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Performance of Cheura, *Diploknema butyracea* (Roxb) Lamb in nursery under lower- and mid-Himalayan conditions of Himachal Pradesh

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ABSTRACT

The area below apple belt ie below 1800 m particularly between 600 and 1800 m in Himachal Pradesh is characterized by unique problems of low productivity, high male out migration, high reliance on women in agriculture, pressure to expand cultivated land at the cost of forest land, undulating terrains, small and scattered holdings, limited irrigation facilities, large number of animals both domestic and wild to compete with human beings for the same resources, severe erosion due to deforestation, erratic rainfall and more susceptibility to climate change. For increasing the overall productivity of the state the vast tracks of this region hold the key. To improve the productivity of these areas an integrated approach is required that includes diversification in traditional agricultural practices, judicious use of available irrigation water and large scale rain water harvesting for gradually shifting from rainfed to commercial production. Even some additional farm income should be ensured from marginal land or grassland by commercializing already existing resources or through introduction of new set of species etc. From forestry point of view tree-borne oilseed species namely Cheura, *Diploknema butyracea* (Roxb) Lamb has great potential to provide some additional income to hill farmers of the region falling in between 300 to 1500 m elevation in Himachal Himalayas. In Uttarakhand this species occurs abundantly in a wild state in the Pithoragarh district near Kali river between altitude of 300-1500 m in hot humid climate. It is right time now for the introduction of this species in lower and mid-Himalayan regions of Himachal Pradesh for testing the suitability of the species. Therefore in the present investigations nursery performance of Cheura was studied under lower- and mid-Himachal Himalayas to eventually popularize this species in the state. It was found that the Cheura planting stock could be easily grown in the nurseries in the foot-hills of Himachal Himalayas provided nursery stock during winter was kept in polyhouse for three months (15 December to 15 March) to avoid frost damage.

Keywords: Low productivity; diversification; additional income; Cheura; nursery stock

INTRODUCTION

Improvement in the economy and quality of life of farming communities in Himachal Pradesh particularly apple growing farmers is widely acknowledged as a success story in the hills and mountains of the Himalayan region. Though the majority (75%) of farming families in the apple growing area of Himachal belongs to small and marginal farming categories yet they are not worried about food security as they have enough surplus money to buy food. It seems that the transition from subsistence to market-oriented cash crop farming is highly successful in apple belt of the state. But the area below apple belt ie below 1800 m particularly between 600 and 1800 m is characterized by unique problems of low productivity, high male out migration, high reliance on women in agriculture, pressure to expand cultivated land at the cost of forest land, undulating terrains, small and scattered holdings, limited irrigation facilities, large number of animals both domestic and wild to compete with human beings for the same resources, severe erosion due to deforestation, erratic rainfall and more susceptibility to climate change. The land resources of this region of the state are not being managed to their potential. For increasing the overall productivity of the state the vast tracks of this region hold the key.

Besides these the soils of lower- and mid-Himalayan slopes are fragile, susceptible to erosion

and subjected to environmental stresses due to frequent drought like conditions. Very few plant species can be economically raised in those conditions and represent a huge challenge for the researchers to enhance the overall productivity of the region. To improve the productivity of these areas an integrated approach is required that includes diversification in traditional agriculture practices, judicious use of available irrigation water and large scale rain water harvesting for gradually shifting from rainfed to commercial production. Even some additional farm income could be ensured from marginal land or grassland by commercializing already existing resources or through introduction of new set of species etc. From forestry point of view tree-borne oilseed species namely Cheura, *Diploknema butyracea* (Roxb) Lamb has great potential to provide some additional income to hill farmers of the region falling in between 300 to 1500 m elevation in Himachal Himalayas. It is a medium-sized tree belonging to family Sapotaceae and distributed from India to Philippines. In India this tree species is distributed from Kumaun eastwards to Sikkim (sub-Himalayan tracts and outer Himalayan ranges) and also occurs sporadically in tropical moist deciduous forest. The species is also reported from Andaman Islands where it is frequently found in semi-deciduous and evergreen forests (Troup 1921). It is found in the elevation range between 300 to 1500 m amsl.

The species is promoted on the margins of agricultural fields as a fodder tree in its zone of occurrence. Milking cows and buffalos fed on Cheura leaves (as fodder) give more milk. Cheura fodder is available in dry months (March-April) and therefore domestic animals prefer it very much. Besides the fruit which is a valuable staple food flowers constitute bee forage during winter months (December to January) and are utilized for the preparation of jaggery and spirituous liquor. Traditional as well as modern methods are used for the production of Cheura honey which is beneficial for health. The kernels of Cheura seeds yield edible oil known in the trade as Phulwara Butter which has been classed along with commercial *Morwa bassia* fats (Singh et al 2010). The oil content of the seed is about 42 to 47 per cent. The oil can also be used as an illuminant as it gives a brisk smokeless flame and makes a good raw material for the candle industry. As the species is multipurpose it is heavily exploited and is under anthropogenic pressure (Tewari et al 2015).

Cheura is most valuable species to the tribal communities of the Pithoragarh region of Uttarakhand and Chepang community of Chitwan district of central Nepal. Despite many useful characteristics the full potential of this wonder plant is far from being released. Cheura as a source of edible tree-borne oilseed is now receiving attention not only to generate additional income in rural sector but also to make India self-sufficient in edible oils. There are many reasons such as technical, economical, cultural and institutional those need further discussion and examination to popularize this species among farming communities for additional income generation. In Uttarakhand this species occurs abundantly in a wild state in the Pithoraggarh district near Kali river between altitudes of 300-1500 m in hot humid climate. It is rarely found in the adjacent districts of Almora and Nainital. It is right time now for the introduction of this species in lower- and mid-Himalayan regions of Himachal Pradesh for testing the suitability of this species. Therefore in the present investigations nursery performance of Cheura was studied under lower- and mid-Himachal Himalayas to eventually popularize this species in the state.

MATERIAL and METHODS

Seed collection

The fruits/seeds of *D butyracea* were collected during the month of July from Champawat district of Uttarakhand from the natural growing trees near Lohaghat during 2012, 2013, 2014 and 2015. The seeds within 48 hours of collection were sown in the nurseries of Himalayan Forest Research Institute at Bir Plassi, Nalagarh and Shilly Solan district viz lower- and mid-Himalayan regions of the state.

Study sites

The seed germination studies were conducted at Bir Plassi, Nalagarh and Shilly nurseries of the institute. The Bir Plassi nursery is located 8 km away from Nalagarh near Punjab border towards Rupnagar at 31°02’21.1"N latitude and 76°37’26.2"E longitude and 282 m amsl in sub-tropical region. The area experiences moderate rainfall during the months of July-August and December-January. The total area of the station is 9 hectare having soil with sandy loam texture and no slope whereas the Shilly nursery is located 4 km away from Solan city towards Jaunaji at 30°54’23.8"N latitude and 77°07’34.6"E longitude and 1550 m amsl in moist temperate region. The area experiences moderate to heavy rainfall during the months of July-September and December-March. The total area of the station is 2 hectare having soil with loamy texture and 40-50 per cent slope.

Germination studies

Germination in the nurseries was recorded after one month of sowing and subsequently seedlings were maintained in the respective nurseries and survival was recorded after six months and one year of sowing. Watering and other maintenance operations were done as and when required. The growth data viz height and diameter were recorded after six months, one year and two years of sowing. The germination data were subjected to analysis of variance (ANOVA) to establish the significance of differences between the treatments. The critical difference was calculated for the treatments studied using a computer programme SX-a statistical package for social sciences.

RESULTS

The freshly-collected Cheura seeds from Champawat district of Uttarakhand during July 2012, 2013, 2014 and 2015 were brought within two days to Himachal Pradesh and sown immediately in Bir Plassi nursery, Nalagarh and Shilly nursery, Solan without providing any pre-sowing treatment. The germination and survival data of different years are depicted in Table 1.

Perusal of data in Table 1 reveal that the germination of Cheura seeds in the nursery was very good in all the studied years viz 2012, 2013, 2014 and 2015 and at par with each other. The germination ranged from 84.50 per cent (2013) to 90.25 per cent (2015). The survival after six months of sowing in different studied years was also found to be non-significant. However the survival after one year of sowing in different studied years was found to be significantly different. The maximum survival (75.64%) was recorded for the 2014 sowing that was at par with 2015 (74.49%) followed by 2013 (69.84%) sowings. However significantly lowest survival (23.59%) was recorded for 2012 seed sowing.

Similarly growth data were also recorded in the nursery under Bir Plassi, Nalagarh conditions and are depicted in Table 2. The comparative growth (height and diameter) was obtained by Cheura plants in foothills of Himalayas in all the studied years. The plants became ready to out-plant after two years with around 20 cm height and 5 mm root collar diameter.

The results of germination and survival of Cheura seeds sown at Shilly nursery Solan ie in mid-hill conditions are depicted in Table 3.

The germination of seeds in the Shilly nursery was very good in all the studied years viz 2012, 2013, 2014 and 2015 and significantly at par with one another. The germination ranged from 84.00 per cent (2014) to 89.50 per cent (2015). The survival after six months of sowing in different studied years in this nursery was also found to be non-significant. After one year the maximum survival (57.30%) was recorded for the year 2015 sowing and was at par with 2014 (54.16%) followed by 2013 (36.27%) sowings. Minimum survival (9.95%) was recorded for the year 2012 seed sowing.

The growth data were recorded in the nursery under Shilly, Solan conditions and are depicted in Table 4. The overall growth of plants remained stunted and plants remained under-sized for plantation even after two years of sowing.

DISCUSSION

The germination of Cheura seeds brought from Uttarakhand was recorded 80-90 per cent in Himachal Pradesh. The survival of plants in nurseries after six months was also satisfactory. However the survival after one year resulted into heavy mortality in both the nurseries during 2012 owing to winter frost. During 2013 onwards the stock of Cheura at Bir Plassi nursery, Nalagarh was kept in polyhouse during 15 December to 15 March (three months) to protect it from frost injury (Fig 1).

Similarly in Shilly nursery, Solan stock was kept in polyhouse during during 15 December to 15 March (three months) in 2013. It was observed that still plants were affected by chilling in the nursery especially during first fortnight of December or in late March as the nursery is located at 1550 m elevation. Therefore in 2014 and 2015 nursery stock was kept in polyhouse during 1 December to 31 March (four months) without having frost injury that resulted in better survival. The growth of stock was recorded for two years in both the nurseries. Thus Cheura stock can be raised easily at Bir Plassi nursery, Nalagarh that can reach plantable size (Fig 2) within two years of sowing. The only precaution one has to take while producing its stock is that seedlings should be kept in polyhouse during winter months. At Shilly nursery the less growth of plants was recorded and stock remained stunted and under-sized for field plantation even after two years of germination. Therefore growing of Cheura nursery stock in such nurseries situated in mid-hills at around 1500 m elevation cannot be recommended owing to less growth.

Table 1. Germination and survival of Cheura at Bir Plassi, Nalagarh nursery

Treatment	Seed sowing (year)	Germination (%)	Survival (%)	
			After six months	After one year
T_1	2012	90.00	77.26	23.59
T_2	2013	84.50	76.62	69.84
T_3	2014	87.25	78.25	75.64
T_4	2015	90.25	79.80	74.49
$CD_{0.05}$		NS	NS	2.67
Maximum value		90.25	79.80	75.64
Minimum value		84.50	76.62	23.59

Table 2. Growth of Cheura plants at Bir Plassi, Nalagarh nursery

Data recording	Average height (cm)				Average collar diameter (mm)			
	2012	2013	2014	2015	2012	2013	2014	2015
After 6 months	6.74	6.23	6.15	6.07	2.69	2.35	2.48	2.59
After one year	11.28	11.84	12.56	11.88	3.68	3.74	3.93	3.95
After two years	18.12	19.99	20.17	-	4.73	4.91	5.01	-

Table 3. Germination and survival of Cheura plants at Shilly, Solan nursery

Treatment	Seed sowing (year)	Germination (%)	Survival (%)	
			After six months	After one year
T_1	2012	85.25	68.32	9.95
T_2	2013	86.25	69.54	36.27
T_3	2014	84.00	66.47	54.16
T_4	2015	89.50	67.63	57.30
$CD_{0.05}$		NS	NS	3.20
Maximum value		89.50	69.54	57.30
Minimum value		84.00	66.47	9.95

Increased production of container-grown nursery crops' roots hardiness has become one of the most important factors determining winter survival (Johnson and Havis 1977) similar to Cheura stock introduced in Himachal Pradesh. In cold climates containers have frequently raised beautiful seedlings only to have them ruined during overwinter storage (Zalasky 1977).

The principles of overwinter storage are well known in outline (Sakai 1970) but there is little specific information on economical environments in which to overwinter container-grown forest tree seedlings in cold climates as reported by Owston and Stein (1977). Another cause of overwinter damage is desiccation. It has been reported that when the root ball is frozen seedlings may not be able to replace moisture as fast as it is lost (Davidson and Mecklenburg 1974, Wiest 1980). Preventing freezing of the root ball to avoid desiccation may be very expensive. Alternatively loss of water can be retarded by using moisture barriers and minimizing temperature fluctuation or perhaps by supplying moisture to the tops as well as the roots (Havis 1976).

In order to have maximum survival and production from the crops grown in the ploy house it is not only necessary to pay proper attention to the supply of manure and water to the plants and protect them from diseases but there cleanliness and pruning is also

Fig 1. Overwintering Cheura plants in polyhouse

Fig 2. Cheura plant ready for planting

Table 4. Growth of Cheura plants at Shilly, Solan nursery

Data recording	Average height (cm)			Average collar diameter (mm)		
	2012	2013	2014	2012	2013	2014
After 6 months	5.62	5.34	5.46	2.4	2.29	2.32
After one year	9.65	8.16	9.05	3.1	3.02	3.23
After two years	11.36	14.62	15.01	4.66	4.79	4.82

very important (Tinus and McDonald 1979). In the present study polyhouse proved very handy in overwintering Cheura stock in both the nurseries located in foothills and mid-hills of Himachal Himalayas. The outcome of the present study revealed that the Cheura planting stock can be easily produced in the nursery in the foot-hills of Himachal Himalayas with special care during winter months.

CONCLUSION

Cheura nursery stock under foot-hill conditions of Himachal Himalayas can be easily grown provided the nursery stock during winter is kept in polyhouse for three months (15 December to 15 March) to avoid frost damage. It takes almost two years to attain plantable size of plants in the nursery under foot-hill

conditions as it is found to be slow growing species and requires at least 2-3 years in the nursery for the production of good size plants for better outplanting success. More research on this species is required before recommending it for introduction in Himachal Himalayas.

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