

Photosynthesis and Water use Efficiency of Important Species of Cold Desert Of Himachal Pradesh, India

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ABSTRACT: The present study was conducted in Goshal, one of the largest villages of cold desert district of Lahaul in Himachal Pradesh, India, during 2010 to 2013 to carry out photosynthetic study and water use efficiency of various species growing in the cold deserts. We classified the study area into three major ecosystems viz; Forest Ecosystem, Alpine Pasture Ecosystem and Agro-ecosystem and found that in Forest Ecosystem *Salix alba* was most water use efficient tree with maximum photosynthetic rate of $36.61 \mu \text{mol/m}^2/\text{sec}$. However in case of Alpine Ecosystem *Podophyllum peltatum* (0.014534) and *Artemisia brevifolia* in Agroecosystem was most water use efficient species. Thus we recommend these species for Agroforestry and afforestation purpose in the cold desert area as dry land cultivation is not possible in Agro-ecosystem and for cultivated area the only source of water is through glacial melts from the upper mountain reaches.

KEYWORDS: Cold Desert Ecosystem, Photosynthesis, Water Use Efficiency, Forest Ecosystem, Alpine Pasture Ecosystem, Agro-ecosystem, Himachal Pradesh, Lahaul.

INTRODUCTION

There are many major biomes on earth such as Tropical forests, Savannah or Tropical grasslands, Temperate grasslands, Desert (hot and cold), Temperate deciduous forests, Coniferous forests, Tundra, etc. (Odum, 1971). Cold deserts are the lands at the polar fringes of the Northern hemisphere continents and the ice covered water of Greenland and Antarctica (Khosla *et al.*, 1993). The cold desert of India is located mainly in two states, viz., Himachal Pradesh and Jammu and Kashmir. In Himachal Pradesh, the cold deserts are restricted to the districts of Lahaul and Spiti, parts of Kinnaur (Sumdo side) and Pir Panjal in Chamba district. The region is characterized by low precipitation, a short growing season, low primary productivity and high stocking density (Mishra, 2000). January and February are the coldest months, with a mean temperature of -20.00°C (Sinha and Samant, 2006). The growing season in cold deserts is restricted to less than six months in a year. The key to settlement in cold deserts of Lahaul and Spiti is through the intelligent use of glacial melts. Dry land cultivation is not possible and the entire cultivated area depends on assured irrigation through long, winding streams from the upper mountain reaches (Oinam *et al.*, 2005). The vegetation of a major part of the district is of dry temperate to dry alpine type. The dry type of vegetation is due to scanty rainfall, low capacity of substratum to retain moisture, excessive lopping and grazing. The area is covered with snow for more than six months in the year. Hence only

those plants, which adapt to these severe conditions, can grow there. The flora is of the steppe type, which is rich at the lower elevations, but becomes scanty upwards. (Rawat *et al.*, 2006). Desert plants tend to look very different from plants native to other regions. They are often swollen, spiny, and have tiny leaves that are rarely bright green. Their strange appearance is a result of their remarkable adaptations to the challenges of the desert climate. Desert plants have developed three main adaptive strategies: succulence, drought tolerance and drought avoidance. Several other adaptations are essential for the water storing habit to be effective. Water is the most limiting factor for plant production in desert regions (Droppelmann *et al.*, 2000). Thus present study was carried out to study water use efficiency and photosynthetic activities of some important desert plants growing in cold desert ecosystem and the importance, utilization and exploitation of the alpine pastures and other grazing areas which would be of great help for researchers working in such harsh areas in other parts of the world, planners and decision makers for drawing interlinked sustainable developmental plans for the area by choosing water use efficient species for afforestation for restricting further desertification.

MATERIALS AND METHODS

The present investigation was conducted during 2010 to 2013 in village Goshal, located in Lahaul and Spiti district of Himachal Pradesh, India, between $32^\circ 33' 15.52\text{N}$ and $76^\circ 57' 47.34\text{E}$ at a mean altitude of 2,930 m amsl. Goshal is one of the largest villages in the district with maximum cropping diversity, abundant alpine pastures and adjoining forest area. Village Goshal in the Lahaul Valley is situated on the left bank of the river Chandra just before it merges with river Bhaga (Fig.1).