 mm (Charmagz) and 24.3 mm (Halman) at harvesting stage. Information regarding dimensional attributes is used in describing fruit shape, which is often necessary in horticultural research for a range of different purpose, including cultivar descriptions in application for plant variety right. Knowledge of the shape and physical dimensions are important in sorting and sizing of apricot fruits. Growth in apricot fruit is completed in three phases following a double sigmoidal pattern and maximum growth occur in III phase, which is also the 'Final swell'[6]. This increase is due to both cell size, i.e. cell enlargement and amount of intercellular spaces[20]. The length diameter ratio was more or less uniform thereby providing spherical shape to fruit. Nigam[25], also observed more increase in fruit length of apricot as compared to diameter in phase I^{st} of growth, thus making the fruit oblong in shape but later on in phase II, the increase in length slows down due to pit hardening and turning fruit shape from oblong to spherical.

Comparison with respect to fruit weight among the apricot cultivars and hybrids shows the fruits of New Large Early gained the largest weight (36.82 g) than in Charmagz, which was measured as 32.58 g (Table 1). New Castle gained the smallest fruit weight of 14.31 g. The hybrid 'New Large Early x New Castle' noticed to attained the highest fruit weight of 43.98 g followed by New Large Early x Safeda (32.21 g) and Charmagz x Safeda (30.91 g). Among the different hybrids the minimum fruit weight was recorded by Charmagz x New Castle as 28.16 g. A significant variation was also noticed on fruit volume among the different apricot cultivars (Table 1). Out of seven genotypes investigated, the maximum volume was confirmed in New Large Early x New Castle (41.77 ml) followed by New Large Early (32.16 ml), Charmagz x New Castle (29.81 ml) and Charmagz (29.40 ml). In respect to the cultivar studied, the minimum volume measured as 11.75 ml (New Castle), thereafter 22.16 ml (New Large Early x Safeda) and Charmagz x Safeda (25.47 ml). Studies on evaluation of morphological and physico-chemical characteristics of important apricot varieties of Ladakh, revealed the maximum fruit volume of 37.18 ml (Koban), 19.03 ml (Safeda) and 18.97 ml (Rakchey karpo), while the cultivar Shakarpara (14.47 ml), Nari (12.20 ml) and Rogan (7.95 ml) showed the lowest fruit volume[5]. Likewise, Sharma *et al.*[33],

evaluated physico-chemical characteristics of some fresh apricot cultivars and recorded the fruit volume of different cultivars as 12.85 ml (Pamarosa), 18.06 ml (Farmingdale) and 15.28 ml (Alfred). Fruit weight is a major quantitative inherited factor determining the yield, fruit quality and consumer acceptability. Therefore, the genotype may be expected to produce large fruit under better cultural practices[3]. The differences among the apricot cultivars and their hybrids may be attributed to inter-varietal/inter-hybrid differences which are ultimately governed by the genetic makeup and inheritance pattern. Fruit weight and size shows wide variation depending on its location within a tree and variety. It depends upon cultivar and crop load. The fruits are smaller in size when productivity is high. Apricot like most fruit trees is sensitive to water shortage during the early stage of fruit growth and development (Bloom to pit hardening). Water stress at these times generally leads to smaller fruits at harvest. To ensure adequate fruit size when water supplies are limited, early varieties should not be water stressed before harvest[16].

A glance at the data presented in table 1 indicates that cultivar New Large Early had maximum stone weight (2.67 g), while for Charmagz and New Castle the average stone weight was recorded as 2.55 g and 1.45 g, respectively. Most of the cultivars possess significant variation to each other except New Large Early Vs Charmagz, which remained *at par*. Out of four hybrids the lowest value of stone weight was observed in New large Early x Safeda (1.48 g), succeeded by Charmagz x New Castle (1.96 g) and New Large Early x New Castle (2.11 g). The maximum stone weight was measured for Charmagz x Safeda i.e.; 2.34 g (Fig. 8). The values presented in table1, also revealed that the kernel weight of apricot had significant variation among each other. The highest kernel weight was recorded in New Large Early i.e., 1.02 g, preceded by Charmagz (0.77 g) and the lowest was estimated for New Castle (0.42 g). All the hybrids also possess significant variation to each other except Charmagz x New Castle and Charmagz x Safeda. The lowest kernel weight was noticed for New Large Early x Safeda (0.38 g) succeeded by 0.62 g for each of Charmagz x New Castle and Charmagz x Safeda. The kernel weight of 1.05 g was observed as the highest for the hybrid New Large Early x New Castle. The pulp: stone ratio reflected significant differences in all the apricot cultivars and hybrids evaluated (Table 1). The minimum pulp: stone ratio was estimated for New Castle (8.33) followed by New Large Early x New Castle and New Large Early with pulp: stone ratio of 10.22 and 10.48, respectively. The maximum pulp: stone ratio was recorded for Charmagz (13.58) preceded by New Large Early x Safeda (12.48), Charmagz x New Castle (11.15) and Charmagz x Safeda (11.10). The results of present investigation are in conformity with the results reported by Dwivedi *et al.*[10], who noticed the pulp: stone ratio of 12.78 (Charmagz), 10.00 (Afghani), 15.40 (Australian), 8.50 (Halman), 13.30 (Raktsey karo) and 12.90 (Safeda) etc. The pulp: stone ratio in apricot cultivars Moorpark, St Ambroise and Turkey was recorded 15.00 and New Castle showed a flesh: pit ratio of 11.82[2]. Nigam[25]. reported that the pulp comprises 90.99% of the total weight of the apricot fruit at harvest and the ratio continuously increased in 3rd phase from 42 days to 70 days. A marked increase in flesh: pit ratio with advancement of maturity may be due to accumulation of metabolites thus increasing its weight, whereas reduction in seed weight resulted from the strong competition for assimilates between pericarp and stone in which stone was weaker competitor[25]. As fruit approaches towards maturity, a gradual rise in pulp: stone ratio was observed. The differential behavior in the development of fruit pulp and stone accounted for gradual increase in pulp: stone ratio during fruit development and maturity[34].

Fruit Bio-chemical Chracteristics

The observations recorded on total soluble solids in different apricot cultivars and hybrids presented in table 2 clearly indicates that the maximum T.S.S. was recorded in Charmagz (18.03 ^{0}Brix) followed by in New Large Early

(17.62 ^{0}Brix). Among three cultivars the lowest TSS was registered for New Castle (12.67 ^{0}Brix). Out of three cultivars studied New Large Early and Charmagz were found to be *at par* and remaining cultivars significantly differed to each other. While for hybrids, the maximum T.S.S. was noticed in New Large Early x Safeda (17.05 ^{0}Brix) followed by New Large Early x New Castle (16.50 ^{0}Brix), Charmagz x New Castle (16.37 ^{0}Brix) and the minimum T.S.S. was observed for Charmagz x Safeda (15.56 ^{0}Brix). All the genotypes studied showed significant superiority over New Castle. The results obtained in the present investigation are found to be close conformity with the studies of Sharma *et al*.[33], and[27], who recorded the value of T.S.S. content i.e., 11.30 ^{0}Brix and 11.01 ^{0}Brix, respectively in apricot cultivar New Castle. Srivastava *et al*.[36], while conducting experiment on different commercial apricot cultivars in U.P. hills, suggested a T.S.S. range varying from 10.87 to 14.00 ^{0}Brix at maturity, while the range in the apricot varieties in Himachal Pradesh was observed as 15.65 to 23.00 ^{0}Brix[2]. Nigam[25]. noticed an increase in T.S.S. with the advancement in the age of fruit and recorded minimum T.S.S. of 16.39 ^{0}Brix at picking maturity. Total Soluble Solids content in fruit juice are regarded as one of the most important component 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 component 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 photosynthates and their further breakdown in to simple metabolites.

The ascorbic acid content presented in table 2 indicates that all the cultivars differed significantly to each other. The Cv. Charmagz possess the maximum amount of ascorbic acid (14.06 mg/100g) preceded by New Large Early (10.33 mg/100g) and New Castle (8.94 mg/100g). Among the hybrids Charmagz x Safeda (15.17 mg/100g) possesses the highest amount of ascorbic acid closely following by New Large Early x New Castle (14.90 mg/100g) and New Large Early x Safeda (12.20 mg/100g). The lowest amount of ascorbic acid is found in Charmagz x New Castle (11.75 mg/100g). All the genotypes differed significantly in their ascorbic acid content to each other. The synthesis of ascorbic acid in the stone fruit depends on adequate supply of hexose sugar, which decline at ripening stage might be due to decrease in acidity, which could be attributed to oxidation of ascorbic acid[21]. A good amount of ascorbic acid ranging from 14.44 to 18.16 mg/100g edible portion has been reported by Srivastava *et al*.[36]. In New Castle the ascorbic acid content of pericarp tissue suddenly increases during first week of growth, thereafter the increase was steady till 28 days with the highest concentration of 17.6 mg/100 g fresh weight, however, decline speedily till picking maturity[32]. Although apricot cultivars are not considered to be a rich source of vitamin C, a good amount of ascorbic acid is estimated ranging in between 14.44 to 18.16 mg/100g edible portion. Wills *et al*.[41], recorded ascorbic acid content of 7 and 16 mg/100g in apricot cultivars Bavinity and Trevant, respectively. However, Sharma *et al*.[31], observed a range of 7.02 to 8.50 mg/100g of ascorbic acid in four apricot cultivars grown under dry temperate region of Himachal Pradesh.

Data recorded on titratable acidity at harvesting stage presented in table 2 shows that all the cultivars were significantly superior over Charmagz. The minimum tritratable acidity among all the cultivars was measured in Charmagz (0.23%) succeeded by New Large Early (1.00%) and New Castle (1.30%). Out of all the hybrids the maximum amount of acidity was estimated in New Large Early x New Castle (3.21%), thereafter Charmagz x New Castle (1.82%) and Charmagz x Safeda (0.77%). While, the minimum amount of titratable acidity recorded in New Large Early x Safeda (0.14%). All the genotypes studied showed significant variation with respect to acidity content, while Charmagz Vs New

Large Early x Safeda, which remained *at par* to each other. In accordance to our present findings Sharma *et al*.[33], observed titratable acid content in New Castle apricot as 1.38%, and Kaur[15], measured it as 1.25% in the same cultivar. She also noticed the tritratable acidity content of 1.88% and 0.30% for New Large Early and Charmagz, respectively which is closer to our findings. Titratable acidity of cultivar New Castle was also recorded 0.69% at harvest[27]. and that of variety Tokhm-Sefid 0.84%[17]. The majority of the apricot genotypes studied by Infante *et al*.[14], had acidity lower than 1%. The titratable acidity for variety Palsteyn was 1.5% and that of Grandir was 1.4% at the time of harvest. Dwivedi *et al*.[10], recorded titratable acidity of 7 important apricot cultivar of Ladakh as 0.9 % (Australian), 0.67 % (Halman), 0.61 % (Raktsey Karpo), 0.64% (Safeda), 0.95% (Shakanda), 0.13% (Shakarpara) and 1% (Tokpopa). Ruiz *et al*., reported the tritratable acidity in the fruit of 37 apricot cultivars grown in Spain which varied from 0.90% to 2.44%. Asma *et al.*[1], worked on several apricot cultivars and genotypes and reported the lowest acidity in 44 K 71 (0.35%) followed by 44 K 79 (0.40%). Sourness of fruits is basically attributed to the presence of organic acids in fruit pulp and taste of fruit is determined by ratio of sugars and acids. Reduction in sourness and increased sweetness at picking maturity observed under the present study might be due to decrease in organic acids and increased sugar level which in turn caused sweetness. With the advancement of maturity and ripening processes, starch is converted into sugar as a result of hydrolysis which is ultimately responsible for accelerated sugar level.

A critical examination of the data indicates that total sugar contents varied significantly among most of apricot cultivars, except New Castle and New Large Early. The cultivars Charmagz have the highest percentage of total sugars (14.17%) followed by New Large Early (9.33%) and New Castle (9.04%). The data presented in Table 2, also indicates that among all the hybrids 'Charmagz x Safeda' had the maximum amount of total sugar i.e.; 13.94% followed by New Large Early x Safeda (12.47%), whereas New Large Early x New Castle had 11.81% of total sugars. The minimum estimate of sugar contents were found in Charmagz x New Castle (7.45%). All the cultivars and hybrids showed significant superiority over New Castle except New Large Early. A close perusal of data presented in Table 2 indicates the maximum mean value of reducing sugars obtained in New Castle (3.16%) followed by New Large Early (2.15%) and in Charmagz (0.81%). Both the cultivars are significantly superior over Charmagz. The maximum reducing sugar was observed as 2.03% for Charmagz x New Castle. In contrast, the lowest mean value of reducing sugars was observed in Charmagz x Safeda (0.86%) and the remaining hybrids New Large Early x New Castle and New Large Early x Safeda possess, 1.73% and 1.97% reducing sugars, respectively. The estimate of non-reducing sugars presented in Table 2, also recorded the highest of it in Cv Charmagz as 12.68% and thereafter New Large Early (7.47%). The Cv. New Castle estimated the lowest value (6.02%) among all three cultivars. A close perusal of the data also indicates that all apricot cultivars significantly differed to each other. The non-reducing sugars estimated in hybrids New Large Early x Safeda and Charmagz x New Castle are nearly equal with 9.97% and 9.59%, respectively. The maximum mean value of non-reducing sugars was observed as 12.41% in Charmagz x Safeda. The minimum value of non-reducing sugars was observed as 5.14% (New Large Early x New Castle). Most of the genotypes differed significantly to each other except Charmagz Vs Charmagz x Safeda and New Large Early x Safeda Vs Charmagz x New Castle. Money and Christian[24]. while analyzing 92 samples of apricot, observed average total sugars contents as 6.05%. Strachan *et al.*[37], also recorded 1.87% of reducing sugars and 5.60%

of sucrose in apricot. Srivastava *et al*.[36], recorded 9.45% to 10.45% of total sugars in four varieties of apricot grown in hills of Uttarakhand, whereas Deshpande and Salunkhe[8], reported the total sugars, reducing sugars and sucrose which ranges from 5.34% to 7.88%, 2.59% to 3.43% and 2.62% to 4.22%, respectively. However, Singh *et al*.[35], reported a range of 6.15 to 16.05% for total sugars, 1.59 to 3.75% for reducing sugars and 3.75 to 13.95% for non-reducing sugars in 10 cultivars of apricot grown in Ladakh region of Jammu and Kashmir. Rodriquez *et al*.[29], observed that the values of reducing and total sugars varied from 0.76 to 2.47% and 5.23 to 15.18%, respectively. The increase in sugar levels is due to the abundance of chloroplast in young fruits which help in synthesis of sugars. Moreover, there is high concentration of starch in developing fruits which are hydrolyzed in component sugars as fruit approaches to maturation and ripening[20]. In apricot, fruits located on long shoots are always sweeter than those on spurs[19]. They also stated that fruits located in the sunniest areas are sweeter. The reducing and non-reducing fraction of the total sugars exhibited a similar trend as was observed for total sugars. Accumulation of non-reducing sugars starts at later stages in the season and is speeded up during maturation and ripening as a result it dominants over reducing sugars. Nigam[25]. noticed a rapid increase in sugar contents after 35 days of full bloom and this trend continued up to picking maturity. He further observed that increase in total sugar contents in the pericarp at weekly intervals showed a linear increase tending in total sugars, reducing sugars and sucrose levels in apricot fruit until maturation from early stages of growth. It was noticed that the amount of sugars in apricot fruits increases throughout the season[11].

Table 1: Fruit physical characteristics of different apricot cultivars and their hybrids

Treatments	Fruit Length (mm)	Fruit Width (mm)	Fruit Weight (g)	Fruit Volume (ml)	Stone Weight (g)	Kernel Weight (g)	Pulp: Stone Ratio
Cultivars							
T_1 (New Castle)	29.25	27.62	14.31	11.75	1.45	0.42	08.33
T_2 (New Large Early)	36.80	43.28	36.82	32.16	2.67	1.02	10.48
T_3 (Charmagz)	36.08	36.84	32.58	29.40	2.55	0.77	13.53
Hybrids							
T_4 (New Large Early x Safeda)	35.54	39.56	32.21	32.16	1.48	0.38	12.48
T_5 (New Large Early x New Castle)	42.98	43.69	43.98	41.77	2.11	1.05	10.22
T_6 (Charmagz x New Castle)	37.27	37.27	28.16	29.81	1.96	0.62	11.15
T_7 (Charmagz x Safeda)	38.12	38.71	30.91	25.47	2.34	0.62	11.10
CD (0.05)	**1.72**	**1.63**	**3.34**	**2.68**	**0.25**	**0.20**	**0.35**
CV (%)	**3.17**	**2.88**	**8.11**	**6.57**	**7.98**	**19.5**	**2.13**
SEm ±	**0.58**	**0.55**	**1.13**	**0.90**	**0.08**	**0.07**	**0.12**

Table 2: Fruit bio-chemical characteristics of different apricot cultivars and their hybrids

Treatments	TSS (^{0}Brix)	Ascorbic Acid (mg/100g)	Titratable Acidity (%)	Total Sugars (%)	Reducing Sugars (%)	Non-Reducing Sugars (%)
Cultivars						
T_1 (New Castle)	12.67	08.94	1.30	09.04	03.16	06.02
T_2 (New Large Early)	17.62	10.33	1.00	09.33	02.15	07.47
T_3 (Charmagz)	18.03	14.06	0.23	14.17	0.81	12.68
Hybrids						
T_4 (New Large Early x Safeda)	17.05	12.20	0.14	12.47	1.97	09.97
T_5 (New Large Early x New Castle)	16.50	14.90	3.21	11.81	1.73	05.14
T_6 (Charmagz x New Castle)	16.37	11.75	1.82	07.45	2.03	09.59
T_7 (Charmagz x Safeda)	15.56	15.17	0.77	13.94	0.86	12.41
CD (0.05)	**1.74**	**0.39**	**0.31**	**0.89**	**0.13**	**0.93**
CV (%)	**7.20**	**2.11**	**17.20**	**5.38**	**4.74**	**6.92**
SEm ±	**0.58**	**0.13**	**0.10**	**0.30**	**0.43**	**0.31**

CONCLUSION

In view of the economic importance of the apricot under the mid dry hill conditions of the Uttarakhand, there is a need to develop and identify the promising cultivars either through selection or by hybridization among the existing cultivars of the superior genotype by involving the suitable cultivars. In the present investigation the cultivars New Large Early is excellent in their fruit physical characteristics, while the cultivar Charmagz is found good in bio-chemical characteristics. Among the hybrids, New Large Early x Safeda, New Large Early x New Castle, Charmagz x New Castle, Charmagz x Safeda, all found promising with respect to one or other characters. However, the above observations are based on the one year study; there is a need for the further investigation among the different apricot cultivars and their hybrids for their yield, and quality attributes before proper selection of promising cultivars and their hybrids.

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