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Source variation in fruit, seed and seedling traits of *Hippophae salicifolia*

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Abstract

Hippophae salicifolia D.Don is a deciduous tree species restricted to the Himalayan region. It is a important medicinal plants with multiple benefits. Source variation tests are necessary to screen the naturally available genetic variation to select the best planting material for higher productivity. In this study, an effort has been made to evaluate the extent of variation among the seed sources with respect to different fruit, seed and seedling traits.

The seeds of *H. salicifolia* were collected from twelve seed sources. Initially fruits and seeds were measured for length, width and 100 seed weight. Seed germination test involved 4 replications of randomly selected 25 seeds each, from the working sample. The present investigation reports the variation in fruit, seed and seedling characters of *Hippophae salicifolia*. The maximum fruit length (7.15 mm), fruit width (6.25mm), seed length (5.20 mm), seed width (2.83 mm) and 100 seed weight (2.83 g) were observed in S_9 seeds source of Chamoli district of Uttarakhand. Germination percentage was also highest in S_9 (96.25 %). Length of radicle (2.30 cm) and plumule (4.43 cm) also showed maximum values in S_9. According to present study, the seed source (S_9) probably can be recommended for large scale plants production of the species from this locality for afforestation programme and for further breeding work.

Key-Words: Seed sources variation, radicle, plumule, Germination percentage

Introduction

Hippophae salicifolia D. Don (Vernacular–Chuk, Tarwa) is a deciduous tree species restricted to the Himalayan region, between 1500-3500 m a.m.s.l. (Hooker 1894 and Gaur 1999). It has been reported as one of the best species of genus Hippophae in terms of high quality fruit, high yield and less thorns (Lu et al., 2001). There are total five species based on morphological variations viz. *H. rhamnoides*, *H. salicifolia*, *H. neurocarpa*, *H. tibetana* and *H. goniocarpa*. The main species distributed in India are *H. rhamnoides*, *H. salicifolia* and *H. tibetana*. Out of these species, only two species, i.e., *H. salicifolia* and *H. tibetana* are reported in Uttarakhand (Yadav, 2006). Among them *H. salicifolia* is the most common and widely distributed species and is reported to exist in abundance in three districts of Uttarakhand viz., Uttarkashi, Chamoli and Pithoragarh (Rattan and Tomar, 2011)

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It is a important medicinal plants also used as fence, fuel, fruit and fodder. This species has great ecological significance as its roots possess excellent soil binding properties. Seeds contain high quality oil which has many bioactive substances (Rongsen, 1992).

Salicifolia plant is tolerant to extreme cold, drought conditions, saline and toxic soils, and it symbiotically fixes nitrogen (Rousi, 1971; Li and Schroeder 1999; Pesonen, 1999). The fruits have a distinctive sours taste and a unique aroma reminiscent of pineapple. The local peoples of Uttarakhand state who leaved nearby, the habitat of *H. salicifolia*, they used berries for pickles. Berries are the rich source of vitamin B, C, E and K. The berries remain on the small tree branches all winter until eaten by birds. Scientifically the quality of fruit was recorded as a rich source of vitamins, and used in preparations of various products including local beverages (Gaur, 1999).

Quality seed has been recognized as an important input in forestry and is considered essential for increasing production and also seed polymorphism has been found to play a great role in seed germination, survival and seedling growth (Pathak et al., 1980). Source variation tests are necessary to screen the naturally available

genetic variation to select the best planting material for higher productivity (Bhat and Chauhan, 2002). The seed germination studies of *H.salicifolia* collected from single population was studied by Sankhyan et al., 2005. However, to achieve higher productivity and select suitable genotypes for future breeding programmes, seed source testing is important (Mamo et al., 2006). In this study, an effort has been made to evaluate the extent of variation among the seed sources with respect to different seed and seedling traits. Such an investigation may help in early evaluation of criteria for selection of some prominent traits which may be related to subsequent performance in the field.

Material and Methods

The seeds of *H.salicifolia* were collected from three districts of Uttarakhand in the month of November 2009 from twelve seed sources as enlisted in Table 1.

The geographic range of seed sources varied from 30° 03´ to 31° 34´ N latitude, 74° 30´ to 80° 13´ E longitude and 1949 to 3212 m altitude. A minimum of ten trees were randomly selected from each population (seed source) located about 100 m apart from each other in order to avoid narrowing down of the genetic base due to relatedness or inbreeding (Turnbull, 1975).

Further fruits and seeds were drawn randomly to measured for their maximum length and width in millimetre up to two decimal places using an electronic vernier calliper. For measurement of seed weight 6 replicates with 100 seeds each were used.

Seed germination test involved 4 replications of randomly selected 25 seeds each, from the working sample. Seed for each replication were placed on top of germination paper in separate petriplates in the seed germinator at $\pm 25^0$C. Each petriplate was marked with date of experiment and replication number. Seeds were observed for germination everyday, recorded and after counting, the germinant were transferred to poly bags in the nursery. Germination percent was calculated at the end of 28 days (ISTA, 1993). Observations were also recorded for growth parameters like length of radicle and plumule.

Results and Discussion

There was significant difference among seed sources for fruit and seed traits. Fruit length amongst the different sources tested varied from 4.93 to 7.15 mm and fruit width from 4.05 to 6.25 mm, seed length varied from 3.08 to 5.20 mm and seed width from 2.08 to 2.83 mm respectively (Table 2). S_9 excelled other seed sources for fruit, seed length and width. The 100 seed weight varied from 1.30 to 2.83 grams. The lowest and highest average 100 seed weight was observed in S_4 and S_9, respectively. It is evident from the above that seed with maximum weights, possessed heavier fruit, higher seed length and width.

Results revealed wide range of variation in germination per cent (61.25 to 96.25). S_9 achieved highest germination per cent (96.25) and differ significantly at the level of 5 % from rest of the seed sources. Seed sources with heavier seed weight possessed higher germination per cent than that of lower seeds weight, due to stored food in endosperm. Similar findings also reported by (Dunlap and Barnett, 1983) in *Pinus taeda* and in *Albizzia lebbek* by (Bhat and Chauhan, 2002). S_9 also attained maximum values for length of radicle and plumule (2.30 cm and 4.43 cm).The mean values of fruit, seed and seedling parameters among 12 sources are presented in Table 2.

The correlation matrix (Table 3) revealed that highly significant correlation exist between fruit length with fruit width and seed length; fruit width with seed length ; seed length with seed weight. The significant but negative correlation was observed between seed length and seed width with latitude. Radicle length is also highly significant but negative correlated with longitude.

Fruit and seed dimensions can be considered as important traits for early selection of seed sources. Seed sources with higher average seed width and seed thickness are expected to give higher germination and field emergence. Similar research findings have been reported in *Pinus brutia* (Isik ,1986). Also, early detection of fast growing provenances on the basis of germination parameters has been recommended by some research workers (Khalil, 1986).Significant positive correlation between seed weight and germination percent has earlier been reported in *Acacia nilotica* (Ginwal et al., 1994) and *Dalbergia sissoo* (Vakshasya et al.,1992) though, in the present study it did not appear significantly correlated with seed germination.

However, an overall consideration revealed that S_9 seed source is superior to rest of the eleven seed source with respect to growth parameters. Superiority might be because of genetic makeup. Similar studies have been reported by (Sneizko and Stewart, 1989) in *Pinus taeda*, (Vakshasya et al., 1992) in *Dalbergia sissoo*, (Bhat and Chauhan, 2002) in *Albizza lebbek* and (Shivanna et al., 2007) in *Pongamia pinnata*. Variability in seed germination ability for several species has been reported among seed sources in different regions (Tewari and Dhar, 1996) Siril et al., 1998). Causes of such variations are attributed to (i) genetic characters of different populations /plants (Bewley and Black, 1994) or (ii) impact of mother plant environment (Andersson and Milberg, 1998) or

(iii) wider habitat conditions (Friis, 1992) or (iv) diverse altitudinal gradients (Rawat et al., 2006).These factors could be considered as important factors affecting germination characteristics of *H. salicifolia.*

Conclusion

On the basis of our results, eventually, it may be concluded that the Hanuman Chatti (S_9) seed source is superior among all seed sources. Therefore, it is advisable that this seed source should be used for collection of bulk quantity of seeds to achieve better productivity.

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Table 1: Geographic information of Uttarakhand seed sources of *Hippophae salicifolia*

Seed Source No.	Seed Source	District	Altitude (m)	Latitude	Longitude
S_1	Lohari nag pala	Uttarkashi	2266	30° 48´ N	78° 37´ E
S_2	Dabrani Dam site	Uttarkashi	2288	30° 55´ N	78° 41´ E
S_3	Sukhi village	Uttarkashi	2345	30° 52´ N	78° 39´ E
S_4	Hurri village	Uttarkashi	2367	31° 34´ N	78° 36´ E
S_5	Harsil	Uttarkashi	2551	31° 02´ N	78° 44´ E
S_6	Dharali	Uttarkashi	2555	31° 02´ N	78° 45´ E
S_7	Pandukasher	Chamoli	1949	30° 40´N	79° 30´E
S_8	Lambagarh	Chamoli	2407	30° 41´N	79° 30´E
S_9	Hanuman Chatti	Chamoli	2560	30° 41´N	74° 30´E
S_{10}	Badrinath	Chamoli	3014	30° 43´N	79° 29´E
S_{11}	Mana	Chamoli	3212	30° 46´N	79° 29´E
S_{12}	Munsiyari	Pithoragarh	2690	30° 03´ N	80° 13´ E

Table 2: Variation in fruit, seed and seedling parameters among different seed sources of *H. salicifolia*

Seed Sources	Fruit length (mm)	Fruit width (mm)	Seed Length (mm)	Seed width (mm)	100 seed weight (g)	Germination per cent	length of radicle (cm)	length of plumule (cm)
S_1	5.68	5.03	3.80	2.53	2.43	76.25	1.43	2.68
S_2	6.38	5.38	3.70	2.13	1.65	76.25	1.63	2.25
S_3	5.08	4.05	3.85	2.10	2.18	76.25	2.18	3.80
S_4	5.45	4.63	3.08	2.08	1.30	81.25	1.68	3.63
S_5	4.93	5.05	3.20	2.08	1.98	61.25	1.63	4.25
S_6	5.50	5.33	3.73	2.63	2.80	95.75	2.10	3.98
S_7	6.68	6.08	4.70	2.58	1.68	85.00	2.05	3.55
S_8	6.25	5.58	4.38	2.55	2.40	87.50	2.18	4.33
S_9	7.15	6.25	5.20	2.83	2.83	96.25	2.30	4.43
S_{10}	6.40	5.80	4.95	2.30	2.10	86.25	1.53	2.33
S_{11}	6.58	5.70	4.75	2.73	2.08	91.25	1.88	4.18
S_{12}	6.23	5.53	4.73	2.80	2.20	95.00	1.15	3.38
Mean ± S.D	6.02±0.69	5.36±0.61	4.17±0.70	2.44±0.29	2.13±0.45	84.02±10.38	2.03±0.99	3.67±0.94
C.V	11.40	11.45	16.85	11.92	21.21	12.33	48.60	25.74
Std.err	0.34	0.48	0.29	0.24	0.19	5.77	0.55	0.47
$CD_{(0.05)}$	0.69	0.98	0.59	0.49	0.39	11.78	1.12	0.96
F-value	0.41	0.39	4.48	3.11	1.11	1.93	0.48	0.34

Table 3: Correlation coefficient between studied traits and geographical parameters in *Hippophae salicifolia*

	Fruit L	Fruit W.	Seed L.	Seed W.	Seed wt.	G. %	RL	PL	Lat.	Lon.	Alt.
Fruit L.	-	.872**	.842**	.646*	.145	.622*	.465	.091	-.492	-.271	.178
Fruit W.	-	-	.763**	.685*	.261	.543	.396	.185	-.484	-.204	.214
Seed L.	-	-	-	.729**	.394	.677*	.424	.173	-.731**	-.155	.373
Seed W.	-	-	-	-	.616*	.805**	.376	.373	-.651*	-.158	.253
Seed wt.	-	-	-	-	-	.449	.506	.438	-.390	-.414	.230
G.%	-	-	-	-	-	-	.334	.224	-.442	-.093	.334
RL.	-	-	-	-	-	-	-	.726**	-.015	-.909**	-.040
PL.	-	-	-	-	-	-	-	-	.021	-.566	.088
Lat.	-	-	-	-	-	-	-	-	-	-.183	-.186
Lon.	-	-	-	-	-	-	-	-	-	-	.098

Level of significance: *P<0.05, ** P<0.01.

Variables: Fruit L. = Fruit length, Fruit W.=Fruit width, Seed L.=Seed Length, Seed W.=Seed width, Seed Wt. = Seed Weight, G.%=Germination per cent, RL.= Length of radicle, PL= Length of Plumule, Lat = latitude, Lon = longitude, Alt= Altitude.