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COLLECTION OF *TAXUS* FROM TIRTHAN VALLEY, HIMACHAL PRADESH, INDIA FOR CONSERVATION IN NON NATURAL ENVIRONMENT

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Abstract

Taxol is the prime component of Himalayan yew (*Taxus baccata*) and it has led to its over-exploitation. Himalayan Yew has slow growing nature and even the survival percentage remains low due to longer seed dormancy. The study aimed at conserving Himalayan yew (*Taxus baccata*) in its non-native conditions and it became evident to collect it from documented natural reserves and then carry out conservation strategies. The lower Himalayan range has enormous *Taxus* plant but the approachability and feasibility of bring plants from such location always remains questionable due to safety concerns. Tirthan valley near Manali, Himachal Pradesh, India was found as an approachable and appropriate place for collecting Yew plants and was executed. The plants were growing in some protected area and with the help of local guides and support extended by the forest department the workers were able to collect the plants as a part of research material in sufficient quantities.

***Keywords*:** *Taxus*; Yew; Bio conservation; Soil-less culture; Taxol; Toxoids.

Introduction

Yew (*Taxus baccata*) is found in lower Himalayan range and is found to be distributed in the states like Arunachal Pradesh, Manipur, Assam, Uttarakhand, Sikkim, Meghalaya, Jammu and Kashmir around an altitude of above 2000 asl (Paul *et al.,* 2013). Since, the Himalayan rangeis present in some other countries also hence the presence of *Taxus* is also witnessed in Pakistan, Tibet, Nepal, Bhutan and China (Sharma and Garg 2015; Rathore *et al.,* 2019). *Taxus* leaves have many different types of medicinal properties which helps in treating diseases like epilepsy, lung disorders, hysteria, nervousness, malaria etc. (Juyal *et al.,* 2014). Other than leaves, bark of *Taxus* is known to have medicinal importance and has been traditionally been the centre of local therapeutic drugs for years (Nadeem *et al.,* 2002). The other local applications of Yew includes oil extraction, making of local beverages using leaf extract, fuelwood, timber, namkeen chai etc. (Pant and Samant, 2008). However, the most important application of this species remains the production of toxoids which are one of the prime ingredients of any anti-cancerous drugs (Fatima *et al.,* 2016; Kundu *et al.,* 2017andVadivel *et al.,* 2018). The local population when realized the importance of this plant has used extensively this plant as a source of their livelihood which has worsened the situation of this plant and pushed its entry into the Red data book as endangered species (Saha *et al.,* 2015; Joshi *et al.,* 2017).

The difference between the demand and supply ratio of *Taxus* has widened the gap which is actually the prime problem for its inclusion into the Red data book. Moreover, the Taxol demand is increasing day by day which has forced the official to protect the plant from unauthorized accessand save from extinction but still the rate of its disappearance is very high (Lanker *et al.,* 2010; Adhikari and Pandey, 2018 and Puri *et al.,* 2018). Biotechnologist have tried for the production of secondary metabolite from the past using different strategies and were able to produce alkaloids (Barrios *et al.,* 2009; Tapia *et al.,* 2013; Milutinović *et al.,* 2015 and Hashemi and Naghavi, 2016). However, all these efforts were not successful for providing solution for large commercial requirements of Taxol. It was thought that whatever strategy we need to use but it will only sustain if we are able to carry out biological conservation of this plant. If the plant is not conserved it will become impossible even to locate this plant and extract Taxol in near future. Procedures like yew cuttings, hydroponics, seed dormancy breaking, in vitro embryo culture, etc. (Wickremesinhe and Arteca 1994; Wickremesinhe and Arteca 1996; Rajewski *et al.,* 2000; Pandey *et al.,* 2002; Aloni *et al.,* 2006; Muller and Leyser, 2011; Singh *et al.*, 2011; Sinha *et al*., 2018;) would be required for conserving these plants. If this plant is conserved and saved from extinction, it would be one of the most critical steps for making the availability of anti-cancerous drug easier. Our work in the manuscript attempted at collection of *Taxus* from approachable Himalayan region and then implement conservation strategies.

Materials and Methods

Literature survey

Review of literature was extensively done and places were identified which could be targeted for collection of the plant. Many places near Himalayan ranges were identified but Tirthan valley was found more appropriate due to its close vicinity with Manali, a well-known tourist spot. It was thought that the place offers advantages like availability of tourist vehicles in reasonable rates, local guides and support from the locals as they are dependent upon tourist as a means of livelihood. Moreover, the language being spoken in and around Tirthan alley is also mostly Hindi which was also supposed to be one of the prime factors for understanding the plant, plant attributes and other problems associated with growing these plants better.

Collection of *Taxus*

Most of the places from Manali to Tirthan valley was covered using a private taxi and a local guide for identification of plants and carrying for safety purpose was also hired. There exist almost a small forest of *Taxus* at that place (Figure 1 and Figure 2) and few small plants were uprooted, collected in nursey bags with some soil attached to

them. It was taken care that being a plant of high altitude, it may not be possible for the plant to survive in its not native conditions and soil from the place was also collected. The soil, *Taxus* plant and few shed leaves lying on the ground were collected. After the collection of the plant, the researchers rushed towards the working place named Department of Biotechnology, Sharda University, Greater Noida, India and were maintained under artificial 900-1200 lux, 60% RH, 25±1 ºC and 16/8 h photoperiod in the tissue culture room.

Result and Discussion

The ecological habitat of *Taxus* has been disturbed due to human interference for reasons like livelihood, profitability and survival of humans but measures like ex-situ and in- situ conservations are required for keeping this plant alive for future (Mohamed and Vidaver 1990; De Klerk *et al.,* 1997; Larsen and Olsen 2007; Nimachow *et al.,* 2010; Aslam 2016). The plant was successfully collected from the terrains of Tirthan valley but the success rate of growing gymnosperms of Himalayan regions is always a challenging task. Previously workers have attempted rhizogenesis, tissue culture, auxin supplementation etc for growing these plants in lab like conditions (Pilet and Saugy, 1987; Kevers *et al.,* 1997; Fogaca and Fett-Neto, 2005; Chauhan *et al.,* 2014; Shah *et al.*, 2008; Kumar *et al.,* 2017).

The plants brought in the nursery polybags were transferred to earthen pots and initially the soil brought from their native place was used for planting them. This actually helped the plants to thrive a little better as the soil of Greater Noida will not have offered the kind of nutrition required by these plantsfor initial survival. The study has targeted a difficult task of conserving *Taxus* in its non-native conditions with limited resources. The plant was collected successfully and it thrived well initially in the provided artificial conditions similar to what the plant usually witness in Himalayas. This was necessary to ensure for the survival of the plant otherwise the plant could die and the efforts taken for bringing it from difficult terrain will go in vain.

Fig. 1: *Taxus* species growing in wild protected areas in Tirthan valley, Himachal Pradesh, India.

Fig. 2: Collection of *Taxus baccata* from reserved region of Great Himalayan National Park, ,Tirthan Valley, Manali, Himachal Pradesh India.

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Authors contribution

PS collected the material and drafted the manuscript; VBS disd literature survey, designed the work and finalized the manuscript for publication.

Conflict of interest:

Authors declare none.

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