

DOI No.: <http://doi.org/10.53550/EEC.2022.v28i07s.067>

Determination of Suitable Pre-sowing Seed Treatments and Fertilizer Doses for Mass Production of Quality Nursery Stock of *Oroxylum indicum*

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(Received 5 April, 2022; Accepted 27 June, 2022)

ABSTRACT

Oroxylum indicum, commonly known as 'Shyonak', Shivnak' or 'Indian trumpet flower', is an important medicinal tree found in India and South East Asia. Various parts of this tree possess immense medicinal properties, which are utilized to cure various diseases. Being highly valuable source of medicinal formulations, this tree is overexploited and is listed as vulnerable and endangered in several parts of India. So, there is an urgent need for conservation of this species through mass multiplication. With the objective to produce good quality nursery stock of *Oroxylum indicum*, the present study was conducted to test the effect of different pre-sowing seeds treatments on seed germination along with the effect of different fertilizer doses for production of good quality seedlings in the nursery. The study revealed that treatment of soaking seeds in water for twelve hours resulted in highest germination per cent (64.44%) and also exhibited better growth parameters of the seedlings than that in the control. Effect of different fertilizers viz. Neem coated urea, Potassium Nitrate, Calcium nitrate and Ammonium Sulphate was studied on the seedlings, where the highest growth (21.42% increase in height) was recorded in application of Neem coated urea at a dose of 3.5 g/l.

Key words : Pre-sowing seed treatment, *Oroxylum indicum*, Germination, Fertilizer doses, Nursery studies

Introduction

Oroxylum indicum (L.) Kurz., commonly known as 'Shyonak', 'Soanpatha' or 'Indian trumpet flower', belonging to the Bignoniaceae family and is a widely used species in the 'Ayurveda' medicine system for the treatment of various ailments. It is a small to medium sized, soft-wooded, deciduous tree which attains a height of up to 12 metres. *Oroxylum indicum* grows in India, Sri Lanka, South China, Philippines, Celebs and Malaysia. In India, it is distributed throughout the country, except in the western drier area, up to an altitude of 1200 m and mainly in ravine and moist places in the forests (Chauhan,

2006). This tree is valued for its anti-microbial, anti-arthritic, anti-cancerous and anti-hepatatic qualities in its various parts. Root extracts from this tree have been used for long in ayurvedic preparations like Dashmularisht and Chyawanprash (Yashoda *et al.*, 2004; Chen *et al.*, 2003). Many secondary metabolites like flavonoids, glycosides, alkaloids, tannins, terpenoids, etc., have been reported from this tree. The phytochemical screening of crude extracts from seeds, stem bark and root of *Oroxylum indicum* showed the presence of bioactive substances that can be used in prevention of major diseases (Darshan and Ved, 2003). *Oroxylum indicum* was distributed throughout the great parts of India but now

it is listed amongst endangered species in many areas in the country (Najar and Ahnihotri, 2012) and as vulnerable in Karnataka and Andhra Pradesh (Darshan and Ved, 2003). Destructive and non-sustainable collection methods such as uprooting the whole of the tree along with the roots for medicinal purposes, coupled with low regeneration and habitat destruction have posed serious threat to the survival and availability of this highly useful tree (Yashoda *et al.*, 2004). Very little effort has been made to conserve this species, so, its conservation has become an immediate need of the country. The seed set of this tree is poor and the seed viability is also low (Tiwari *et al.*, 2007). Proper nursery growing techniques are not available for this species and its cultivation is also not being followed at a large scale by farmers as well as by government agencies. So, with the main objective of standardizing the technique of good quality nursery stock of *Oroxylum indicum*, the present study was conducted to test the effect of different pre-sowing seed treatments on seed germination; and response of its seedlings to different fertilizers.

Materials and Methods

The research experiments were carried out in the Himalayan Forest Research Institute Nursery, Bir Palasi, Nalagarh, Distt Solan (H.P.). The pods of *Oroxylum indicum* were collected from healthy, vigorous mature and disease free trees before splitting of the pods during February-March from Herbal Garden, Jogindernagar, District Mandi (H.P.) The pods were split open and the seeds were extracted. These seeds were subjected to the following pre-sowing seed treatments:

- T₁: Control- The seeds were sown without any treatment
- T₂: Overnight soaking of seeds in water- The seeds were soaked in a beaker full of water at room temperature for 12 hours.
- T₃: Soaking of seeds in warm water- The seeds were soaked in warm water having temperature of 80 °C. The seeds were soaked till the water cooled down to room temperature (for approximately 15-20 minutes) and were taken out.
- T₄: Treating seeds with boiling water 1- The water was boiled to 100 °C and the seeds were placed in the boiling water for 1 minute
- T₅: Treating seeds with boiling water 2- The water was boiled to 100 °C and the seeds were placed

in the boiling water for 2 minutes.

- T₆: Cold stratification: The seeds were kept in wet thick cotton bag and were placed in refrigerator for one day.

The treated seeds were then sown in Completely Randomized Design with four replications having fifty seeds in each replication. Under the germination study, the number of days taken from sowing to start of emergence in and germination percentage (%) of the seeds was observed. The germination percentage was calculated using the following formula:

$$\text{Germination percentage (\%)} = \frac{\text{No. of seeds germinated}}{\text{No. of seed sown}} \times 100$$

In addition to this, observations on other growth parameters such as root length (cm), shoot length (cm), collar diameter (mm), and plant weight (g) were also recorded. These growth performance parameters were studied by taking ten seedlings from each replication of all the treatments after three months of sowing. The data thus obtained were subjected to analysis of variance and the critical difference (CD) was calculated at significance level of P=0.05. The data recorded were analyzed using ANOVA.

For determining the best suitable fertilizer treatment for production of healthy and vigorous seedlings, the seedlings having almost same height were selected. The initial height of the seedlings was recorded and 50 ml fertilizer solution as per the treatments mentioned below was applied per seedling:

- T₁: Control
- T₂: Neem coated urea @ 1.5 g/litre
- T₃: Neem coated urea @ 2.5 g/litre
- T₄: Neem coated urea @ 3.5 g/litre
- T₅: Potassium Nitrate @ 1.5 g/litre
- T₆: Potassium Nitrate @ 2.5 g/litre
- T₇: Potassium Nitrate @ 3.5 g/litre
- T₈: Calcium nitrate @ 2 g/litre
- T₉: Calcium nitrate @ 3 g/litre
- T₁₀: Calcium nitrate @ 4 g/litre
- T₁₁: Ammonium Sulphate @ 1 g/litre
- T₁₂: Ammonium Sulphate @ 2.5 g/litre
- T₁₃: Ammonium Sulphate @ 4 g/litre

The fertilizer application was done at one week interval for eight weeks and the final height of the seedlings was recorded. To study the growth of the seedlings, increase in height was calculated by subtracting the initial height from the final height. The percent increase in height was also calculated. The experiment was laid out in CRD with 4 replications

having 50 seedlings per replication. The statistical analysis of the data was done using ANOVA.

Results

Pre-sowing seed treatments: The results from the experiments revealed that the pre sowing seed treatments had a significant effect on the seed germination and subsequent seedling growth in *Oroxylum indicum*. The results obtained are presented in Table 1. It was observed that the treatment T2 (Treatment in which seeds were soaked in water at room temperature for 12 hours) resulted in fastest germination (9.5 DAS) and highest germination percentage (64.44 %), which was found to be significantly higher than those in control (14.25 days for emergence and 42.80% germination percent). This was followed by the treatment T3, i.e. warm water treatment, where seeds were soaked in warm water having temperature of 80 °C (9.75 days for emergence and 58.89 % Germination percentage). The maximum number of days taken for starting of emergence of seeds was taken by the control (14.25 DAS) i.e. the untreated seeds. Boiling water treatment of the seeds for 1 minute also resulted in faster (11.50 DAS) and higher germination (44.44%) than in the control plots. The least germination percentage was observed in T5, i.e. treatment of seeds in boiling water for 2 minutes (37.78%), however the number of days taken to first emergence (10.50 DAS) was lower than the control. The cold stratification treatment of the seeds also resulted in higher germination than the control, however the difference was not found to be statistically significant. The root length and collar diameter was recorded to be highest in the seedlings produced from the seeds treated with warm water.

The shoot length and plant weight was found to be highest in seedling produced from seeds soaked overnight in water. The root:shoot ratio ranged from 0.84 in T5 to 1.264 in T3. The survival percentage the seedling in all the treatments was observed to be between 80.4 % and 97.64%.

Fertilizer treatments: The different fertilizers also had a significant effect on the growth of *Oroxylum indicum* seedlings in nursery. The observations recorded on the initial and final height, increase in height of the seedlings, percent increase in height, and survival of the seedlings in the nursery are presented in Table 2. The results revealed that maximum increase in height of the seedlings was observed in T4, i.e. Neem coated urea at a dose of 3.5 g/l followed by T3, i.e. Neem coated urea at 2.5 g/l (5.925 cm) and T2, i.e. Neem coated Urea @1.5 g/l (5.825 cm). These treatments were found to be significantly effective in increasing the seedling height as compared to the control (4.20 cm) and all the other treatments. The lowest increase in seedling height was recorded in T1, i.e. control (4.20 cm) and T6, i.e. 4g/l Ammonium sulphate (4.775 cm). Highest percent increase in height of the seedlings was observed in T4 (21.42%) and least in T1 (14.643%). The survival was found to be highest in T2, i.e. Neem coated urea @ 1.5 g /l (95.00%) and lowest in T8, i.e. Calcium nitrate at the dose of 2 g/l (89.165%). The effect of the treatments on survival of the seedlings was not statistically significant.

Discussion

It can thus be interpreted from the current experiments that the treatments of soaking of seeds in water for 12 hours and soaking of seeds in warm

Table 1. Effect of pre –sowing water treatments on germination of *Oroxylum indicum* seeds

Treatments	Days to first emergence (DAS)	Germination percentage (%)	Root length (cm)	Shoot Length (cm)	Collar diameter (mm)	Plant wt (g)	Root: Shoot ratio	Survival %
T ₁	14.25	42.80	14.19	11.57	2.87	8.09	1.227	87.17
T ₂	9.50	64.44	18.98	15.41	3.87	21.89	1.233	91.38
T ₃	9.75	58.89	19.43	15.36	4.06	16.23	1.264	86.31
T ₄	11.50	44.44	17.37	15.12	3.89	14.37	1.148	91.04
T ₅	10.50	37.78	11.50	13.79	3.42	11.95	0.84	80.4
T ₆	12.50	46.68	18.13	11.5	3.47	9.47	1.567	84.95
CD (0.05)	1.836	8.898	5.060	1.959	0.728	5.986	0.326	NS

* CD= Critical Difference, NS= Non Significant, DAS= Days after sowing

Table 2. Effect of fertilizers on *Oroxylum indicum* seedling growth

Treatments	Initial Height (cm)	Final Height (cm)	Increase in height (cm)	Percent increase in height (%)	Survival (%)
T ₁	28.698	32.898	4.200	14.643	90.833
T ₂	28.600	34.425	5.825	20.365	95.000
T ₃	29.030	34.955	5.925	20.415	93.333
T ₄	28.658	34.783	6.125	21.420	90.833
T ₅	29.080	34.105	5.025	17.278	90.835
T ₆	28.688	33.463	4.775	16.648	94.168
T ₇	29.050	34.075	5.025	17.300	93.335
T ₈	29.163	34.463	5.300	18.178	89.165
T ₉	29.108	34.483	5.375	18.468	93.333
T ₁₀	28.858	33.958	5.100	17.68	92.500
T ₁₁	28.955	34.180	5.225	18.048	91.668
T ₁₂	29.080	34.280	5.200	17.898	90.833
T ₁₃	29.193	34.343	5.150	17.648	91.668
CD (0.05)	NS	0.871	0.358	1.365	NS

*CD= Critical Difference, NS= Non Significant

water (at a temperature of 80 °C) were found to be the best treatments for enhanced germination and seedling growth parameters. The faster germination may be attributed to the softening of the seed coat due to soaking of seeds in water, which ultimately enhances the germination. Earlier germination leads to better growth and thus, higher plant root length, shoot length, collar diameter and plant weight as compared to the seedlings produced from late germinated seeds. The treatment of seeds with boiling water for a short duration of time i.e. not more than 1 minute in *Oroxylum indicum* also resulted in enhanced germination. However, boiling water treatment for longer than 1 minute resulted in lower germination which could be mainly due to the damage of seed embryo caused by exposure to water at high temperature. It was also observed that the treatments did not have any significant effect on the survival of the seedlings and the mortality observed in the seedlings after germination can be attributed to the microclimatic conditions and physical factors such as heat stress, mechanical damage etc.

Similar results were obtained by various workers in many species. Hasnat *et al.* (2014) observed that soaking of seeds of Kusum (*Schleichera oleosa*) in water for 24 hours resulted in higher germination (42%) than the control, where germination was observed to be 25%. The seeds of *Berberis aristata*, that generally exhibit late, erratic and poor germination, resulted in 90% germination when soaked in water for 24 hours and compared to 69% germination in untreated control seeds (Thakur *et al.*, 2005). Similar

results were also reported by various other workers in many other difficult to germinate species *viz.* *Spartium junceum* (Travlos *et al.*, 2007), *Cryptocarya amygdalina* Nees. (Dey *et al.*, 2020) and *Terminalia chebula* (Hossain *et al.*, 2005), where soaking of seeds in water prior to sowing resulted in improved germination over the control.

Under the study of effect of fertilizers on seedling growth in *Oroxylum indicum*, there was no significant difference in the initial seedling height as the seedlings of similar height were selected for the study. However, a significant difference was observed in the seedlings treated with different fertilizers at different doses. The maximum final height was observed in application of 3.5g/l solution of Neem coated urea to the seedlings, which also recorded the maximum percent increase in seedling height (21.42%). Overall, higher growth was observed in treatments with neem coated urea at all tested doses (3.5g/l, 2.5 g/l and 1.5 g/l) than the control and all the other fertilizers. Similar results were obtained in different species such as *Cassia siamea* (Paliwal *et al.*, 1995), *Fraxinus angustifolia* (Cicek *et al.*, 2010); *Acer mono* (Razak *et al.*, 2017), *Glycine max* (Yagoub *et al.*, 2012) etc., where, application of Nitrogen to the seedlings significantly increased the growth of the seedlings.

Conclusion

From the present study, it can be concluded that overnight soaking of *Oroxylum indicum* seedlings for 12 hours can significantly enhance the seed germi-

nation and result in establishment of seedlings with better growth parameters. To further increase the growth of the seedlings, neem coated urea should be applied to the seedlings at a dose of 3.5 g/l. These results obtained can be recommended and utilized in large scale production of good quality nursery stock of *Oroxylum indicum*, which can ultimately help in conservation of this highly valuable tree species.

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