

INTRODUCTION

Lahaul-Spiti, parts of Kinnaur and Chamba districts of Himachal Pradesh along with Ladakh region of Jammu and Kashmir and Uttarkashi area of Uttarakhand together constitute the cold deserts of India. Lahaul-Spiti, the presently studied area is a part of the cold deserts in western Himalaya. It is the largest district of Himachal Pradesh with an area of ca.13835 km², situated between 31° 44' 57" and 32° 59' 57" N latitude and 76° 29' 46" and 78° 41' 34" E longitude. It has Chamba on its west, and Kangra, Kullu and Kinnaur districts on its south. In the north is Ladakh (Jammu and Kashmir), while on its east is Tibet (Map 1a, b, 2). The district has a wide variety of attractions like, snow covered mountain peaks, rugged terrains, imposing monasteries, gompas, perennial rivers, beautiful lakes and glaciers (¹Fps. 1-6). The existing topography of the district is unique in nature and beyond one's imagination. On the basis of geographical conditions, Lahaul - Spiti district consists of two main regions, i.e. Lahaul Valley and Spiti Valley which are different in many aspects. Kunzum Pass (4550 m) keeps these two valleys isolated from each other for more than six months in a year due to heavy snowfall (Fp. 7). Rohtang Pass (3980 m) is the gateway to Lahaul Valley and it connects Lahaul with the Kullu district. The Lahaul Valley is also approachable from Ladakh through Baralacha Pass (5030 m) and from Spiti Valley through Kunzum Pass (Fps. 7, 8). Spiti is linked with Kinnaur via Sutlej Valley with motorable road which is open throughout the year. Due to excessive snow at Rohtang Pass (Fp. 9), the road to Lahaul Valley remained closed from mid November to mid May every year. Due to heavy snow at Kunzum Pass the road from Lahaul Valley to Spiti Valley also remained closed for 7-8 months between November to June.

¹ Fp/s denotes field photograph/s and plates for which are given at the end of chapter 'Vegetational account'.

1.1. The Lahaul

The Lahaul which is on the western side of the district covers an area of 6097 km². Keylong is the district head-quarter which falls in the Lahaul Valley. It has two rivers, 'Chandra' and 'Bhaga', which ultimately merge to become 'Chandra-Bhaga' near Tandi. When Chandra-Bhaga enters the Chamba district its name changes to 'Chenab'. In this valley, mountain peaks range between 5480 m and 6400 m. The Lahaul region has three valleys, the Chandra Valley, the Bhaga Valley and the Chandra-Bhaga Valley. The valley of the river Chandra is locally called *Rangoli*. A considerable portion of the valley is uninhabited. This region mainly contains high mountain peaks, large glaciers and vast snow fields. Koksar is the first village in the valley. The Valley of the river Bhaga is locally called *Gara*. The earlier regions of this Valley like Chandra Valley also gave the desert like look (Fp. 10). The valley of Chandra-Bhaga River is locally known as *Pattan* Valley. The land between the Chandra and Bhaga rivers contains mass of mountains and has very little and scattered population. The portion of the region contains mighty mountains, torrential nullahs and most of the glaciers. Lahaul is also called the "Valley of Glaciers". Bara shigri, Chhota shigri, Gangstang, Sonapani and Perad are the prominent glaciers. Besides these glaciers, there are four lakes, the Chandar Tal, the Suraj Tal, the Sissu Lake and the Patseo Lake (Fps. 11, 12). Chandar Tal Lake has been designated as the Wetland of International Importance along with Renuka Lake in the year 2006 under the "Ramsar Convention" on Wetlands. The highest point in Lahaul is Mulkilli Peak (6400 m), while the lowest point (2400 m) is near the exit of Chandra-Bhaga from the district. The region has the distinction of having Baralacha Pass (5030 m, Fp. 8) which is nearly 8 km long, also known as 'Pass with crossroads on summit' where roads from Zanskar, Ladakh, Lahaul and Spiti meet. Three rivers i.e., Chandra, Bhaga and Yunan also

originate near this pass. Lingti plains which are uninhabited, uncultivated and desert area are situated across the Baralacha Pass toward the north.

1.2. The Spiti

Spiti is pronounced as 'Piti' in local language which means "middle country", lies in the middle of Ladakh and Tibet and on the eastern side of the district with Kaza as its head-quarter. Geologically and archeologically, Spiti is a living museum and also known as the fossil park of the world. The area is more desolate compared to Lahaul and barrenness is the rule here (Fp. 13). Spiti is generally higher and the terrain here is more rugged than Lahaul. The valley is a remote high area in the Himalayas situated on Tibetan plateau, with almost no rain and remains snow-covered for more than 6 months. The Spiti Valley is formed by the Spiti River which arises at the Kunzum Pass and descends into the mighty Sutlej River. En-route, the river receives waters from Lingti and Pin rivers. The valley is narrow except in places where the width can be up to 3km, thus limiting the cultivable land. The landscape of Spiti is similar to that of Ladakh which it borders. Kibber village (4200 m) is said to be the highest permanently inhabited village in the valley (Fp. 14). The mountain ranges in the Spiti Valley belong to the Great and Middle Himalayas. The valley is flat and broad bordered by vertical cliffs. For *in-situ* conservation of the flora and fauna of this area, two Protected Areas (PAs) viz., Pin Valley National Park and Kibber Wildlife Sanctuary were set aside.

1.3. Geology and Soil

Geology of Lahaul-Spiti Valley witnesses a complete sequence of geological formations dating from the Precambrian to the Cretaceous period with short breaks in Carboniferous and Jurassic periods and by the occurrence of fossils of ancient vascular plants (Aswal and Mehrotra, 1994). Soil of the Lahaul-Spiti is of the alpine sward type

as the upper stratum of the earth and vegetable mould is filled with incompletely decomposed roots of grasses and other herbaceous plants.

1.4. Climate

Climate of Lahaul-Spiti varies considerably. The season cycle is like that of dry temperate and alpine zones. Spring begins about the middle of April and lasts up to the end of May. Next four months are mostly regarded as summer season. Rainfall in the area is scanty. Snowfall occurs in winter. August is the hottest month with temperature rising up to 30⁰C during day time, while January is the coldest when mercury dips to -30⁰C or below. Except the periods of rain or snowfall, the air is very dry in both the summer and winter, and strong winds blow almost throughout the year. The winds are stronger at higher elevations compared in the valley.

1.5. Agriculture

Primary source of economy here is the agriculture but due to scanty rainfall, dry cold climate, very limited agricultural land and meager irrigation potential, only 25% of total geographical area is under cultivation (Bajpai, 2002). Cultivation is mainly carried out in the river valleys and nearby mountain slopes up to altitude of 4200 m. People of Lahaul-Spiti cultivate barley, buckwheat, maize, sarson, cabbage, cauliflower, radish, carrot, tomato, etc. and cash crops like, pea, potato, kuth and hops (Fps. 15, 16). Recently, the pea and potato crops have taken the front seat and have changed the economy of area. The common fruit trees are apple, pear, apricot and plum but only in the Pattan Valley.

1.6 People/Social life/Dresses/Food/Fairs and Festivals/Livestock/Religion/Tourism

The people of Lahaul -Spiti are a mixed race. '*Swangla*' and '*Gaddi*' constitute the main tribes of the area. The society is vertically divided into different economic classes on the basis of caste system. The higher castes are generally more affluent. The

features of Lahaulis are combination of Mongolian and Aryan while the Spitian people are Mongoloids. The women are very hard working. It is the women who tend fields, fetch fuel and water, and carry loads. By and large, men are lazy and lethargic. The only time when men assist women is during harvesting or during fuel collection. Otherwise, they take '*Chang*' (barley brew) and play dice. The traditional dress of the men consists of an undershirt, a long shirt (*cholu*) and pajamas. A long piece of cloth (*gachi*) is often used as belt. Women wear a jacket over *cholu* in winter and scarf or *jogi* is used as a head-wear. The common ornaments of the women include '*kanthi*' (a silver necklace) and '*chully*' or '*long*' (a gold nose ring or nose pin). The staple food comprises of wheat, barley, buckwheat, potato and meat. Rice is also eaten, and among pulses, 'masar', 'rajmash' and peas are more common. The people of Lahaul-Spiti have three meals a day, Ken or tshema in the morning, Shod or chicken in the noon and Yangskin or Gongal at night. Besides, they consume a lot of lugri or tsagti, chhang (beer) and salted tea mixed with butter. Smoking of tobacco is very common among the aged people, but is forbidden for the ladies. Drinking is common among both the sexes. The ideal livestock of a household consists of a small flock of sheep and goats, a few cows, oxen or hybrid Yaks, horses and donkeys. People of Lahaul-Spiti also celebrate a number of fairs and festivals in different months of the year which include Khogla (Pattan Valley, January/February), Halda (Lahaul Valley, January/February), Fagli (Lahaul, February), Gothsi or Gochi (Bhaga Valley, February), Tsheshu Fair (Shashur, Kardang, Gemur, Kyi Gompas in Lahaul-Spiti, June/July), Ladarcha Fair (Kaza, August), Pauri Fair (Udaipur, August) and Tribal Fair Keylong (Lahaul, August). The people are peace loving and violent crime is almost unknown among them, which might be due to the fact that most of people of Lahaul-Spiti follow Buddhism. The temples of worship are called '*Gomphas*'. The famous monasteries of

the area are Kye (Fp. 3), Tabo, Dhankar, Guru Ghantal and Kungri. These monasteries give religious training to '*Lamas*' and also known for their beautiful murals, thankas, rare manuscripts, woodcarving and golden images of Padmasambhava. The people also believe in super natural powers, worship God and Goddesses. However, due to the exposure of people in recent times to the outside world, the deep rooted social taboos, superstitions and outdated beliefs are fading out and new thinking has developed. The tourism in the district has not flourished due to some earlier restrictions. But the efforts are now being made to attract the tourists. The tourists who mostly visit the area are of foreign origin. The best period to visit the area and to enjoy the awesome beauty of Lahaul-Spiti is between June to September.

1.7. Fauna and Flora

The district is endowed with a wide variety of rare animal species like, Ibex, Himalayan brown bears, Himalayan [foxes](#), Himalayan Blue sheep, Tibetan antelope, Argali, Kiangs, Musk deer, Yaks, Dzos, Mouse hare and Marmots, Porcupine, Weasels, Lizards and Snow leopards. Yaks and Dzos can be seen roaming across wild in Lingti plains. However, over-hunting and a decrease in food supplies has led to decrease in the population of the Tibetan antelope, [Argali](#), Kiangs, Musk deer and Snow leopards, reducing them to the status of endangered species.

Lahaul-Spiti consists of rugged mountains, snow clad peaks, bare rocks, steep sandy slopes with rock gravels, and oppressive and inhospitable conditions which include freezing temperature, dry arid weather, strong winds and low precipitation. As a consequence of harsh climatic conditions prevailing in the region, plants tend to become prostrate, thick, hairy, bushy, hardy, sturdy, mat and cushion forming and spiny with long roots and small succulent or woolly leaves (Fps. 17, 18, 19, 20, 21, 22). Another remarkable feature of these plants is that they have developed different means

of vegetative propagation. Most of the plants are perennial in nature and perennate by means of rootstocks, runners, bulbs, rhizomes and tubers (Fps. 23, 24). The area is quite rich in plant wealth represented by a variety of plants which includes plenty of flowering plants of dry alpine and temperate zones, and a few gymnosperms and pteridophytes. While studying the floristic diversity of the cold deserts of Lahaul-Spiti, Aswal and Mehrotra (1994) reported as many as 985 species of 353 genera belonging to 79 families of dicots, monocots and gymnosperms. The area is quite rich in floral diversity and includes some rare, threatened and endemic species and plants of immense medicinal and economic importance like, *Aconitum heterophyllum*, *Arnebia euchroma*, *Astragalus munroi*, *Bunium persicum*, *Betula utilis*, *Cortusa matthioli*, *Ephedra gerardiana*, *Hyoscyamus niger*, *Jurinella macrocephala*, *Meconopsis aculeata*, *Microsisymbrium axillare*, *Picrorhiza kurrooa*, *Podophyllum hexandrum*, *Pseudomertensia lahulensis*, etc. The area is under considerable pressure of human intervention and natural disasters which include agriculture, heavy grazing, snow avalanches, windstorms, landslides, increasing entry of tourists and transport vehicles, and overexploitation of medicinally important plants. Due to high floral diversity, Lahaul-Spiti cold deserts had already attracted the attention of a number of botanists over the years. And majority of these attempts pertain to floristic diversity (Rau, 1960, 1961; Aswal and Mehrotra, 1994; Chauhan, 2001; Roy *et al.*, 2001; Kala and Prakash, 2006) and ethnobotanical studies (Koelz, 1979; Sood *et al.*, 2001). The plants of the area which are exposed to extreme cold stress conditions and high incidence of UV rays expected to show a considerable amount of genetic diversity in the form of intraspecific polyploids, aneuploids, hybrids, apomicts, structural heterozygotes, and taxa with B-chromosomes and various meiotic irregularities. So far no concerted attempt has been made to explore the cytomorphological diversity in the flowering plants of the area.

And till date only few medicinally important plants have been studied cytologically from the area (IHBT progress report, 2004-2005; Bhatia, 2005; Lattoo *et al.*, 2005; Pimenov *et al.*, 2006). Thus it becomes essential to carry out intensive and extensive cytological studies to have an assessment of genetic variability in the plant resources of Lahaul-Spiti region. Keeping in view the paucity of cytological information on the plants of Lahaul-Spiti and the importance of cytomorphological studies, the present problem has been undertaken to explore the cytomorphological diversity in the members of Polypetalae. The objectives of the present studies have been -

1. to carry out extensive cytomorphological surveys on population basis covering Lahaul and Spiti and its adjoining high altitudinal hills,
2. to determine the chromosome number and to study in detail the meiotic course, microsporogenesis and pollen fertility for each species,
3. to collect information with respect to flowering and fruiting period for each species which might be useful for future breeding programmes,
4. to record morphological variation wherever exist and to correlate these with cytological characteristics,
5. to carry out cytological analysis in the species with intraspecific, morphological and chromosomal diversity, and
6. to understand the various cytological processes operative in the evolution of plants growing under extreme cold conditions.

During the exploration surveys, field notes on the floristic constituents of study area were also taken. A generalized account based on these surveys is given separately under '**Vegetational Account**'. The purpose has been to study the distribution pattern of species covered presently. The present study involves extensive surveys in a vast area, where some localities are not easily accessible and could not be visited due to

limited public conveyance. Also in many species, flowering occurs for a very short duration and materials for male meiotic studies could not be obtained. In spite of all these limitations and drawbacks, attempts have been made to cover the species on population basis from different localities. The present work includes cytomorphological studies on 148 taxa belonging to 140 species.