Print : ISSN 0970 – 7662
Online : ISSN 2455 – 7129

Journal of Tree Sciences

online available at www.ists.in

Volume 38 No. 2 December, 2019

Effect of Seed Size on Seed Germination and Seedling Vigour Index of *Abies spectabilis* (D.Don) Spach

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DOI: 10.5958/2455-7129.2019.00015.3

ABSTRACT

Germination trial was conducted to study the effect of seed size on germination behaviour and seedling vigour index of *Abies spectabilis* - an important high altitude conifer of Western Himalayan. The seeds of *A. spectabilis* collected from Kalabagh forest in Shimla district (H. P.) were segregated into three different seed size classes *viz.*, small (6 mm – 7 mm x 3 mm – 4 mm), medium (7 mm – 8 mm x 4 mm – 5 mm) and large (> 8 mm x > 5 mm). Maximum germination40.50% was recorded in large seeds and minimum of 12.00% in small seeds. Maximum germination capacity 42.75% was recorded in large seeds which is significantly better than 17.00% which was recorded in small seeds. The highest seedling vigour index of 354.05 was recorded in large seeds followed by 253.79 in medium seeds and minimum of 72.17was recorded in small seeds in a decreasing order. Hence, the study concluded that seeds of *A. spectabilis* should be segregated after their collection from the field on the basis of size and only large seeds having size >8mm x >5mm should be use for getting better germination and vigorous growth of seedlings in the nursery.

Key Words:

Abies spectabilis, Germination per cent, Germination capacity, Seedling vigour index

INTRODUCTION

Abies spectabilis (D. Don) Spach *syn. Abies webbiana* Lindl.is one of the ecologically important conifer of higher temperate regions of Western Himalaya. It belongs to the family Pinaceae. It is commonly known as '*Talispatra*'. It is found in India, Afghanistan, Bhutan and Nepal. In India, it is found in the Western- Himalayan states of Himachal Pradesh, Jammu & Kashmir, Uttarakhand and North-East India at altitudes of 2800 m - 4000 m above msl. As far as state of Himachal Pradesh is concerned, it is mainly distributed in Kinnaur, Shimla and Kullu districts at elevations ranging from 3000m-4000m above msl. It is a pyramidal tree and grows up to a height of 40-50 m. The crown is broadly conical with horizontally spreading

branches. The bark is dark gray, rough and scaly. The needles are 2-4 cm long. The cones are cylindrical, violet-purple when young and turn brown in colour on maturity (Vidakovic 1991). It resembles *Abies pindrow* but usually more stunted and gnarled, with leaves 0.5 - 1" long densely covering the upper side of the twigs. The young shoots have short brown hairs. The cones are shorter and thicker than *Abies pindrow* (Troup 1921). It grows in moist and cool areas having mostly acidic soil condition.

It commonly occurs as a canopy dominant species in wet forest accompanied by *Rhododendron campanulatum*, *R. lepidotum* and *R. anthopogon* as well as *Betula utilis* (Chhetri 2008).

Talispatra is well known for its medicinal value and is commonly used in Indian system of medicine especially in Ayurvedic system for preparing different medicines. The leaves are astringent, carminative, expectorant, stomachic and tonic. The leaf juice is used in the treatment of asthma and bronchitis (Chopra *et al.,* 1986). An essential oil obtained from the leaves is used to treat cold, rheumatism and nasal congestion (Manandhar 2002).Natural regeneration of this species in its zone of occurrence is very poor, owing to many biotic and abiotic factors. The seed germination is often poor, usually taking about 6 – 8 weeks in the nursery. The seeding does not occur frequently in this conifer and good seed year occurs less frequently. Keeping in view the importance of this species in its zone of occurrence, the present study was conducted to study the effect of seed size on germination behaviour and seedling vigour index of *Abies spectabilis* under laboratory condition.

MATERIALS AND METHODS

The cones of *A. spectabilis* were collected from the natural forests in Kalabagh near Churdhar area of Shimla district (H.P.) situated at $30^0$52' 40.1"N latitude and $77^0$29'40.0"E longitude at an elevation of 3,158m above msl. The cones were collected directly from the trees during second fortnight of October, 2015 and packed in the paper bag and brought to the Seed laboratory of Himalayan Forest Research Institute, Shimla. The cones were spread on the ground for two weeks period in the laboratory for shade drying and subsequently seeds were separated from the cones manually. The dried seeds were separated from the impurities with the help of seed blowers and segregated on the basis of seed size. The seeds of *A. spectabilis* were categorized into three seed sizes and subjected to germination test.

The treatments used in the experiments were:

T_1: Small (6mm -7mm x 3mm - 4mm)
T_2: Medium (7mm - 8mm x 4mm - 5mm)
T_3: Large (>8mm x >5mm)

300 seeds per treatment were sown on sterilized filter paper in petri dishes in a lot of 50 seeds per replication using completely randomized design with six replications in a seed germinator at 20^oC. The filter paper containing seeds were irrigated as and when required. The seeds were then allowed to germinate. The seed germination was noticed when radicle emerged having 0.5cm length. The germination count was taken daily after the commencement of germination until it was over and stable germination was obtained. The total germination percentage was calculated at the end of the experiment. To ascertain effectiveness of different seed size classes on germination behaviour, the final seedling count was considered. The total germination per cent was determined as per the procedure prescribed by International Seed Testing Association (ISTA 1985) at the end of the experiment.

Germination Percent =

$$\frac{\text{No. of seeds germinated}}{\text{Total no. of seeds sown}} \times 100$$

After completion of germination test, seeds which were not germinated were tested through cutting test whether they are viable (filled) or empty. The per cent

number of viable and empty seeds of each replication was counted and germination capacity was calculated by following methods:

Germination Capacity =

Germination Percent + number of viable seeds after cutting test

After one month, ten seedlings from each replication of all the treatments were randomly selected and measured for total seedling height. Seedling vigour index (SVI) was derived by multiplying per cent germination with total seedling height in centimeter (Abdul-Baki and Anderson 1973).

Seedling Vigour Index =

Germination Percent x Average Seedling Height (cm)

The data of germination percent, total seedling height and seedling vigour index thus obtained were subjected to analysis of variance (ANOVA) to establish the significance of differences between the treatments. The critical difference (CD) was calculated for the variables studied using a computer program "SX"-a statistical package for agricultural sciences.

RESULTS AND DISCUSSION

The results of the germination percentage, germination capacity, average seedling height and seedling vigour index as affected by different seed sizes in *A. spectabilis* seeds have been given in Table 1. The effect of different seed size on seed germination, seedling height and seedling vigour index were evaluated based upon their comparative effects. Perusal of data from the Table 1 reveals that seed size affects seed germination of *A. spectabilis* seed significantly under laboratory condition. The maximum germination of 40.50 % was recorded in large sized seeds (T_3) which was significantly better than germination percent of 32.50% recorded in medium sized seeds (T_2) and minimum germination of 12.00% recorded in smaller seed size (T_1).

Presence of empty seeds varied significantly among different seed size classes. Maximum number of empty seeds (83%) was recorded in small sized seeds (T_1)followed by medium sized seeds (T_2) having 66% empty seeds and minimum number of empty seeds(57.25%) was recorded in large sized seeds(T_3) respectively in a decreasing order. The large number of empty seeds in small seeds may be duty to non-existence or underdeveloped embryo as well as absence of storage food material. The presence of empty seeds has also been reported in *A. spectabilis* (Negi and Sharma 2019) and in *Abies balsamea* Fye and Wylie 1968).

The germination capacity also varied significantly among different treatments/seed sizes. The maximum germination capacity of 42.75% was recorded in large sized seeds (T_3) which was significant better than germination capacity of 34.00% recorded in medium sized seeds (T_2) and minimum germination capacity of 17.00% recorded in small sized seeds (T_1).

The average seedling height also varied significantly among different seed sizes. The maximum seedling height of 8.74 cm was recorded in large sized seed (T_3) followed by medium sized seeds (T_2) having seedling height of 7.87 cm and minimum seedling height of 6.05 cm was recorded in small sized seeds (T_1) respectively in a decreasing order.

The seedling vigour index (SVI) also varied significantly among different seed sizes. The maximum seedling vigour index of 354.05 was recorded in large sized seeds (T_3) followed by medium sized seeds (T_2) having seedling vigour index of 253.79 and minimum seedling vigour index of 72.17was recorded in small sized seeds (T_1) respectively in a decreasing order.

The role of seed size, seed weight and grading in improving seed germination is also observed in many other forestry species *viz., Picea smithiana* (Singh et al. 1990), *Pinus roxburghii* (Chauhan and Raina 1980) *Bauhinia variegata* (Bhardwaj et al. 1986), *Alangium lamarckii* (Ahirwar

2012), *Q. dilatata* (Singh 1998), *Aesculus indica* (Bhagat et al. 1993) and *Dioscoreophyllum cumminsii* (Toluloppe et al. 2016) and also in broad leaved species like Sterculia (Bhuva et al. 2019), *Albizia lebbeck* (Bhardwaj et al. 2002), *Albizia procera (*Shukla et al. 2007), *A. chinensis* (Bhardwaj et al. 2002) *etc.* The empty seeds percent also varied significantly among different seed sizes.

CONCLUSION

The findings of the present investigation reveals that seeds of *A. spectabilis* should be segregated on the basis of seed size after their collection from the field and only seeds having size >8mm x 5 mm should be used for getting better germination and vigorous growth of seedlings in the nursery.

ACKNOWLEDGEMENTS

The authors are thankful to the Director, Himalayan Forest Research Institute, Shimla for providing necessary facilities and Indian Council of Forestry Research & Education, Dehradun for giving financial support.

Table 1. Effect of Seed Size on Germination Parameters and Seedling Vigour Index of *Abies spectabilis* seeds.

Seed Sizes	Germination (%)	Viable Seeds (%)	Empty Seeds (%)	Germination capacity (%)	Seedling Height (cm)	Seedling Vigor Index
Small Size (T_1)	12.00	5.00	83.00	17.00	6.05	72.17
Medium Size (T_2)	32.50	1.50	66.00	34.00	7.87	253.79
Large Size (T_3)	40.50	2.25	57.25	42.75	8.74	354.05
S. Em. ±	3.05	0.99	3.32	3.32	0.30	19.60
CD value at 5% level	6.91	2.25	7.52	7.52	0.67	44.35

Small Seed Medium Seed Large Seed

Fig. 1. Seed Size Variation in *A. spectabilis*

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