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Cold arid Ladakh: A natural conservatory of folk apricot cultivars for horticultural use

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Abstract

Traditional knowledge is the essence of social capital helps in the faster development of science in favour of human kind through a holistic approach. Local culture, spirit, social and ethical norms possessed by local people has often been determining factors for sustainable use, and conservation of biodiversity. In present paper, an effort has been made to converge the information on traditional knowledge generated by the tribes of Ladakh about growing and conservation of folk apricot cultivars for sustainable livelihood. To achieve this objective twenty-three major apricot growing villages of Ladakh from five different eco-geographical regions i.e. Kargil, Khaltsi, Dha-Hanu, Leh and Nubra of Ladakh province have been considered. Study revealed that there were forty-three major folk apricot cultivars are grown for commercial and house hold use. The peoples of Ladakh gained location specific life-long experience and indigenous strategy for sustainable biodiversity use and management at individual as well as community level. This has been built up through regular use and attentive observations related to fresh fruit, drying and oil extraction purposes of fruits and kernels. The conserved materials of these folk cultivars are serving the country as *in-situ* field gene banks. Which will be a boon to the development of apricot industry leads to the enhanced livelihood and nutritional security.

Keywords: Traditional knowledge, apricot, *Chulli*, Ladakh, folk cultivars

Introduction

Apricot (*Prunus armeniaca* L.), locally known as '*Chulli*' is one of the sole fruit crops of cold arid areas of Ladakh providing the sustainable livelihood. In Ladakh dried apricot is a valuable commodity, and the value of its production from the Kargil district alone amounts to 20 M Indian rupees per annum (Dar and Wani, 2007; Mir, 2000). Many folk cultivars are cultivated and maintained by farmers in their orchards, backyards or isolated mountainous tracts since ancient world. Most of the trees are of seedling in origin and tend to produce variable quality fruits ranging from very sweet to sub-acidic in taste, yellow to orange/dark red in colour, white to orange pulp colour and sweet to bitter kernels. The available genetic variability also reflects the introduction from neighbouring countries (Zaffer *et al*., 2004). This variability is very important for further crop improvement programs. But due to lack of proper documentation and management, genetic erosion may cause losing of folk cultivars soon (Dwivedi and Dwivedi, 2004). We know that this region is one of the hotspots for apricot diversity. That is clearly documented in the Vavilov center of origin that apricot was domesticated in the Chinese region including Himalayas and reported that apricot was first cultivated in India during 3000 BC (Huxley, 1992). It is also believed that it had a wide native range including Armenia, Caucasus, the Himalaya, China, and Japan (Loudon, 1838). In recent findings, it is reported that apricot was originated in the mountains of northern and north-eastern China, with the Dzhungar and Zachlag Mountains of central Asia as a secondary centre of origin (Zeven and DeWet, 1982). Gazette information shows that apricot was the main trading commodity of Ladakh when the Silk Route connecting Leh to China, Tibet and Pakistan was open prior to 1947. British gazetteers Moorcroft and Trebek reported an export of 600 mounds of dried apricot from Leh to Tibet and Tartary in 1825. Some varieties are even known to have come from Yarkhand in China and Tibet (Kaur, 2012). Therefore, cold arid desert of Ladakh is one of the richest sources of variability of apricot, which needs critical attention for documentation and future use of gene pool.

The traditional knowledge especially on natural resource management is crucial for sustainable farming. Traditional knowledge is a cumulative body of knowledge, knowhow, practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment. Such an interaction between modern science and local knowledge can serve the purpose of sustainable agriculture. The value of traditional knowledge has been dully endorsed in the UNESCO's Universal Declaration on Cultural Diversity (UNESCO, 2001). But till date traditional knowledge concerning about folk cultivars of

apricot has not been comprehensively documented, especially from the more remote and inaccessible areas of the high-altitude areas of cold arid Ladakh. It is mostly being maintained and transferred orally from one generation to next. The increasing accessibility of other commercial fruits, combined with the changing life style, leading to the loss of knowledge on traditional varieties in the region (Malik *et al*., 2010). The concerns of ethnobotanists over such a loss of knowledge have been widely emphasized many times (Brosi *et al*., 2007; Shanley *et al*., 2004). But still the systematic collection and characterization of Indian apricot germplasm has not been attempted, and, yet, a few studies have been made to emphasize the genetic variability present (Sofi *et al.*, 2001; Zaffer *et al.*, 2004; Malik et al., 2010). Therefore, we conducted several explorations in Ladakh to survey and collection of folk apricot cultivars present in the high-altitude areas of Ladakh and a documentation of traditional knowledge on horticulturally important traits.

Materials and Methods

Explorations and collection

Five explorations and collections were undertaken in the north-western Himalayas (Jammu and Kashmir). Ladakh is the highest plateau of state of Jammu and Kashmir covering an area about 86,904 square km and located between 32^{0}15'-36^0 N and 75^{0}15'-80^0 15' E. Altitude ranges from 2750 m (Kargil) to 7672 m (Saser Kangri) in Karakoram range. It spans the Himalayan and Karakoram mountain ranges and the upper Indus River valley. The climate of the cold desert is characterized by the extremes of heat and cold, coupled with excessive dryness, intense solar radiation and rarification of the atmosphere that causes the southerly winds. Air movements are towards the North Pole in southerly currents and offer a slight check on transmission of sunrays that the noon temperature often reaches upto 25^0 C to 40^0 C, while the night temperature falls below freezing points. Temperature during winter months reaches to -30^0 C (Kargil) to -59^0 C (Drass). Annual average rainfall is only 99 mm. Average relative humidity remains around 40-50% which makes the area totally arid. Soils are poor in most of the essential plant nutrients except potash. Vegetation is very sporadic, mainly concentrated along the river and other minor water sources. Most of the villages are located on isolated hillsides along the water source either near or far from the roadside. The apricot is one of the major fruit crops grown and maintained by each household either in the orchards or backyards. It has a wide range of distribution in different parts of Ladakh with particularly abundance in Sham areas (lower Ladakh) including Hardas, Shilikchey, Khaltsi, Dumkhar, Skurbachan, Achinathang, Dha-Hanu, Biama, Garkone and Upper Ladakh including Saspol, Nimmo, Basgo/Bazgo, Leh, Skuru, Nubra, Sumur, Hunder, Bogdang, Changmer, Turtuk, Garari, Chalunga Post and Thang (Fig. 1).

The explorations were conducted during the years 2000 to 2015 in above apricot growing areas comprising of twenty three villages in collaboration with FRL, DRDO, Leh.

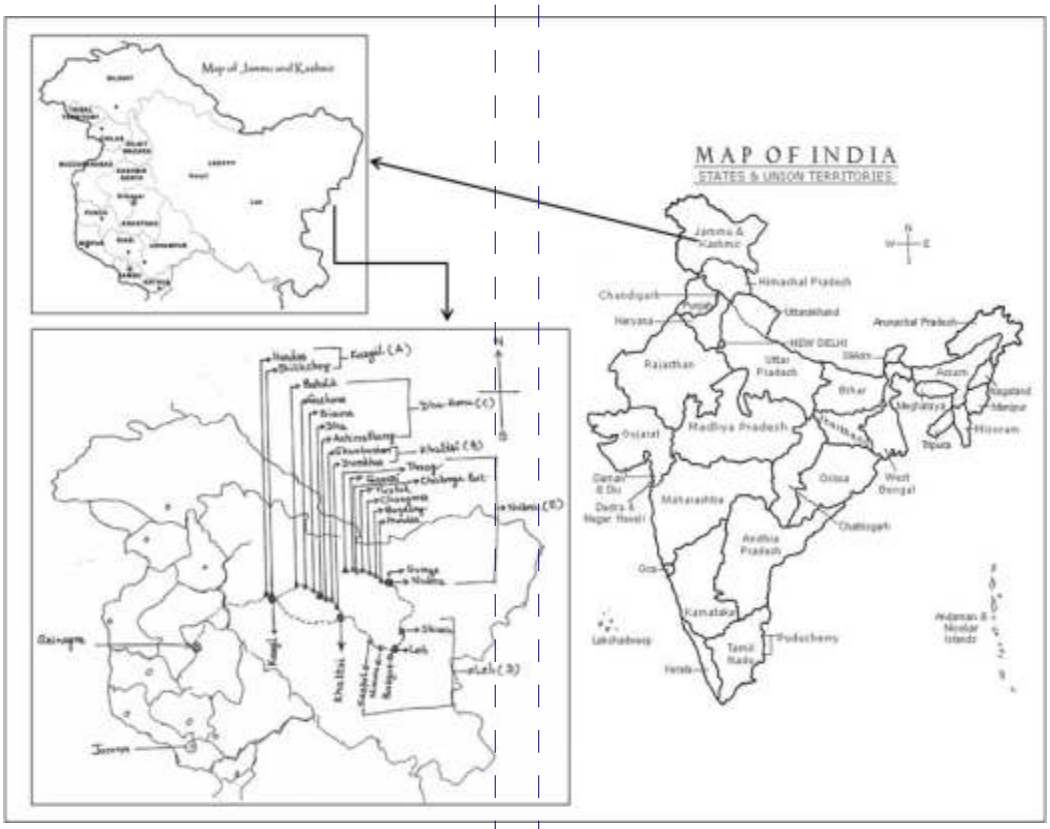

Fig. 1: Location map of the study area in Ladakh, Jammu & Kashmir

During these explorations, collections of folk cultivars of apricot were made based on selective sampling strategy, where samples collected from individual trees conserved by growers. Information about traditional knowledge was collected from apricot growers includes heads of the families, women and communities.

Characterization

Morphological characterization of fruits was carried out on the same day of collection. Descriptors developed for fruit crops (Mahajan *et al*., 2002) at NBPGR, New Delhi, were uniformly used for recording characterization data of fruit, stone and kernel. Physico-chemical traits were recorded in sixty-three genotypes, wherein, forty three were identified as folk cultivars.

Results and Discussions

Exploration and collection

The exploration work was conducted in the traditional apricot growing regions of Ladakh. Most of the areas were located on high altitudes ranging from 2785 m (Garkone; 34°38'06.8"N, 76°26'01.6"E) to 3480 m (Bazgo; 34°12'49.8"N, 77°17'07.0"E) above mean sea level. The latitude ranged from 34°11'42.4"N, 77°20'06.8"E to 34°50'53.7"N, 76°49'38.4"E. The terrain is mountainous, dried and rocky (Fig. 1).

Traditional use

Sixty-five folk cultivars were collected from selected villages (Table 1 & 2). These were found highly diversified cultivars were conserved in these villages since sanctuaries (Malik *et al*., 2010). The observations revealed that local farmers are aware about the importance of biodiversity and natural resource management (Singh, 2004; Singh and Nathiben, 2003). Most of the traditional cultivars are as long as the settlements in the Ladakh region. They have been maintained from generation to generation by the nomadic inhabitants of Ladakh.

They were perpetuated by seeds as well as clonal means for expansion in newer areas. The traditional cultivars have been mainly used for fresh consumption followed by drying and oil extraction (Table 1). There were about fourteen traits observed like sweet kerned, table purpose, drying, oil extraction, kernel use, bitter kernelled, suitable for osmotic dehydration, mid-season maturing, late season maturing, natural hybrids, retain colour after drying, tolerant to low temperature, twin kernelled and cultivar with poor self life (Table 1). Some of varieties have been grown with the different folk names with slight changes in their uses (Table 2). Most of the folk cultivars has sweet kernel. However, most of the cultivars were used for fresh consumption followed by drying purpose and oil extraction.

Pomological characteristics and traditional importance of genetic resources

The observations revealed that local farmers were aware about the importance of biodiversity and natural resource management (Singh and Nathiben, 2003; Singh, 2003; Singh, 2004). They have classified the folk cultivars mainly based on fruit colour, shape and sweetness. Two cultivars '*Rakshey Karpo'* and '*Halman*' were found in most of the locations. Because fruits of '*Rakshey Karpo*' are very attractive, suitable for fresh consumption; kernel is very sweet as almond and stone is white in colour; and '*Halman*' is grown because of its fruit sweetness makes it suitable for drying purpose. Similarly, other folk cultivar like '*Margolam*' had characteristic red fruit colour with larger in size and mainly grown in Garkone and nearby settlements of *Brokpa* tribe. In the *Brokpa* language, these folk cultivars are assigned with specific names like '*Gui*', which means large and flat fruit shape; '*Tilli*' indicates very sweet taste, '*Charrap*' means very juicy and watery and '*Damoma*' means demon shape. The fruits of '*Orjan Chulli*' are characterized by white flesh with milky taste. The folk nomenclature about cultivars are very interesting which sometimes also contains synonyms to cultivars. The name of one cultivar is spoken with different names in different dialect languages. For instance, the name of '*Halman*' is common accepted name in most of the areas particularly in *Baltis* language, but in *Brokpa* language it is also known by '*Shakanda*' (Table 2).

Similarly, other folk cultivar like *Aam Chulli* is named by its mango shape, *Angoor Chulli* bear fruits in clusters like grapes, *Badam Chulli* resembles almond traits, *Bamasuf* retains its natural colour after drying, *Bro Chulli* have good quality oil, Charrap fruits are very juicy, *Demoma* fruits are bright red in colour, *Guitilli* fruits are large in size and flat in shape, *Gulzar Aalu* resembles potato taste, *Halman fruits* are very sweet in taste, *Hangol* fruits are sweeter than *Halman* and also retains better colour after drying, *Khantey* fruits are sub-acidic in taste, *Koban* fruits are larger in size, *Mangol* fruits are very juicy, *Mamur Chulli* resembles *Halman* but more juicy, *Narmo* are mostly sweet kernelled, *Rakshey Karpo* nuts are white in colour, *Tokpopa* and *Zen Chulli* are also very attractive in shape, colour and texture.

Genetic diversity among eco-geographical regions of Ladakh

Based on traditional knowledge a total of forty-three folk cultivars identified from twenty three major apricot growing areas of Ladakh (Table 2). These are distributed in five different eco-geographical regions i.e., Kargil (Hardas and Shilikchey), Khaltsi (Khaltsi, Dumkhar and Skurbachan), Dha-Hanu (Achinathang, Dha, Hanu, Biama and Garkone), Leh (Saspol, Nimmo, Bazgo/Basgo and Skuru), and Nubra (Nubra, Sumur, Hunder, Bogdang, Changmer, Garari, Turtuk, Chalunga Post and Thang) of Ladakh.

Kargil eco-geographical region

In this region the major folk cultivars were *Halman*, *Shamber, Zenchulli/ Papachulli, Badamchulli, Brochulli, Khusta, Margolam*, *Nurmo Guzmin* and *Shakanda*. This region is producing apricots mainly for fresh consumption. A little quantity of *Halman* is also being used for drying purpose.

But most of the cultivars table purpose.

Khaltsi eco-geographical region

This region also grows table purpose like *Bhomali, Khantey, Narmo, Rakshey Karpo* and *Tokpopa*. Oil extraction is one of the major enterprises in this region using cultivars like *Khantey* etc. Drying type cultivars are generally not grown, but a small quantity of the fruits from *Halman* are utilized for this purpose. *Rakshey Karpo* kernels are used as substitute of almond.

Dha-Hanu eco-geographical region

This area lies along the snow bound river and most of the belt is covered with apricot plantations. These plantations include the folk cultivars like *Aam Chulli, Angoor Chulli, Charrap, Demoma, Guitilli, Gyalchuma, Mangol/Hangoe, Mamur Chulli, Margolam, Orjan Chulli, Papa Chulli, Rakshey Karpo, Rogan, Suka* and *Vasu Kangyeb*. In this region home-scale sun drying practices are very common for making dried apricots. Generally, they dry fruits under natural day light on the roof tops of their houses. *Suka* is one of the rare genotypes have sweetest fruits, therefore used for making dried apricots. Oil extraction is another activity, uses bitter apricot kernels.

Leh eco-geographical region

This eco-geographical region is around district head quarter of Leh. The natural plantations of apricots are less mainly in scarecity of water and poor fertility of soil. Therefore, small numbers of cultivars exist. But backyard plantings are in general in peri-urban settlements. The main folk cultivars include *Halman, Koban, Narmo, Rakshey Karpo* and *Tokpopa*. There also dual type cultivars generally grown, but they use it mainly for fresh consumption.

Nubra eco-geographical region

Nubra region is very rich in the apricot germplasm. Large numbers of villages are growing different folk cultivars of *Chulli*. Mostly are located at much higher altitudes as compared to earlier four eco-geographical areas. There apricots are being grown mostly for drying purpose. The important among them are *Bamasuf, Chama Chulli, Charrap, Gulzar Aalu, Gurtsi, Hangol, Hiljing Stachu, Karpo Stachu, Khantey, Khapiyuk, Koban/ Kwun, Kowan, Margolam, Narmo, Rogan, Shahkanda, Shakarpara, Shambiar, Shakashair, Shamatipeyan, Stachu/ Khokhoos* and *Zen Chulli/ Papa Chulli*.

In all the five regions, most common folk cultivars are *Halman, Rakchakarpa, Tokpopa, Margulam, Narmu and Khante*. These folk cultivars are the natural hybrids developed by open pollination in this cold arid desert of Ladakh and acclimatized particularly for such conditions. These generally require long chilling period for breaking dormancy and intense sunlight during summer along with dry weather for maturity and colour development. The experiments were also conducted to evaluate these cultivars under Kashmir valley conditions to harness their commercial potential under Kashmir conditions. But results were found discouraging with poor fruit quality. As the climate of Kashmir valley is different as compared to Ladakh. In Kashmir valley, annual precipitation is about 750 mm is much higher as compared to Ladakh (90 mm), derived partially from the summer monsoon and partially from storms associated with winter low-pressure systems. Snowfall often is accompanied by rain and sleet. Temperatures vary considerably by elevation; the average minimum temperature is in the upper -2 °C in January, and the average maximum is about 31 °C in July. The valley is surrounded by Himalayas on all sides. Spring is the wettest season while autumn is the driest. Therefore, it is concluded that these folk cultivars of apricot are very specific to the existing climatic conditions of Ladakh and should be restricted to such climate conditions.

The production system is mostly organic in nature that is directly influenced by Buddhism which believes in *Ahimsa* (or non-injury means entire abstinence from causing any pain or harm whatsoever to any living creature), prohibits the use of chemicals to control the economic pests like codling moth etc. The fruits of these folk cultivars are usually harvested manually and collect in '*Tsepo*' (basket) and wash them under running water to remove the dusts and then spread on the roof top for their drying under open sunlight. The harvesting period generally starts from July to September. The fruits are dried either as whole fruit (locally known as *Fating*) or seed are separated before drying, and the dried fruit without seed are called '*Chulli Skampo*'. Bitter kernels are used for oil extraction (locally called '*Tseghumar*') is multipurpose oil with a peculiar apricot flavour. Traditionally, the oil was extracted from the semi-roasted kernel by crushing them in a large wooden mortar (locally called as '*Thorn*'), followed by heating and compressing them with few drops of water on a flat stone (locally called as '*Tsigg*').

For the effort of informal *in-situ* indigenous agrobiodiversity conservation, peoples of Ladakh deserves the reward and honour. The agro-biodiversity is rainfed and most of the farmers are economically poor. During the study of exploring the dynamics of traditional knowledge associated with *Chulli* cultivars and its conservation, most felt that the folk cultivars should remain with them for coming generations for their source of livelihood as well as nutrional security. This land should not be allowed to convert into orchards of other fruit cultivar. Majority of them are interested in either expanding or preserving their folk apricot cultivars. Looking to the importance of the *Chulli*, growers are very much interested to see further to identify still better ecotypes from the natural population for further improvement and multiplication.

Traditional knowledge plays an important role in the food security, resource management, and biodiversity conservation. The traditional knowledge generated from many years by the inhabitant of these areas are very useful will surely reduce the time taken to develop the better ecotypes. They have already reached to the point where about forty-three genotypes/folk cultivars are performing better in terms of fruit and nut quality. These forty-three folk cultivars are the land

mark for sustaining the livelihood of this land locked terrain. Plantations under different eco-geographical conditions are facilitating as centre of multi-location trials to see the feasibility of a cultivar. Scientists need to keep an open eye for opportunities to learn from local people, especially given that financial resources and the scientific toolbox are often inadequate in addressing the complex natural and human interactions. Traditional knowledge is the area where there is need to cultivate a bottom-up approach to development building upon the resources and strength of indigenous people, their experiences and diversified knowledge system.

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Table 1. Traditional use of folk cultivars of apricot grown in cold arid region of Ladakh

Sl. No.	Traditional use	Folk cultivars
1	Sweet kernel	Aam Chulli, Angoor Chulli, Badam Chulli, Bamasuf, B homli, Bro Chulli, Chama Chulli, Charrap, Demoma, Guitilli, Gulzar Aalu, Gurtsi, Gyalchuma, Halman, Halmaan, Hiljing Stachu, Karpo Stachu, Khantey -Hunder, Khapiyuk, Koban (Kwun), Kowan, Mangol (Hangoe), Mamur Chulli, Margolam, Margolam (Amba), Margol am-Garari, Narmo -Dumkhar, Narmo -Thang, Narmo Guzmin, Orjain Chulli, Papa Chulli, Rakchey Karpo, Rogan, Shakanda -Shilikchey, Shakanda-Chalunga, Shakanda -Turtuk, Shakanda -Thang, Shakarpara, Shambiar, Shakashair, Shamatipeyan, Stachu (Khokhoos), Suka, Tokpopa -Nimmo, Vasu Kangyeb, Shamber, Yakar, Zen Chulli
2	Table purpose / fresh consumption	Aam Chulli, Angoor Chulli, Badam Chulli, Bamasuf, Bro Chulli, Chama Chulli, Charrap, Demoma, Guitilli, Gurtsi, Halman, Karpo Stachu, Khusta, Koban -Bogdang, Mangol (Hangoe), Mamur Chulli, Margolam, Margolam (Amba), Margolam-Garari, Narmo Guzmin, Orjain Chulli, Rakchey Karpo, Rogan, Shakanda-Shilikchey, Shakanda-Turtuk, Shakanda-Thang, Shakarpara, Shambiar, Shakashair, Stachu, Stachu (Khokh oos), Tokpopa -Nimmo, Vasu Kangyeb, Shamber, Yakar,
3	Drying	Bamasuf, Bro Chulli, Chama Chulli, Guitilli, Halman, Halmaan, Hiljing Stachu, Karpo Stachu, Khusta, Koban -Skuru, Mangol (Hangoe), Margolam (Amba), Narmo-Thang, Papa Chulli, Rakchey Karp o, Rogan, Shakanda -Chalunga, Shakanda-Turtuk, Shambiar, Shakashair, Stachu, Stachu (Khokhoos), Suka
4	Oil extraction	Khantey-Hunder, Shakanda-Shilikchey, Shakanda-Thang, Zen Chulli
5	Kernel use	Badam Chulli, Bhomli, Bro Chulli, Hangol
6	Bitter kernel	Khantey-Khaltsi, Koban-Skuru, Koban-Bogdang,
7	Osmotic dehydration	Gyalchuma,
8	Mid Season maturity	Koban (Kwun), Margolam (Amba),
9	Natural hybrids	Gulzar Aalu (Apricot x Plum),
10	Retain colour after drying	Hangol,
11	Tolerant to low temperature	Hangol,
12	Late maturing	Kowan,
13	Twin kernel	Kowan,
14	Poor self life	Shamatipeyan

Table 2. Pomological characteristics and importance of folk apricot cultivars grown in Ladakh region of Jammu and Kashmir

Local cultivars	Place	Altitude	Traditional knowledge	Physico-chemical parameters recorded
Aam Chulli	Achinathang, Khaltsi	3015 m	Large fruits, firm fruits, medium fruit quality, table purpose, mango shape	Fruit weight 25.6 g, TSS 13 ^{0} Brix, kernel sweet
Angoor Chulli	Achinathang, Khaltsi	3015 m	Small fruit size, bearing in clusters, very sweet in taste, juicy, table purpose	Fruit weight 30 g, TSS 28.2 ^{0} Brix, kernel sweet
Badam Chulli	Hardas, Kargil	2800 m	Late maturing, fresh consumption and oil extraction	Fruit weight 17.5 g, TSS 11.5^0 Brix, kernel sweet
Badam Chulli	Shilikchey, Kargil	2790 m	Late maturing, used for oil extraction, kernel	Fruit weight 18.4 g, TSS 12.1^0 Brix , kernel sweet
Bamasuf	Chalunga Post	2930 m	Table and drying purpose, introduced from Pakistan	Fruit weight 16.6 g, TSS 22.8^0 Brix, kernel sweet
Bamasuf	Turtuk	2900 m	Best for drying, retains good colour after drying	Fruit weight 13.4 g, TSS 18 ^{0} Brix, kernel sweet
Bhomli	Dumkhar, Khaltsi	2975 m	Kernel semi-sweet	Fruit weight 18.9 g, TSS 18.4^0 Brix, kernel sweet
Bro Chulli	Shilikchey, Kargil	2790 m	Fruits large in size, late maturing, table purpose, kernel used for oil extraction	Fruit weight 16.4 g, TSS 22.3^0 Brix, kernel sweet
Chama Chulli	Turtuk, Nubra	2900 m	Drying and table purpose	Fruit weight 12.2 g, T SS 13.6^0 Brix, kernel sweet
Charrap	Garkone, Kargil	2785 m	Very large fruits, juicy, sweet, fresh consumption	Fruit weight 35.4 g, TSS 21 ^{0} Brix, kernel sweet
Demoma	Garkone, Kargil	2785 m	Late maturing, red colour, table purpose, sweet kernel	Fruit weigh t 25.8 g, TSS 21.4^0 Brix, kernel sweet
Guitilli	Garkone, Kargil	2785 m	Bigger fruits, table & drying type, sweet kernel	Fruit weight 25 g, TSS 14.8 ^{0} Brix, kernel sweet
Gulzar Aalu	Turtuk, Nubra	2900 m	Natural hybrid between apricot and plum	Fruit weight 21 g, TSS 11.4 ^{0} Brix, kernel sweet
Gurtsi	Thang, Nubra	2840 m	Table purpose, sweet kernel	Fruit weight 22.4 g, TSS 14.3^0 Brix, kernel sweet
Gyalchuma	Biama, Dha-Hanu	2880 m	Good for osmotic dehydration, sweeter than Tokpopa, sweet kernel	Fruit weight 29. 6 g, TSS 22.6^0 Brix, kernel sweet
Halman	Hardas, Kargil	2800 m	Very sweet , medium in size, drying and table purpose	Fruit weight 25.6 g, TSS 25.6^0 Brix, kernel sweet
Halmaan	Nimmoo, Leh	2980 m	Medium fruit size, drying purpose, very sweet	Fruit weight 1 6.7 g, TSS 34.3^0 Brix, kernel sweet
Hangol	Thang, Nubra	2840 m	Medium fruit size, very sweet, fruits dry on trees, retain color on drying, resistant to low temperature	Fruit weight 19.8 g, TSS 26 ^{0} Brix, kernel sweet
Hiljing Stachu	Thang, Nubra	2840 m	Better than Halman for drying purpose	Fruit weight 19 g, TSS 24 ^{0} Brix, kernel sweet
Karpo Stachu	Turtuk, Nubra	2900 m	Table and drying purpose, sweet kernel	Fruit weight 19 g, TSS 21.3 ^{0} Brix, kernel sweet
Khantey	Hunder, Nubra	3120 m	Round stone and kernel, high oil content	Fruit weight 22.5 g, TSS 12.3^0 Brix, kernel sweet
Khantey	Khaltsi	2975 m	Local landrace, kernel bitter, medium fruit quality	Fruit weight 15.4 g, TSS 12.5^0 Brix, kernel bitter
Khapiyuk	Thang, Nubra	2840 m	Fruits less juicy, pointed tip, sweet kernel	Fruit weight 16 g, TSS 11 ^{0} Brix, kernel sweet
Khusta	Shilikchey, Kargil	2790 m	Medium in size, sweet in taste, table and drying purpose	Fruit weight 18.2 g, TSS 14 ^{0} Brix, kernel sweet

Koban	Skuru, Leh	3110 m	Fruits sweet and juicy, drying t ype, kernel bitter	Fruit weight 22.4 g, TSS 17.6^0 Brix, kernel sweet
Koban	Bogdang, Nubra	2980 m	Bigger size fruits, juicy, table purpose, sweet kernel	Fruit weight 22 g, TSS 20 ^{0} Brix, kernel sweet
Koban (Kwun)	Chalunga Post, Nubra	2930 m	Fruits large si ze, sweet in taste, dried whole, sweet kernel, table purpose, mid season maturity	Fruit weight 30 g, TSS 25 ^{0} Brix, kernel sweet
Kowan	Hunder, Nubra	3120 m	Bigger size fruits, twin stone, twin kernel, dried after removal of stone, late maturing	Fruit weig ht 35.5 g, TSS 12.3^0 Brix, kernel sweet
Mangol (Hangoe)	Dha-Hanu	2840 m	Highly juicy, table and drying purpose, sweet, sweet kernel	Fruit weight 23.1 g, TSS 21.4^0 Brix, kernel sweet
Mamur Chulli	Achinathang, Dha-Hanu	3015 m	Table purpose, taste like Halman but juicier than Halman, kernel sweet	Fruit weight 15 g, TSS 26 ^{0} Brix, kernel sweet
Margolam	Dha, Dha-Hanu	2840 m	Table purpose	Fruit weight 30.5 g, TSS 19.4^0 Brix, kernel sweet
Margolam	Shilikchey, Kargil	2790 m	Table purpose	Fruit weight 19.7 g, TSS 20.7^0 Brix, kernel sweet
Margolam (Amba)	Chalunga Post, Nubra	2930 m	Mid season maturity, table and drying purpose	Fruit weight 26 g, TSS 17.2 ^{0} Brix, kernel sweet
Margolam	Garari, Turtuk	3280 m	Bigger fruit size, table purpose, very juicy	Fruit weight 26 g, TSS 18.6 ^{0} Brix, kernel sweet
Narmo	Dumkhar, Khalsi	2975 m	Good quality traits of fruits	Fruit weight 26.5 g, TSS 18.7^0 Brix, kernel sweet
Narmo	Skuru, Leh	3110 m	Heavy bearing in clusters, dried whole fruits, juicy, sweet kernel, regular in bearing	Fruit weight 19 g, TSS 17.6 ^{0} Brix, kernel sweet
Narmo	Thang, Nubra	2840 m	Very sweet fruits, better than Halman for drying purpose, sweet kernel	Fruit weight 19 g, TSS 25 ^{0} Brix, kernel sweet
Narmo Guzmin	Shilikchey, Kargil	2790 m	Table purpose	Fruit weight 8.4 g, TSS 13 ^{0} Brix, kernel sweet
Orjain Chulli	Achinathang, Dha-Hanu	3015 m	Sweet like milk, table purpose, sweet kernel	Fruit weight 13.5 g, TSS 14.5^0 Brix, kernel sweet
Papa Chulli	Achinathang, Dha-Hanu	3015 m	Medium and drying purpose	Fruit weight 13.5 g, TSS 17.4^0 Brix, kernel sweet
Rakchey Karpo	Achinathang, Dha-Hanu	3015 m	Sweet kernel, medium in size, table and drying purpose	Fruit weight 24.5 g, TSS 21.4^0 Brix, kernel sweet
Rakchey Karpo	Dha, Dha-Hanu	2840 m	Sweet kernel, medium in siz e, table and drying purpose	Fruit weight 25.7 g, TSS 16.6^0 Brix, kernel sweet
Rakshey Karpo	Nimmo, Leh	2980 m	Fruits are large, moderately sweet, sweet kernel	Fruit weight 25.5 g, TSS 26.5^0 Brix, kernel sweet
Rakshey Karpo	Bazgo, Leh	3480 m	Late maturing , medium sweet fruits, table purpose, sweet kernel	Fruit weight 36.8 g, TSS 16.8^0 Brix, kernel sweet
Rogan	Achinathang, Dha-Hanu	3015 m	Medium fruit size, table and drying purpose	Fruit weight 9.5 g, TSS 13.4^0 Brix, kernel sweet
Rogan	Hunder, Nubra	3120 m	Table and drying type, dried as whole, sweet kernel	Fruit weight 22.8 g, TSS 16 ^{0} Brix, kernel sweet
Shakanda	Shilikchey, Kargil	2790 m	Fruits bigger in size, profuse bearing, bearing in bunches, table purpose and kernel used for oil extraction	Fruit wei ght 16.2 g, TSS 25.3^0 Brix, kernel sweet
Shakanda	Chalunga Post, Nubra	2930 m	Small fruits, drying purpose	Fruit weight 12 g, TSS 22 ^{0} Brix, kernel sweet
Shakanda	Turtuk, Nubra	2900 m	Table and drying type, sweet kernel	Fruit weight 10 g, TSS 14 ^{0} Brix, kernel sweet

Shakanda	Thang, Nubra	2840 m	Fruits bigger in size, profuse bearing, bearing in bunches, table purpose and kernel used for oil extraction	Fruit weight 12.4 g, TSS 18 ^{0} Brix, kernel sweet
Shakarpara	Sumur, Nubra	3250 m	Round fruits, white flesh	Fruit weight 30.6 g, TSS 12 ^{0} Brix, kernel sweet
Shambiar	Turtuk, Nubra	2900 m	Table and drying purpose, juicy, clingstone, mid season maturity	Fruit weight 19.6 g, TSS 15.3^0 Brix, kernel sweet
Shakashair	Thang, Nubra	2840 m	Fruits bigger in size, very ju icy and sweet	Fruit weight 33.4 g, TSS 22.3^0 Brix, kernel sweet
Shakashair	Thang, Nubra	2840 m	Drying purpose, sweet kernel	Fruit weight 26.4 g, TSS 20.3^0 Brix, kernel sweet
Shamatipeyan	Thang, Nubra	2840 m	Fruits highly perishable	Fruit weight 17.8 g, TSS 21.4^0 Brix, kernel sweet
Stachu	Chalunga Post, Nubra	2930 m	Table and drying purpose, profuse bearing, red bluish fruit surface, skin thick, slightly acidic in taste, best for drying purpose	Fruit weight 20 g, TSS 18.6 ^{0} Brix, kernel sweet
Stachu (Khokhoos)	Turtuk, Nubra	2900 m	Table and drying purpose, sweet kernel	Fruit weight 15.6 g, TSS 16.6^0 Brix, kernel sweet
Suka	Dha, Dha-Hanu	2840 m	Extremely sweet in taste, orange red in colour, drying purpose	Fruit weight 22 g, TSS 31.2 ^{0} Brix, kernel sweet
Tokpopa	Nimmo, Leh	2980 m	Bigger fruit size, smooth, table purpose, medium sweet	Fruit weight 39.7 g, TSS 15.7^0 Brix, kernel sweet
Tokpopa	Khaltsi	2975 m	Fruits are large, smooth surface, medium sweet	Fruit weight 21.3 g, TSS 12.6^0 Brix, kernel sweet
Vasu Kangyeb	Achinathang, Dha-Hanu	3015 m	Large fruit size, medium fruit quality, very juicy, table purpose	Fruit weight 37.5 g, TSS 17.3^0 Brix, kernel sweet
Shamber	Hardas, Kargil	2800 m	Table purpose, sweet in taste	Fruit weight 9.3 g, TSS 26 ^{0} Brix, kernel sweet
Yakar	Turtuk, Nubra	2900 m	Very juicy, white stone	Fruit weight 20 g, TSS 19 ^{0} Brix, kernel sweet
Zen Chulli	Shilikchey, Kargil	2790 m	Kernel used to extract oil	Fruit weight 23 g, TSS 17.3 ^{0} Brix, kernel sweet

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