

Experiences on Mass Multiplication and Systematic Plantation of Seabuckthorn in Cold Desert Condition of Himachal Pradesh

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ABSTRACT

Seabuckthorn (*Hippophae rhamnoides* L.) is one of the important natural resources of the mountainous region in cold climates. The present investigations were carried out at Krishi Vigyan Kendra, Kukumseri Distt. Lahaul & Spiti under NAIP project during 2008-09 to 2013-14. On the basis of survey carried out in different pockets of Lahaul and Spiti district 8 potential sites were identified for collection of cuttings for different species. Out of the total species of *Hippophae*, two species (*Hippophae rhamnoides* ssp. *turkestanica* and *H. salicifolia*) were selected for mass multiplication through hardwood cuttings at Krishi Vigyan Kendra at Kukumseri (2730 m asl) in Lahaul. The cuttings for mass multiplication were taken from these sites, where fruit yield per plant was comparable up to 3 to 4 kg. For mass multiplication, the cuttings of *Hippophae rhamnoides* ssp. *turkestanica* were taken from Jispa, Gemur, Chaaling and Darcha in Lahaul valley; Shego, Schiling, Lara and Rangrik in Spiti valley; and the cuttings of *H. salicifolia* from Tinu villages at Lahaul valley. Cuttings of female and male plants in the ratio of 9:1 were collected from different identified sites either in October-November for winter storage purpose or March-April for fresh plantation without storage. During project period in all 2, 94,059 plants of seabuckthorn (*H. salicifolia* and *H. rhamnoides*) have been produced by KVK. To undertake the systematic plantation in the farmer's field, farmers were first trained, after that the plants were supplied to them. In the month of March-April, one-year old rooted plants in the ratio of 9:1 (female:male) quality planting materials of two species of *Hippophae* were supplied to the farmers according to their demand with the help of local NGO "Lahaul Kila Sangam Avam Rojgar Srijan Munch" based at Jhalma. The plants were supplied to farmers after compilation of preliminary requirement like preparation of pits (45 cm³ size) at the distance of 3 m x 1.5 m, assurance of irrigation facilities. Out of total plants produced, about 2,53,120 plants were supplied to the farmers for systematic plantation in Lahaul valley covering about 122 ha new area under seabuckthorn cultivation. Simultaneously, time to time feedback were also been taken at local meetings/ trainings and by visiting the plantation/ demonstration sites. Every year, the survival rate of plants supplied to farmers in the Lahaul valley was conducted and increasing trend for survival rate was observed which ranges from 45 per cent to 70 per cent.

Keywords: Seabuckthorn, methods of mass multiplication, survival rate and systematic plantation.

INTRODUCTION

The cold deserts of Himachal Pradesh state are located in the districts of Lahaul-Spiti, Pir Panjal area of Chamba and Sumdo area of Kinnaur. These areas have very difficult terrains with ice fields, perpetual snow covered peaks and extreme and hostile climatic conditions. The region is characterized by the extreme climatic conditions, high rates of soil erosion and landslides, low agricultural production, scarcity of fuel wood, timber and fodder and sparse vegetation and socioeconomic problems like migration of youths due to lack of job opportunities. Most of the farmers are marginal (80%) in the region. The overall size of holding of farmers is about 1.25 ha. The 86% of

gross income was provided by potatoes and peas (Rs.3.14 lakhs) in Lahaul, whereas other areas like Spiti, most of the farmers are highly poor (90%), their annual income being lesser than 1.25 lakhs annually. The willow the life line of region, a useful fuelwood and fodder is dying rapidly due to climate change and pest attack.

Seabuckthorn (*Hippophae* L.) is a nitrogen fixing, deciduous, thorny plant, which grows widely in Asia and Europe. The plant has recently attracted global attention due to its rich nutritional and medicinal values. It has been reported that the chemical constituents of Indian *Hippophae* species have high potential than the Chinese and Russian *Hippophae* (Arimboor *et al.*, 2006). Seabuckthorn berries are quite rich in vitamins and other bioactive substances. Asian populations have been found in general richer in vitamin C (600-2700 mg/100 g). The content of glycine is also quite high. Because of the presence of high content of vitamin C and amino acids, its juice has been utilized for the production of several health protection juices, jams etc., particularly for weak children, pregnant ladies, aged persons and sport persons in China (Lu Rongsen, 1992). In India, Singh *et al.* (2015) has evaluated some exotic forms of seabuckthorn at university farm at Kukumseri, Lahaul, Himachal Pradesh and found them highly promising. However, at ground level, comprehensive study on selection of high yielding land-races from natural populations/ habitats, evaluation of promising forms, mass multiplication and conservation of superior genotypes of seabuckthorn in India are few so far (Singh, 2006; Singh *et al.*, 2010).

Domestication of wild natural populations is a challenging work that we have undertaken for the first time under National Agriculture Innovative Programme in Lahaul valley of Himachal Pradesh. In view of increasing demand of seabuckthorn in Indian market and potential of seabuckthorn in environmental conservation, the present study has been carried out with an aim to increase the area under plantation and production of seabuckthorn.

MATERIALS AND METHODS

The present study was carried out at Krishi Vigyan Kendra, Kukumseri in the Lahaul and Spiti district of Himachal Pradesh State in India during the year 2008-2014. The district lies between 31°44'57" to 32°59'57" N latitudes and 76°46'29" to 78°4'34" E longitudes and covers approximately 13,835 km² area with an altitudinal range of 2400 to >6600 m above mean sea level. The climate of the area varies from dry temperate, semi-arid and alpine type. The area remains snow covered almost for six months and receives up to 120 to 750 cm average snowfall year⁻¹. Rainfall varies from 10-300 mm year⁻¹ and temperature -19° to +32° C. The soil of an area is sandy to sandy loam in texture and neutral to alkaline in reaction and low in fertility.

Mass Multiplication

On the basis of survey carried out in different pockets of Lahaul and Spiti district 8 potential sites were identified for collection of cuttings for different species. Out of the total species of *Hippophae*, two species (*H. rhamnoides* ssp. *turkestanica* and *H. salicifolia*) were selected for mass multiplication through hardwood cuttings at Krishi Vigyan Kendra at Kukumseri (2730 m asl) in Lahaul. The cuttings for mass multiplication were taken from these sites, where fruit yield per plant was comparable up to 3 to 4 kg. For mass multiplication, the cuttings of *H. rhamnoides* ssp. *turkestanica* were taken from Jispa, Gemur, Chaaling and Darcha in Lahaul valley; Shego, Schiling, Lara and Rangrik in Spiti valley; and the cuttings of *H. salicifolia* from Tinu villages at Lahaul valley. Cuttings of female and male plants in the ratio of 9:1 were collected from different identified sites either in October-November for winter storage purpose or March-April for fresh plantation without storage.

Methods of mass multiplication

Mass multiplication was carried out through hardwood cuttings at Krishi Vigyan Kendra at Kukumseri (2730 m asl) in Lahaul, Himachal Pradesh. Out of the total species of *Hippophae*, two species (*H.*

rhamnoides ssp. *turkestanica* and *H. salicifolia*) were selected. In the wild populations, most of the sites contained less number of superior plants with exceptional physical characteristics and hence, the cuttings for mass multiplication were taken from these sites, where fruit yield per plant was comparable up to 3 to 4 kg. During survey, the potential sites were identified for both the species for mass multiplication. For mass multiplication, the cuttings of *H. rhamnoides* ssp. *turkestanica* were taken from Jispa, Gemur, Chaaling and Darcha in Lahaul valley; Shego, Schiling, Lara and Rangrik in Spiti valley; and the cuttings of *H. salicifolia* from Tinu villages at Lahaul valley. Since, the right of local people for seabuckthorn stands is more and hence, the help of trained local self help groups were taken for collection of cuttings.

Every year, the cuttings of female and male plants in the ratio of 9:1 were collected from different identified sites either in October-November for winter storage purpose or March-April for fresh plantation without storage. The collected cuttings during October-November were tagged and stored in the pit for winter season (15th November to March end) in alternate layer with river sand. To reduce water loss by transpiration, regular watering was done before snow fall and after snow melts.

Mass propagation in the nursery was done in polybags as below

To increase the survival rate in the field, the cuttings were raised in polybags of size 9" x 4". Before planting of cuttings in polybags, preliminary operations like development of land, preparation of sunken beds of size 3 x 1 m for adjusting polybags, sieving of soil and sand, preparation of potting mixture in the ratio of 5:4:1 ratio (soil: river sand: FYM) operations were completed timely. Every day depending upon the requirement, stored cuttings were taken out for treatment with running water for 24 hours. After water treatment, the basal end is treated up to for 30 seconds either with Indole-3-butyric acid (IBA @ 500 ppm) or Naphthalene acetic acid (NAA @ 500 ppm) solutions. Simultaneously, the cuttings were planted in the beds at a distance of 6 inches.

To get maximum survival rate, regular irrigation by sprinkler irrigation system for whole of the season (April to October end) till senescence of leaves in dormant season will be ensured. For obtaining maximum growth, hoeing and weeding operations were carried out for every 10-15 days interval in the rainy and summer season.

Systematic Plantation on marginal lands

The seabuckthorn in Lahaul and Spiti district is found growing in wild and there is no cultivated variety and cultivars, and therefore, there is no systematic plantation. To undertake the systematic plantation in the farmer's field, farmers were first trained, after that the plants were supplied to them. In the month of March-April, one-year old rooted plants in the ratio of 9: 1 (female: male) quality planting materials of two species of *Hippophae* were supplied to the farmers according to their demand with the help of local NGO "Lahaul Kila Sangam A vam Rojgar Srijan Munch" based at Jhalma.

The plants were supplied to farmers after compilation of preliminary requirement like preparation of pits (45 cm³ size) at the distance of 3 m x 1.5 m, assurance of irrigation facilities. Simultaneously, time to time feedback were also been taken at local meetings/ trainings and by visiting the plantation/ demonstration sites. Every year, the survival rate of plants supplied to farmers in the Lahaul valley was conducted.

RESULTS AND DISCUSSION

Mass Multiplication

8 potential sites selected on the basis of survey carried out in different pockets of Lahaul and Spiti district for collection of cuttings for different species are given in Table 1. Out of the total species of *Hippophae*, two species (*H. rhamnoides* ssp. *turkestanica* and *H. salicifolia*) were selected for mass multiplication through hardwood cuttings. The cuttings of *H. rhamnoides* ssp. *turkestanica* were

taken from Jispa, Gemur, Chaaling and Darcha in Lahaul valley; Shego, Schiling, Lara and Rangrik in Spiti valley; and the cuttings of *H. salicifolia* from Tinu villages at Lahaul valley.

Table 1. Potential site identified for seabuckthorn

Valley	Potential sites	Species
Lahaul	1.Tinu	<i>H. salicifolia</i>
	2.Darcha	<i>H. rhamnoides</i>
	3. Gemur	<i>H. rhamnoides</i>
	4. Jispa	<i>H. rhamnoides</i>
Spiti	1.Shego	<i>H. rhamnoides</i>
	2. Rangrik	<i>H. rhamnoides</i>
	3.Schichling	<i>H. rhamnoides</i>
	4.Takcha	<i>H. tibetana</i>

Among the two species of *Hippophae* (*H. salicifolia* and *H. rhamnoides* ssp. *turkestanica*), *H. salicifolia* showed higher success rate in both the conditions (polybags as well as direct filed plantation methods) in the nursery after treatment with IBA. The genotype of high yielding and nutritionally rich *H. salicifolia* was identified and morphologically characterized in 1994 (Singh, 1994) and later biochemically characterized (Singh *et al*, 2011). Fresh collected cuttings of *H. salicifolia* species planted in the polybags showed higher rooting percentage, i.e. 97.23 per cent when planted in April and 88.78 per cent when planted during May month. However, success rate of winter stored cuttings of *H. salicifolia* showed 88.73 per cent in April and 57.68 per cent in May planting. Similarly, fresh cuttings of *H. rhamnoides* ssp. *turkestanica* showed 74.34 per cent survival for April and 49.43 per cent for May month planting. Similar trend as that of *H. salicifolia* for winter stored cuttings was recorded in *H. rhamnoides* ssp. *turkestanica* (64.53 per cent in April and 48.73 per cent in May).

Plants produced since inception

Total plants of seabuckthorn produced and supplied to the farmers since inceptions are given in Table 2. It is clear from the table that during the project period in all 2, 94,059 plants of seabuckthorn have been produced out of which 2,53,120 plants were supplied to the farmers. The systematic plantation have been done in an area of about 100 ha, including gap fillings.

Table 2. Total plants produced and supplied to farmers since inception

Year	No. of plants produced	No. of plants supplied
2009-10	30,000	30,000
2010-11	49,900	49,900
2011-12	70,477	58,130
2012-13	73,682	45,090
2013-14	70,000	70,000
Total	2,94,059	2,53,120

Details of different Genotypes supplied to the farmers

Different genotypes supplied to the farmers are presented in Table 3. It is evident from the data presented in Table that during the year 2009-10 and 2010-11 plants of two species *H. salicifolia* and *H. rhamnoides* were supplied to the farmers. Whereas from the year 2011-12 onwards only plants of specie *H. salicifolia* were made available to the growers.

Table 3. Different Genotypes Supplied to the Farmers

Month/year	<i>H. salicifolia</i>	<i>H. rhamnoides</i>	Male	Total
2009-10	15,190	10,426	2,384	30,000
2010-11	21,500	23,784	4,616	49,900
2011-12	52,130	-	6,000	58,130
2012-13	40,090	-	5,000	45,090
2013-14	62,000	-	8,000	70,000
Total	1,90,910	34,210	26,000	2,53,120

Systematic Plantation

Plants were supplied to trained farmers. Simultaneously, time to time feedback were also been taken at local meetings/ trainings and by visiting the plantation/ demonstration sites. In all 2,53,120 plants were supplied to the farmers which brought about 122 ha new area under systematic plantations of seabuckthorn. About 550 farmers from 82 villages have carried out systematic plantations of seabuckthorn in their fields.

Plants survival in the field

Data on the survival rate of seabuckthorn in the farmer's field are given in Table 4. Every year, the survival rate of plants supplied to farmers in the Lahaul valley was conducted and increasing trend for survival rate was observed which ranges from 45 per cent to 70 per cent. It is not so good as far as the farmer's feedback is concern.

Table 4. Survival rate of seabuckthorn on the marginal lands, Lahaul, HP

Year	Survival rate (%)
2010	45-70
2011	60-70
2012	70-75
2013	70-80
2014	70-75

The main reason behind is that it is the preliminary experiment for commercial cultivation in the farmers field, which we have undertaken in the Himalayan region, with obvious less interest by the local people. Further, the plantations have been carried out on wasteland type of land, with little moisture. It was also found that plantation carried out during mid April gave the highest survival rate of the saplings.

CONCLUSION

The study was carried out in the cold desert area of Himalayan region to increase area under cultivation as well as to increase productivity of seabuckthorn stands. Among the different land races, *H. salicifolia* selection from Tinu village, Lahaul is the valuable resource for breeding and cultivation purposes. Mass multiplication of available good stands of native populations of seabuckthorn species and about 3.00 lakhs plants have been raised and distributed among the local inhabitants of this area. Farmers are very keen to cultivate seabuckthorn in view of high demands in industries.

Further, it is concluded that hardwood cuttings of seabuckthorn should be collected during March-April and should be treated with IBA @ 500 ppm instead of NAA @ 500 ppm. Farmers needed to be educated about the potential of *H. salicifolia* selection, and Russian varieties needed to be introduced in the region.

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REFERENCES

1. Arimboor, R., Venugopalan, V., Sarinkumar, K., Arumughan, C. and Sawhney, R.C. 2006. Integrated processing of fresh Indian seabuckthorn (*Hippophae rhamnoides*) berries and chemical evaluation of products. J. Sci. Food and Agri. 86 (14): 2345-2353.
2. Rongsen, L. 1992. Seabuckthorn – A multipurpose plant species for fragile mountains. Occasional Paper No. 20, ICIMOD, Kathmandu, 62 p.
3. Singh, V 1994. A report on arboreal seabuckthorn (*Hippophae salicifolia*) from dry temperate Himalayas. Journal of Tree Sciences 3 (1): 67-68.
4. Singh, V 2006. Research and development of seabuckthorn (*Hippophae* L.) in India. In: Seabuckthorn (*Hippophae* L.) – A Multipurpose Wonder Plant. Vol. II: Biochemistry and Pharmacology (V Singh, Ed. In Chief, 2006), pp. 542-575, Daya Publishing House, New Delhi, 600 p.
5. Singh, V, Sharma, V.K., Sharma, M., Tyagi, S.P., Dhaliwal, Y.S., Rana, R.K., Saini, J.P., Pathania, P., Lal, M., Singh, A., Sharma, R.K., Sharma, V., Devi, R. and Kumar, R. 2010. Fifteen years of research on seabuckthorn in CSK Himachal Pradesh Agriculture University, Palampur. In: Proceedings of National Conference on Seabuckthorn, pp.1-12, February 16-18, 2010, CSKHPKV, Palampur, 82 p.
6. Singh, V, Gupta, R.K., Arumughan, C., Sawhney, S.C., Rana, R.K., Singh, A., Lal, M., Devi, R and Sharma, N. 2011. Biochemical evaluation of *Hippophae salicifolia* and *H. mongolica* as horticultural crops in dry temperate Himalayas. In: Proceedings of National Conference on Seabuckthorn: Emerging Trends on R & D on Health Protection and Environmental Conservation, CSKHPKV, Palampur, HP, pp. 75-92. 7
7. Singh, V., Sharma, L.K. and Rana, R.K. 2015. Evaluation of some exotic forms of seabuckthorn (*Hippophae rhamnoides* ssp. *mongolica*) in cold desert Himalayas. Annals of Plant Sciences 4 (03): 1003-1007.