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Original Research Article

Evaluation of some exotic forms of Seabuckthorn (*Hippophae rhamnoides* ssp. *mongolica*) in cold desert Himalayas

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Abstract: Five exotic improved forms of seabuckthorn (*Hippophae rhamnoides* ssp. *mongolica*) introduced during 3 different years, are being evaluated for their growth at Himachal Pradesh Agricultural University's High Land Agricultural Research and Extension Centre, located at Kukumseri (2730 m a.s.l) in district Lahaul-Spiti, a dry temperate region of Himalayan state of Himachal Pradesh. The region is characterized by low rainfall (about 450 mm/yr) and heavy snowfall (100-400 cm/yr). The first exotic form "H1-1" introduced in 1995, after 7 years of growth, had a diameter of 2.8 cm at base, 178 cm of height, a narrow canopy spread of 29 cm. This form had the fruit weight of 30.5 cm/100 fruits. The two other exotics HI-2 and HI-3, after 4 years of growth had the heights of 37 and 52 cm and canopy spread of 6.5 and 12 cm, respectively. The other two exotics HI-4 and HI-5 introduced in 2001, have also adapted to the local conditions. No decease has been recorded in any exotic form introduced at the center. All the forms were nearly thornless, except HI-4.

Key words: Seabuckthorn, exotics, evaluation, cold desert Himalayas

Introduction

Seabuckthorn grows very widely in high altitude areas of dry temperate parts of Indian Himalayas, i.e. Lahaul-Spiti, parts of Chamba and Kinnaur districts in Himachal Pradesh (Singh *et al*., 1995; Singh, 2003), Ladakh (Dwivedi *et al*., 2001), upper regions of Uttranchal, Sikkim (Basistha *et al*., 2001) and Arunachal Pradesh (Tiwari and Singh, 2001). Traditionally, it is being used in local medicines and as an important source of fuelwood in Himalayas (Brijlal *et al*., 2001; Singh, 2001). After the realization of its rich nutritional and medicinal properties and its role in environmental conservation (Lu Rongsen, 1992), active research on several aspects of seabuckthorn have been started in several institutions of India. We have carried out studies on its surveys (Singh *et al*., 1995, Singh and Dogra, 1996 and Singh and Singh, 2004), propagation (Singh, 1994) and fodder values (Singh *et al*., 1999) and evaluation of some local forms of seabuckthorn (Singh *et al*., 2001), whereas a number of studies are in progress on clinical and experiment parameters of seabuckthorn (Geetha *et al*., 2002a, b), consequently some products have also been developed. In view of increasing demand of seabuckthorn raw material in Indian and international markets, we are making efforts to develop high yielding cultivars, having desirable features like dwarfness, few thorns, large fruit and high fruit yield and oil content and absence of diseases. The present paper discusses the results of five exotic improved forms, growing under the nursery conditions.

Materials and Methods

We started the work on introduction of improved forms in 1995 and since then five exotics have been introduced with the titles of "HI" series. The present paper discusses the results of studies on the growth of 5 exotics of seabuckthorn raised in nursery conditions at Highland Agriculture Research and Extension Centre, located at Kukumseri in Lahaul valley of Chenab river in district Lahaul-Spiti, a semiarid valley of district Lahaul-Spiti (north latitude, 31° 44'57" and 33° 42' 54" and east longitude 76° 56' 29" and 78° 41' 34"), a dry temperate region of Himachal Himalayas. The Centre is located at the base of northern slope at an altitude of 2730 m asl. The site experiences heavy snowfall during winter (100-400 cm) and temperature goes down to –20°C during winter. The average rainfall of the area is about 450 mm per year, most of which occurs during July-August.

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The soil of the center is sandy loam. Soil depth at the site is about 1 m. Soil makes 30-40% (volume basis) up to 1 m of the depth, whereas remaining portion of the soil is comprised of gravels of small size. The soil texture is sandy loam, whereas clay particles are very less (7-8%), silt particles are 62%. The water holding capacity of the soil is 40%. The available soil moisture range is quite good (6-28% w/w). The soil pH is neutral (6.5-7.1), organic matter content is medium to high. Available nitrogen is low to medium, whereas available phosphorus is medium to high and available potassium is low to medium. The detail of soil properties was taken from the centre (Table 1).

Table 1: Physical properties of the soil of High Land Agriculture Research and Extension Centre, Kukumseri (2730 m asl), Lahaul-Spiti, HP

S.No.	Parameter	Value
1.	Sand	62%
2.	Silt	31
3.	Clay	7.4
4.	Soil texture	Sandy loam
5.	Soil depth	About 1 m
6.	Soil slope	20-25%
7.	Soil at surface (v/v)	30-40
8.	Water holding capacity (% w/w)	40
9.	Available soil water (% w/w 0.1 bar to 15 bar)	22
10.	Soil pH	6.5-7.1

The seeds of exotics were sown at the distance of 5 cm and spacing of 20 cm in the nursery beds of 3 m x 1 m size at the depth of 2 cm after water treatment for a week. HI, HI2 and HI 3 are mild thorny forms. HI-4 is a thorny form, with fruit weight varying from 15 to 55 g per 100 fruits, quite rich in oil (5.2%), whereas HI-5 is thornless form with very large fruits (71-100 g/100), being richer in vitamin C content (104-955 mg) and medium in oil content (2.7%) (Table 2).

Proper weeding was carried out when ever required and plants were regularly irrigated, particularly during dry days of summer (April-June). No fertilizer was provided to the plants. Height of the plants, number of thorns, canopy spread and fruit size and colour etc. were recorded in the plants growing under the nursery conditions. The plants of HI-1 have been propagated vegetatively to transplant them under field conditions to evaluate their fruit yield at a particular spacing.

Table 2: Known characteristics of five exotics of seabuckthorn

Characteristics	HI-1	HI-2	HI-3	HI-4	HI-5
Source	World bank	Russia	Russia	Ukraine	Russia
No.of accessions	487	8	18	74	105
Thorns	Nearly thornless	Nearly thornless	Nearly thornless	Thorny	Thornless
Fruit weight (g/100)	NA	NA	NA	15-55	71-100
Fruit yield (kg/plant)	NA	NA	NA	13	16
Oil (%)	NA	NA	NA	5.2	2.7
Vitamin C (mg/100g)	NA	NA	NA	4-86	104-955

NA: Not available

Results and Discussion

These exotics of seabuckthorn raised at our university center at Kukumseri in Lahaul are precious genotypes, as thornlessness and pest free characterize majority of them. Their fruits are large enough with long fruit stalk. Except HI-1, other exotics are in early stage of growth and likely to bear fruits within next few years. However, their survival and good growth under the conditions make them suitable materials for the breeding and afforestation programmes of dry temperate Himalayas.

Comparison of HL-1 and HI-1:

HI-1 has shown the characteristic of a dwarf form, as it has a height of 178 cm as compared to a local form (193 cm) after 7 years of growth. HI-1 had a thicker diameter of 2.8 cm at base, as compared to HL-1 (2.6 cm). HI-1 also had a narrow canopy spread (29 cm) as compared to local form (65 cm). HI-1 has few thorns (1.3 thorns per 10 cm) on the 2 years old branches, whereas the local form was highly thorny. HI-1 has quite large fruits (30.5 g/100) as compared to local form (13.7 g). Length of fruit stalk of HI-1 was 3.4 mm, as compared to 1.4 mm of HL-1. Fruits of HI-1 were of yellowish-orange

colour, whereas fruits of local form were reddish orange colour (Table 3).

While observing growth dynamics of HL-1 and HI-1 forms, it was found that HI-1 had a vigorous growth initially for 3 years (83 cm), which was 2 times higher than HL-1 (46 cm), however, later, growth of HL-1 picked up (180 cm) and surpassed HI-1 (167 cm) in 6th year (Fig.1).

Comparison of HL-2 and HI-3:

Plants of HI-3 were taller (52 cm) than the HI-2 (37 cm) after 4 years of growth. The diameter of stem at base also varied to 1.1 cm and 1.6 cm respectively. HI-3 had wider canopy (12 cm) than the HI-2 (7 cm). HI-2 and HI-3, both have very few thorns (Table 4). HI-2 remained more dwarf (63 cm), even after 6 years of growth, as compared to HL-3 (102 cm, respectively) (Fig.2).

Table 3: Comparison of performance of exotic form "HI-1" and local form "HL-1" of seabuckthorn after 7 years of growth

Form	Height	Canopy spread (cm)		Average of canopy spread (cm)	No.of thorns /10 cm	Weight of 100 fruits (gm)	Fruit colour
		East	South				
HI-1	178	30	28	29	1.3	30.5	Yellowish orange
Local form	193	67	63	65	3.2	13.7	Reddish orange
CD (P<0.05)	6.4	2.1	2.2	-	0.1	5.8	-

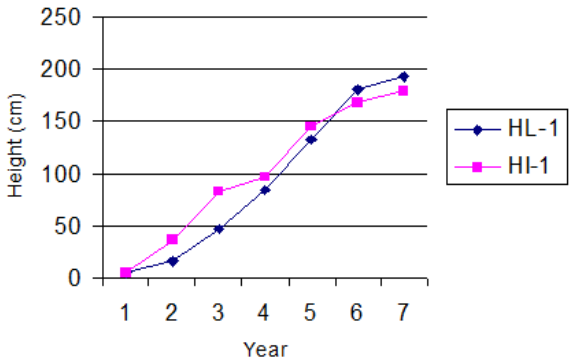

Figure 1: Comparison of growth dynamics of HL-1 and HI-1 forms

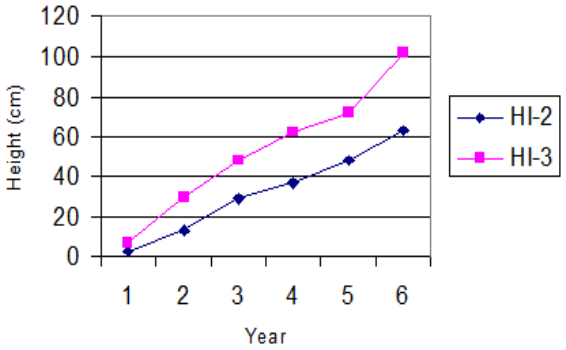

Figure 2: Comparison of growth dynamics of HI-2 and HI-3 forms.

Table 4: Comparison of performance of HI-2 and HI-3 exotic forms of seabuckthorn after 4 years of growth

Form	Height (cm)	Canopy spread (cm)		Average of canopy spread (cm)	No.of thorns /10cm
		East	South		
HI-2	37	7	6	6.5	0.6
HI-3	52	13	11	12.0	0.7
CD (P<0.05)	4.9	1.3	1.6	-	0.03

Comparison of HL-4 and HI-5:

After 2 years of growth, HI-4 was 4 times taller (39 cm) than HI-5 (10 cm), which is a dwarf form. After 2 years of growth, HI-4 has 2.5 times wide spread of canopy (15 cm) than the HI-5 (6 cm). HI-4 was thorny, thorn number ranging from 0 to 4 thorns (1.7 thorns, average), whereas HI-5 was thornless. HI-4 was showing a very vigorous growth right from the year of sowing in 2001 to 3rd year of its growth (91 cm) in 2003, which was more than double than that of HI-5 (38 cm) (Fig. 3).

Table 5: Comparison of performance of HI-4 and HI-5 exotic forms of seabuckthorn after 2 years of growth

Form	Height	Canopy spread (cm)		Average of canopy spread (cm)	No.of thorns/10 cm
		East	South		
HI-4	38.9	16	13	14.5	1.7
HI-5	10.1	6	5	5.5	-
CD (P<0.05)	6.9	2.3	2.1	-	-

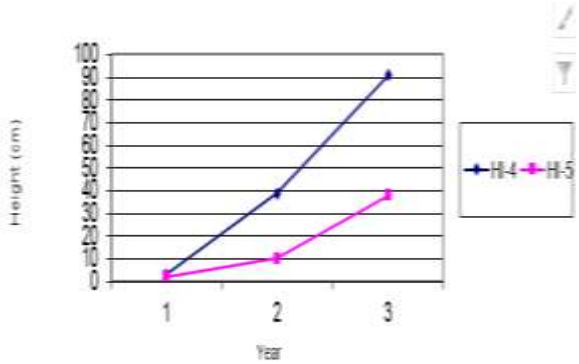

Figure 3: Comparison of growth dynamics of HI-4 and HI-5 forms

Conclusion

HI-1 shows the characteristics of a dwarf form with narrow canopies, large fruits and few thorns as compared to the local form. HI-2 shows the characteristics of dwarfness with narrow canopies, as compared to HI-3. Both are nearly thorn less. HI-5 shows the characteristics of dwarfness with narrow canopies and absence of thorns, as compared to HI-4. No disease was found on the leaves and branches of all the exotic forms.

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