



Effect of Seed Source on Germination Parameters and Seedling Vigor Index of *Oroxylum indicum* (L.) Kurtz

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Abstract: A germination study was conducted to evaluate the effect of different seed sources on germination parameters and seedling vigor of *Oroxylum indicum* seeds under laboratory conditions. Significant differences were observed in various germination parameters, moisture content, seed weight, seedling length and seedling vigor index of seeds collected from five different sources in Himachal Pradesh. The maximum germination per cent (100%), mean daily germination (2.17% and 2.08%), peak value (0.67 and 0.63), germination value (1.47 and 1.31), germination speed (3.96 and 3.89), seedling length (6.14 cm and 5.71 cm) and seedling vigor index (614.00 and 571.00) was recorded in seeds collected from the Dhamtal and Jheol seed sources. Like wise the minimum germination per cent (87.25%), mean daily germination (1.74%), peak value (0.60), germination value (1.04), Germination speed (3.39), seedling length (4.76 cm) and seedling vigor index (415.31) was recorded in seeds collected from the Behran seed source. The maximum moisture content (7.02%) was recorded in seeds collected from Behran whereas the minimum moisture content (5.93%) was recorded in seeds collected from the Jalari seed source. The maximum value of 100 seed weight (8.50 g) was recorded in seeds collected from the Dhamtal whereas the minimum value of 100 seed weight (8.23 g) seeds was recorded in seeds collected from the Behran seed source. Similarly, a maximum seedling length (6.14 cm) and seedling vigor index (614.00) were also recorded in seeds collected from Dhamtal whereas a minimum seedling length (4.76 cm) and seedling vigor index (415.31) was recorded from seeds collected from the Behran seed source. The present investigation revealed that the seeds of *O. indicum* collected from the Dhamtal and Jheol seed source in the Kangra district can be used for better germination and raising nursery stock for its plantation in the lower belt of Himachal Pradesh.

Key words: Seed Source, germination percent, moisture content, seed weight.

Oroxylum indicum (L.) Kurtz is a medico-socio-culturally important plant species native to Indian Sub-continent. It is commonly called as "Indian Trumpet Tree" or "Indian Trumpet

Flower” and is locally known by various names viz., Shyonak, Sonapatha, Arlu, Ullu, and Tatpalanga, particularly in the North-West Himalayan region. It is a small to medium-sized deciduous tree reaching a height of up to 12 meters. It is distributed in India extending to Bhutan, Nepal, South China, Malaysia, Vietnam etc. In North-West India, it grows naturally in the foothills of Himachal Pradesh, Uttarakhand, and Jammu & Kashmir UT at an altitude of 300m-1200 m above msl. It grows in association with *Pinus roxburghii*, *Ficus palmata*, *F. roxburghii*, *Morus serrata*, *M. alba*, *Bombax ceiba*, *Rosa moschata*, etc. It is a light demander and grows well in exposed conditions. It flowers during June- July and the pods mature during February-March. The dried seeds with papery wings are used by the Kinnaura tribes of Himachal Pradesh extensively for making floral heads locally called “Chamaka” which are stitched on the famous “Kinnaur Cap” and are worn by the local communities during various fairs and festivals organized by them in Kinnaur district. The pods are collected from the lower belt of Himachal and sold in markets by the local communities to supplement their additional income in the Kinnaur district of Himachal Pradesh.

It is also an important medicinal plant that has been widely used in the preparation of different types of ayurvedic formulations for curing the various ailments of human beings since ancient times. It belongs to the family Bignoniaceae. In Himachal Pradesh, its distribution is sporadic in Una, Hamirpur, Kullu, Kangra, Chamba, Mandi, Bilaspur, Solan, and Sirmour districts up to an altitude of 1200 m above msl. (Chauhan, 1999). The bark, roots, leaves, seeds, stems, and fruits are used in the preparation of various formulations in the Ayurvedic system of medicine for the treatment of diarrhoea, dysentery, otorrhoea, ulcer, headache, enlarged spleen and rheumatism (Anon, 1966). The seeds are used in the traditional Indian system of medicine especially Ayurvedic and Chinese medicines for curing various human ailments (Harminder and Chaudhary, 2011). The root bark of *O. indicum* is one of the active ingredients of Dashmoola which possesses anti-inflammatory, anti-helminthic, anti-bronchitis, anti-leukodermatic, antirheumatic, and, anti-anorexic activity (Manonmani *et al.*, 1995; Doshi *et al.*, 2012; Bhattacharjee, 2000).

Seed sources play a significant role in the production of quality seedlings in nurseries. The seeds collected from the elite seed sources will lead to improved germination percentage and ensure the production of uniform and quality seedlings in the nursery. In order to raise quality seedlings, the use of seeds from identified seed sources is always preferred by nursery managers all over the world. The seed sources of *O. indicum* have not yet been evaluated and identified in Himachal Pradesh. Therefore, the present study is carried out to screen the best seed source of *O. indicum* for better germination and production of quality planting stock.

Materials and Methods

The pods of *Oroxylum indicum* were collected from five different seed sources in Himachal Pradesh in February, 2022 and packed in Jute bags. The seed sources were selected based on superior phenotypic characteristics viz., straightness, healthiness, diseased-free trees and availability of seed-bearing pods in respective seed sources. The geographical coordinates of five seed sources viz., altitude, latitude and longitude were recorded. The maximum temperature of the sites from where seeds were collected goes up to 44°C during the summer and the minimum temperature goes down to 2°C during the winter. The average annual rainfall ranged from 1200 mm to 1500 mm. The natural vegetation of each site is represented by sub-tropical vegetation type. The soil was sandy loam. The seed-bearing pods were collected from medium-sized mother trees of 8-10 m in height and 30-40 cm GBH. The mature seeds were extracted from the pods manually and dried in shade conditions. Eight replications of 100 seeds each were weighed in the analytical balance to obtain 100 seed weights. The moisture content of the seeds was determined by placing the seeds in an oven at $103 \pm 2^\circ\text{C}$ for 17 hours (ISTA, 1985 and 2010). The details of seeds collected from five seed sources from Una, Hamirpur, Kangra and Bilaspur districts of Himachal Pradesh along with geo-coordinates were given in Table 1.

The seeds collected from different seed sources were considered as treatments and were subjected to germination testing after overnight soaking in water to study the effect

Table 1. Geo-coordinates of seed sources of *Oroxylum indicum* in Himachal Pradesh

Name of seed source	District	Altitude (m)	Latitude (N)	Longitude (E)
Kinnu	Una	730	31°46'21.20"	76° 06' 47.15"
Jalari	Hamirpur	524	31°46'31.07"	76° 21' 12.10"
Jheol	Kangra	1007	32°08' 52.02"	76° 20' 54.79"
Dhamtal	Kangra	372	32°45' 04"	75° 40' 04"
Behran	Bilaspur	693	31°22' 27.12"	76° 38' 45.67"

of seed sources on germination behavior as per ISTA rules (2010).

Germination test

200 seeds from each seed source were sown on the thick moist filter paper placed above the cotton in Petri dishes, in a lot of 50 seeds per replication were tested on a completely randomized design with four replications per treatment as per ISTA rules (1985 and 2010). The Petri dishes with seeds were kept in the seed germinator and temperature was maintained at 20° C. Watering was done as and when required. Seed germination was recorded after the emergence of radicle from the seed. The germination data was taken daily after the commencement of germination until constant value of germination was obtained. The germination started after 7th days of seed sowing and culminated within a month. To evaluate the effect of different seed sources on various germination parameters viz., germination percentage (GP), mean daily germination (MDG), peak value (PV), germination value (GV), germination speed (GS) and germination energy (GE), the final seedling count was considered. The total germination percentage was calculated at the end of the experiments.

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

The Mean daily germination (MDG) was calculated as the cumulative percentage of all the seeds germinated at the end of the test divided by the number of days from sowing to the end of the test.

$$\text{Mean daily germination} = \frac{\text{Cumulative per cent of seed germinated at the end of the test}}{\text{Days since sowing to the end of the test}}$$

The Peak value (PV) was calculated as the maximum mean daily germination reached at

any time during the period of the test (Czabator, 1962).

$$\text{Peak Value} = \frac{\text{Cumulative germination per cent}}{\text{Days since sown}}$$

Germination energy (GE) was calculated as the percentage of the number of seeds in a given sample which germinate up to the time of peak germination (William, 1985). Germination speed (GS) was calculated as per the method given by Panwar and Bhardwaj (2007).

$$\text{Germination Speed} = \sum_{i=1}^n (n/t)$$

where, n = no. of newly germinated seed at time t; t = no. of days since sowing

After one month of seed germination, ten seedlings from each replication of all the treatments were randomly selected and measured for total seedling length. Seedling vigor was calculated as per (Abdul-Baki and Anderson, 1973)

$$\text{Seedling Vigor Index} = \frac{\text{Germination per cent} \times \text{Total seedling length (cm)}}{\text{seedling length (cm)}}$$

The data of moisture content, 100 seed weight, germination per cent, mean daily germination (MDG), peak value (PV), germination value (GV), germination energy (GE), germination speed (GS), total seedling length and seedling vigor index were subjected to one-way analysis of variance (ANOVA) to establish the significance of differences between the treatments ($p \leq 0.05$) by Duncan's test using SPSS software.

Results and Discussion

A perusal of data from Table 2 revealed that moisture content and 100 seed weight of *Oroxylum indicum* seeds collected from different seed sources in Himachal Pradesh varied significantly.

The maximum moisture content (7.02%) was recorded in seeds collected from the Behran seed source followed by seeds collected from

Table 2. Moisture Content and Seed Weight of *Oroxylum indicum* as affected by different Seed Sources in Himachal Pradesh

Name of seed source	Moisture content (%)	100 seed weight (g)
Kinnu	6.01 ^b	8.28 ^{bc}
Jalari	5.93 ^b	8.34 ^b
Jheol	6.18 ^b	8.47 ^a
Dhamtal	5.98 ^b	8.50 ^a
Behran	7.02 ^a	8.23 ^c
(p≤0.05)	0.035	<.0001
S.Em ±	0.37	0.03
C. D. Value at 5% Level	0.78	0.06

Note: Mean with the same letters are not significantly different @5% level of significance

the Jheol (6.01%), Kinnu (5.98%) and Dhamtal (5.98%) seed sources, whereas minimum (5.93%) moisture content was recorded in seeds collected from Jalari in Hamirpur district of Himachal Pradesh. The 100 seed weights varied significantly among the different seed sources. The maximum 100 seed weight (8.50 g) was recorded in seeds collected from the Dhamtal followed by the Jheol (8.47 g), Jalari (8.34 g) and Kinnu (8.28 g) seed sources, whereas the minimum 100 seed weight (8.23 g) was recorded in seeds collected from Behran in Bilaspur district of Himachal Pradesh.

A perusal of data from Table 3 revealed that seed sources significantly influenced the various germination parameters, seedling length and seedling vigor index of *O. indicum* for seeds collected from different seed sources in Himachal Pradesh. The germination percentage of seeds collected from different seed sources varied significantly from 87.25 to 100.00% (p<0.05). The maximum 100.00% germination was recorded in seeds collected from the Dhamtal and Jheol seed sources in

the Kangra district and are statistically at par with each other but significantly better than all other treatments. It was subsequently followed by 96.33% germination in seeds collected from Kinnu in Una district and 95.20% in seeds collected from Jalari in Hamirpur district which are statistically at par with each other. The minimum germination (87.25%) was recorded in seeds collected from the Behran seed source in the Bilaspur district of Himachal Pradesh.

The maximum mean daily germination (2.17) was recorded in seeds collected from the Dhamtal followed by seeds collected from the Jheol (2.08), Kinnu (2.00) and Jalari (1.98) seed sources, whereas the minimum mean daily germination (1.74) was recorded in seeds collected from Behran seed source in Hamirpur district. The maximum peak value (0.67) was recorded in seeds collected from the Dhamtal seed sources followed by seeds collected from the Jheol and Kinnu seed sources (0.63) and Jalari seed source (0.61), whereas the minimum peak value (0.60) was recorded in seeds collected from Behran seed source in

Table 3. Germination parameters, seedling length and seedling vigor index of *Oroxylum indicum* as affected by different seed sources

Name of seed source	Germination (%)	MDG	Peak value	Germination value	Germination energy	Germination speed	Seedling length (cm)	Seedling vigor index
Kinnu	96.33 ^b	2.00 ^c	0.63 ^{ab}	1.27 ^{bc}	54.50 ^a	3.78 ^{bc}	5.84 ^a	562.56 ^b
Jalari	95.20 ^b	1.98 ^c	0.61 ^b	1.17 ^c	65.50 ^a	3.70 ^c	5.68 ^a	540.74 ^b
Jheol	100.00 ^a	2.08 ^b	0.63 ^{ab}	1.31 ^b	63.50 ^a	3.89 ^{ab}	5.71 ^a	571.00 ^b
Dhamtal	100.00 ^a	2.17 ^a	0.67 ^a	1.47 ^a	57.50	3.96 ^a	6.14 ^a	614.00 ^a
Behran	87.25 ^c	1.74 ^d	0.60 ^b	1.04 ^d	59.00 ^a	3.39 ^d	4.76 ^b	415.31 ^c
(p≤0.05)	<.0001	<.0001	0.154	<.0001	0.399	<.0001	<.0001	<.0001
S.Em ±	1.36	0.02	0.03	0.06	6.02	0.07	0.21	17.65
CD value at 5% level	2.89	0.04	0.06	0.12	13.12	0.16	0.44	37.61

Note: Mean with the same letters are not significantly different @5% level of significance

Bilaspur district. The maximum germination value (1.47) was recorded in seeds collected from the Dhamtal followed by seeds collected from the Jheol (1.31), Kinnu (1.27) and Jalari (1.17) seed sources, whereas the minimum germination value (1.04) was recorded in seeds collected from Behran seed source in Bilaspur district.

The maximum value of germination energy (65.50%) was recorded in seeds collected from the Jalari followed by Jheol (63.50%), Behran (59%) and Dhamtal (57.50%) seed sources, whereas the minimum germination value (54.50%) was recorded in seeds collected from Kinnu seed source in Una district. The maximum germination speed (3.96%) was recorded in seeds collected from the Dhamtal followed by seeds collected from the Jheol (3.89%), Kinnu (3.78%) and Jalari (3.70%) seed sources, whereas the minimum germination speed (3.39%) was recorded in seeds collected from Behran seed source in Bilaspur district.

The average seedling length also varied significantly among the seeds collected from different seed sources. The maximum seedling length (6.14 cm) was recorded in seeds collected from Dhamtal followed by Kinnu (5.84 cm), Jheol (5.71cm) and Jalari (5.68 cm) whereas minimum seedling length (4.76 cm) was recorded in seeds collected from Behran seed source. Significant differences were also observed in the seedling vigor index (SVI). The maximum seedling vigor index (614.00) was recorded in seeds collected from Dhamtal and was significantly better than all other treatments. It was subsequently followed by the Jheol (571.00), Kinnu (562.56) and Jalari (540.74) seed sources. These are statistically at par with each other but significantly better than the seedling vigor index of 415.31 recorded in Behran seed source which recorded minimum seedling vigor index.

The findings revealed that seeds collected from the Dhamtal and Jheol seed sources in the Kangra district of Himachal Pradesh are the best seed sources having maximum values of various germination parameters viz., germination per cent (100%), mean daily germination (2.17% and 2.08%), peak value (0.67 and 0.63), germination value (1.47 and 1.31), germination speed (3.96 and 3.89), seedling length (6.14 cm and 5.71cm) and seedling vigor index (614.00 and 571.00)

respectively. The seeds collected from Dhamtal and Jheol seed sources also possessed the maximum weights of 100 seeds (8.50 g and 8.47 g) which may have contributed in getting the highest values of various germination parameters, seedling length and seedling vigor index. The role of seed size and seed weight in improving seed germination is also reported in other forestry species viz., *Pinus roxburghii* (Chauhan and Raina, 1980), *Bauhinia variegata* (Bhardwaj et al., 1986), *Picea smithiana* (Singh et al., 1990), *Aesculus indica* (Bhagat et al., 1993), *Quercus dilatata* (Singh, 1998), *Alangium lamarckii* (Ahirwar, 2012), *Dioscoreophyllum cumminsii* (Tolulope et al., 2016) and *Abies spectabilis* (Negi and Sharma, 2019).

The results of the present investigations also confirm with the earlier studies undertaken on various forestry species viz., *Grewia oppositifolia* (Uniyal et al. (2002), *Celtis australis* (Singh et al. 2004), *Pinus wallichiana* (Thapliyal et al., 2008; Rawat and Bakshi, 2011), where significant variation was observed in germination per cent of seeds collected from different seed sources. Significant differences were observed in germination per cent of seeds of *Khaya senegalensis* collected from different locations (Kuje et al., 2019). Further, significant variations were also observed in germination and seedling growth parameters of *Pongamia pinnata* (Patil et al., 2011), *Madhuca latifolia* (Nayak and Sahoo 2020), *Pinus sylvestris* (Batkhuu et al., 2020), *Betula utilis* (Sofi et al., 2020) and *Pinus gerardiana* seeds (Negi et al., 2022) collected from different seed sources/provenances.

Conclusions

The result of the present investigations revealed that seeds of *Oroxylum indicum* collected from the Dhamtal and Jheol seed sources in the Kangra district performed better among the studied seed sources under laboratory conditions. Hence, seeds of *Oroxylum indicum* should preferably be collected from Dhamtal and Jheol seed sources for getting better germination and raising quality nursery stock as the current study is an indicator of screening of seed sources based on laboratory studies of seeds only.

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