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## EVALUATION OF NINE INTRODUCED APPLE CULTIVARS UNDER COLD DESERT CONDITIONS OF INDIA

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## ABSTRACT

The present investigations on performance of nine introduced apple cultivars were carried out at progeny cum demonstration orchard, Boktu, Kinnaur (H.P.) for their suitability for commercial cultivation. The observations were recorded on various growth parameters like plant height, plant spread, trunk girth, annual shoot growth, fruit set, fruit drop, tree habit and vigour etc. Analysis of variance showed significant differences among all the cultivars for all the characters under study. Among different cultivars Golden Spur recorded maximum increment in trunk girth (17.44 mm). Plant height (4.82 m), plant spread (4.58 m) and tree volume (45.97 m<sup>3</sup>) was highest in 'Red Chief'. The varieties namely Gale Gala, Coe Fuji, Red Fuji and Golden Spur had spreading tree habit while others had upright growth. Fruit set percentage was found to be highest in 'Super Chief' (76.50 %).

## INTRODUCTION

Apple (*Malus × domestica* Borkh.) is one of the world's leading fruit crop widely grown, both in the Northern and Southern hemisphere. There are about 32 major apple producing countries of the world, China being the largest producer followed by United States, India, Turkey and Poland. India ranks third in world with apple production 2,891,000 tonnes annually (FAO, 2011). In India, apple cultivation is mostly confined to the states of Jammu & Kashmir, Himachal Pradesh and Uttarakhand which together accounts for 99 per cent of the total production and the remaining is contributed by the states of Sikkim, Arunachal Pradesh, Nagaland and Meghalaya (Chadha & Awasthi, 2005).

The yield performance of delicious group varieties have unfortunately started declining due to emerging challenges under the prevailing climatic conditions like weather vagaries, lack of superior genetic material, monoculture of variety and poor soil health leading to replant problems. This has necessitated the replacement of delicious varieties with spur and colored mutant in a phased manner. Adoption of improved varieties with proper placement of pollinizers, cultural management practices including plant protection measures can further increase the productivity.

During the recent past (2006) the State Department of Horticulture, Himachal Pradesh imported some new cultivars of apple namely Super Chief, Scarlet Spur, Gale Gala, Coe Fuji, Red Fuji, Red Chief, Granny Smith, Golden Spur, Oregon Spur-II and planted them at Progeny cum Demonstration Orchard (PCDO), Boktu in Kinnaur which is situated at an elevation ranging between 2200-2400 m *a.m.s.l.* These cultivars have successfully established and have started fruiting. No scientific studies on the performance of these cultivars have so far been conducted to screen them for their suitability under high hill conditions with changing climatic conditions.

## MATERIALS AND METHODS

The studies were carried out on nine introduced cultivars namely Super Chief, Scarlet Spur, Gale Gala, Coe Fuji, Red Fuji, Red Chief, Granny Smith, Golden Spur and Oregon Spur-II planted during 2006 at Progeny cum Demonstration Orchard, Boktu, District Kinnaur, H.P. at an elevation of 2200 m above mean sea level and falls under cold desert areas in the North Western Himalayas. The experiment was laid out in a Random Block Design with five replications at spacing of 3 x 3 m during 2011-12. The experimental trees received uniform cultural practices during the years of study. The statistical analysis was carried out for each observed character under the study using MS-Excel, SPSS 16.0 and SPAR 2.0 packages. The mean values of data were subjected to analysis of variance as described by Gomez and Gomez (1986).

## RESULTS AND DISCUSSION

The trunk growth ranged from 46.86 mm to 86.30 mm in December, 2011 being maximum in 'Golden Spur' and minimum in 'Super Chief' (Table 1). Similarly the

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**Table 1: Performance of different apple cultivars with respect to plant growth**

Name of Cultivar	Trunk Girth (mm)		Growth		Plant height (m)	Plant spread (m)	Tree volume (m <sup>3</sup> )	Annual shoot growth (cm)
	December, 2011	December, 2012	increment (mm) (%)					
Super Chief	46.86	50.89	4.03	8.16	2.95	1.08	1.83	25.95
Scarlet Spur	48.42	51.12	2.70	5.18	2.82	1.18	2.49	28.46
Gale Gala	54.02	61.77	7.75	12.60	3.12	2.52	11.80	37.89
Coe Fuji	66.25	71.79	5.54	7.78	3.98	2.43	12.49	36.83
Red Fuji	75.00	80.06	5.06	6.35	4.05	3.23	20.74	34.83
Red Chief	82.50	90.51	8.01	8.67	4.82	4.58	45.97	24.63
Granny Smith	66.83	71.98	5.15	7.05	3.45	2.22	8.60	33.12
Golden Spur	86.30	103.74	17.44	16.72	4.30	4.15	38.94	24.54
Oregon Spur-II	73.50	87.36	13.86	15.87	4.09	3.84	31.59	21.47
C.D. <sub>(0.05)</sub>	8.65	9.08	4.61	4.88	0.60	0.95	12.92	7.69

**Table 2: Characteristic feature of different apple cultivars**

Name of cultivar	Tree habit	Bearing habit	Tree vigour
Super Chief	Upright	Spur bearer	Dwarf
Scarlet Spur	Upright	Spur bearer	Dwarf
Gale Gala	Spreading	Spur and shoot bearer	Semi vigorous
Coe Fuji	Spreading	Spur and shoot bearer	Semi vigorous
Red Fuji	Spreading	Spur and shoot bearer	Semi vigorous
Red Chief	Upright	Spur and shoot bearer	Semi vigorous
Granny Smith	Upright	Spur and shoot bearer	Vigorous
Golden Spur	Spreading	Spur and shoot bearer	Vigorous
Oregon Spur-II	Upright	Spur bearer	Dwarf

**Table 3: Fruit set and fruit drop in different cultivars of apple**

Name of Cultivar	Fruit set (%)	1 <sup>st</sup> Fruit drop(%)	Pre-harvest fruit drop(%)	Total fruit drop (%)
Super Chief	76.50	8.50	12.60	21.10
Scarlet Spur	66.00	6.50	11.50	18.00
Gale Gala	72.00	7.50	8.50	16.00
Coe Fuji	66.40	7.40	8.00	15.40
Red Fuji	68.50	8.50	8.50	17.00
Red Chief	62.40	10.10	12.00	22.10
Granny Smith	86.70	8.50	8.60	17.10
Golden Spur	88.00	4.50	6.80	11.30
Oregon Spur-II	58.50	10.50	12.00	22.50
C.D. <sub>(0.05)</sub>	5.19	2.38	2.28	4.01

trunk growth varied from 50.89 to 103.74 mm in different cultivars in December, 2012 and followed a similar trend, being maximum in 'Golden Spur' and minimum in 'Super Chief'. The difference in the trunk girth have been reported by several workers and is generally attributed due to elevation and genotypic behavior of the cultivars and the site of plantation. Similar results in variation of trunk girth have also been reported by Kumar and Verma, (2001) in a study under kullu valley. The maximum plant height was attained by 'Red Chief' (4.82 m), followed by 'Golden Spur' (4.30 m), 'Oregon Spur-II' (4.09 m), 'Red Fuji' (4.05 m) and lowest height was recorded in 'Scarlet Spur' (2.82 m) closely followed by 'Super Chief' (2.95 m) (Table 1). The results are in line with the findings of Sharma *et al.* (2004) who reported that the cultivar Tropical Beauty was rated best with respect to plant height. Similarly, Bhat *et al.* (2006); Sharma (2011) and Hampson *et al.* (2009) also reported tree height to vary from orchard to orchard.

The data presented in Table 1 revealed that the plant spread

ranged from 1.08 m to 4.58 m in different cultivars being maximum in 'Red Chief' (4.58 m) and minimum in 'Super Chief' (1.08 m). The cultivar Golden Spur, Oregon Spur-II and Red Fuji were statistically at par with each other. The results are divergent as compared to the values recorded by Onofrei and Iacobuta (1989); Sharma, (2011) and Hampson *et al.* (2009). This may be due to the differences in the climatic conditions at different locations. Tree volume was recorded highest in 'Red Chief' (45.97 m<sup>3</sup>) and minimum in 'Super Chief' (1.83 m<sup>3</sup>) (Table 1). The maximum and minimum values of present studies are in accordance with the findings of Sharma and Chua, (2004). The variation in tree volume could be attributed to the combined effect of varietal makeup of the cultivars as well as the environmental conditions and nutrient status of the plantation sites. Present study revealed maximum annual shoot growth in 'Gale Gala' (37.89 cm) and minimum in 'Oregon Spur-II' (21.47 cm) (Table 1). Kumar and Verma, (2001) under kullu valley conditions also reported variation

in shoot growth. Sharma *et al.* (2004) under Nauni conditions registered substantial variation on annual shoot growth which was probably due to higher temperature during the growth period.

The tree habit of different cultivars was recorded and the data is presented in Table 2. Cultivars Gale Gala, Coe Fuji, Red Fuji and Golden Spur showed spreading tree habit, whereas 'Super Chief', 'Scarlet Spur', 'Red Chief', 'Granny Smith' and 'Oregon Spur-II' were upright in the tree habit. Watkins and Smith, (1982) developed Apple descriptor and classified different apple varieties on the basis of tree growth habit as ranging from extremely upright to weeping. Most of the apple cultivars under study were found to have mixed bearing habit (Table 2) (*i.e.* both spurs and terminally on two or more year growth) except 'Super Chief', 'Scarlet Spur' and 'Oregon Spur-II' which were found to bear exclusively on spurs. The present investigations were supported by the findings of Watkins and Smith, (1982) who reported both type of bearing habit. 'Super Chief', 'Scarlet Spur' and 'Oregon Spur-II' were dwarf in stature (Table 2), whereas cultivars Granny Smith and Golden Spur were classed as vigorous and semi-vigorous tree were observed in cultivars Gale Gala, Coe Fuji, Red Fuji and Red Chief. Similar results were obtained by Sharma *et al.* (2004) while assessing the variability in different apple cultivars. Watkins and Smith, (1982) have categorized the tree vigor on the basis of plant growth of different cultivars taken for study. Further in the present study tree vigor was described as per the Apple descriptor published by IBPGR (1982).

The variation in fruit set is entirely based on the genetic makeup of the cultivars *i.e.* self compatible or self incompatible, pollen fertility and the prevailing climatic conditions. From the perusal of data presented in Table 3. It is evident that the fruit set ranged from 58.50 to 88.00 per cent in different cultivars under study. The highest fruit set was recorded in 'Golden Spur' (88.00 %) and the lowest in 'Oregon Spur-II' (58.50 %). Sharma, (2002) and Sharma (2011), registered fruit set between 17-68 per cent in an evaluation work of different low chill apple cultivars under Kwagdhara conditions. Two fruit drops were recorded in the different cultivars under study (Table 3). The first fruit drop which occurred at pea stage size ranged from 4.50 to 10.50 per cent. The highest fruit drop was recorded in the cultivar Oregon Spur-II (10.50 %) followed by Red Chief (10.10 %) and the lowest fruit drop was recorded in 'Golden Spur' (4.50 %). The second or pre harvest fruit drop ranged from 6.80 to 12.60 per cent in different cultivars. The total fruit drop ranged between 11.30 to 22.50

per cent in different cultivars being lowest in 'Golden Spur' (11.30 %) followed by 'Gale Gala' (16.00 %), 'Granny Smith' and 'Red Fuji' (17.00 %) and the highest fruit drop was recorded in 'Oregon Spur-II' (22.50%) and 'Red Chief' (22.10 %). Iglesias, (1991) and Sharma (2011) reported higher fruit drop in the range of 20.17 to 65.66 per cent. Fruit drop and retention are the distinct characteristics of cultivars and various workers have indicated varied range(s) of drop percentage during the study.

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