



Influence of Provenance Variation on Seedling Characteristics of *Celtis australis* in Nursery Environment

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Abstract: *Celtis australis* L. is a fast growing multipurpose tree species which is largely utilized for fodder, fuelwood, fruit and timber in the Himalaya. Therefore, in this study, the eleven provenances of *C. australis* were selected and tested in nursery environment to identify suitable seed source for plantation programme. The seed morphological parameters evaluated which showed that the seed length (8.80mm) in Kathua, and seed diameter (7.72mm) and 100 seed weight (21.06g) in Chamba provenance was greater compared to other provenances. Germination percentage was significantly higher in Chakrata provenance (68%) compared to other provenance and the lesser germination was in Shimla provenance (20%). In nursery environment, height (131cm) and collar diameter (12.80mm) growth was higher in Chakrata provenance and the minimum height (90cm) and collar diameter (5.46mm) growth was in Chamba and Shimla provenance. The total biomass production was higher (63.78g) in Chakrata and the lower (33.39g) in Shimla provenance. The overall Sum Rank Index confirmed the superiority of Chakrata provenance over other provenances in nursery environment. Therefore, provenance selection and testing have great potential to improve different characteristics of *C. australis* for higher growth and productivity.

Keywords: *Celtis australis*, Provenance, Germination, Seed, Growth, Biomass

Throughout the globe, multipurpose species are subjected to severe anthropogenic pressure making them less productive with large number species are threatened with extinction (Amagnide et al 2015). The indiscriminate harvest for fuelwood, fodder, timber and other uses have severely affected growth, quality and development of plants (Kumar et al 2014, Kumar et al 2016a). However, great success has been achieved in enhancing tree species productivity through different plant improvement techniques. Therefore, it is pertinent to assess the success of provenance selection on productivity of multipurpose tree species. The high biotic pressure, such as indiscriminate and unscientific logging and pruning have severely affected growth, development, quality (Kumar 2016b), biological diversity (Kulkarni and Laender 2017) and genetics (Helm et al 2009) of such plant species. In addition, climate change has also significantly affected populations of different plant species throughout the globe (Oliveira et al 2015).

In order to improve the plant growth and productivity, several techniques such as breeding, biotechnology and vegetative propagation has been tested and adopted for different tree species. However, selection of suitable species followed by the selection of suitable provenance within species has been considered as one of the most important tool to improve tree characters. Moreover, provenance

selection in tree species improved growth and carbon stock, and also provide greater resilience against climate change (Whittet et al 2016). The natural variation present in different geographical regions induces variation in plant characters in a particular species; as a consequence, plant depicts variation in its character in new region compared to the original geographical region. In general, improvement in plant character through provenance selection are of great significance for meeting afforestation needs, which can provide greater climatic and economic benefits such as controlling soil erosion, mitigating climate change, improved carbon stock and provision of fuel wood, fodder, fruit and timber (Oliveira et al 2015). Himalayan agriculture landscapes are characterized by few multipurpose tree species. This includes species such as *Morus alba*, *Grewia optiva*, *Bauhinia* and *Ficus* spp. Beside these species, the *Celtis australis* L., a fast growing multipurpose tree species which is largely utilized for fodder, fuel, fruit and timber in the Himalaya (Yadav and Bisht 2015). But, it is subjected to severe anthropogenic pressure, while it has a great potential to further improve the productivity of Himalayan landscapes (Singh et al 2006). Hence, it is utmost important to improve the plant growth and productivity of *C. australis*. Therefore, we investigated the effect of provenance selection on seed and seedling characteristics of *C. australis* in the nursery environment.

recorded between nursery parameters, seed length (-0.03–0.39), breadth (-0.02–0.64), 100 seed weight (0.39–0.65).

CONCLUSION

The provenance selection successfully increased growth and biomass productions of *Celtis australis* in nursery environment. The significant variation in seed characteristics observed among the provenances. In addition, provenance wise significant variation in plant characters recorded in the nursery environment. Chakrata provenance performed best among all provenances followed by Solan, Almora, Kathua, Sirmour, Nainital, Palampur, Tehri, Kullu, Chamba and Shimla under nursery conditions. The provenance selection and testing through improved plant characteristics has great potential to mitigate the negative effect of climate change through greater climate resilience and enhanced CO₂ sequestration and will also stabilize the degraded ecosystem of the Himalaya. Therefore, the provenance selection and testing of other commercially important tree species should be initiated to further enhance the productivity of Himalaya for improving the climatic and economic benefits in these regions.

AUTHOR'S CONTRIBUTION

Raj Kumar recorded data and wrote the manuscript. Harsh Mehta helped in recording experimental data. Rajesh Kaushal and JMS Tömar helped in designing and layout of the experiment. Sneha Döbhal, Rakesh Banyal and Manish Kumar helped in writing the manuscript.

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