Comparative Evaluation of Seed Treatment Methods for Optimum Germination and Growth of *Moringa Oleifera* in Pothohar Region

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https://doi.org/10.62345/jads.2026.15.1.13

Abstract

Moringa oleifera is a fast-growing, multipurpose tree species. It is high in protein and is used for human consumption, animal feed, and medicine. The aim of this study was to determine the adaptability of four landraces of Moringa oleifera at Koont Research Farm of Pir Mehr Ali Shah, Arid Agriculture University, Rawalpindi. Seeds were sown in polythene bags in the nursery after control, hot-water, and tap-water seed treatments. The germination and growth potential were assessed by using different parameters. Seed germination was recorded for three weeks in the laboratory and in nursery conditions, and the data were statistically analysed using ANOVA. Controlled water-seeding treatment enhances the germination potential of different landraces. Hot water treatment shows significant value in growth parameters. It is recommended that Moringa oleifera be treated with water to enhance the germination and growth parameters in the Pothwar region. So, it can be grown in other countries.

Keywords: Growth; Moringa Oleifera; Nursery; Germination.

Introduction

Moringa oleifera is a small, fast-growing evergreen or deciduous tree that can reach a height of 10 to 12 meters. It features a spreading, open crown with drooping, brittle branches, tripinnate leaves, and thick, corky, whitish bark. The fragrant, bisexual, yellowish-white flowers are borne in spreading or drooping axillary clusters (Ashfaq et al., 2011; Parrotta, 2014). When the pods dry out, they split into three pieces. Each pod contains spherical seeds with a brownish, semi-permeable seed shell. Because it is a softwood tree, it produces low-quality wood, yet it has been claimed for ages that the tree has a variety of industrial, heritage, and medical uses. The other terms used for Moringa are Horseradish tree, Mulangay, Mlonge, Benzolive, Drumstick tree, Sajna, Kelor, Saijihan and Marango. The horse radish tree's name for Moringa was due to the taste of its roots (Fahey, 2005; Anwar & Rashid, 2007). Moringa have 13 species, viz., M. arborea, M. borziana, M. concanensis, M. drouhardi, M. hildebrandtii, M. longituba, M. oleifera, M. ovalifolia, M. peregrina, M. pygmaea,

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Compliance with ethical standards: There are no conflicts of interest (financial or non-financial). This study did not receive any funding.

M. rivae, M. ruspoliana, and M. stenopetala (Farooq & Koul, 2018).

Moringa oleifera is a part of the ontogenetic family (Moringaceae) of shrubs and trees that originated in Agra and Oudh in northwest India. It is native to the sub-Himalayan regions of Pakistan, Bangladesh, and Afghanistan (Shujatha & Patel, 2017; Rani & Arumugan, 2017). Moringa is mostly cultivated in tropical and sub-tropical countries (Moyo et al., 2014; Leone et al., 2016; Rajput et al., 2019). The plant is a drought-resistant agricultural cultivar that grows quickly. It may thrive in less fertile environments (Fahey, 2005; Anwar & Rashid, 2007).

In Pakistan, Moringa oleifera is locally known as "Sohanjna" and grows wild in the provinces of Punjab, Sindh, and Khyber Pakhtunkhwa (KP). A wide genetic diversity of Moringa is present in Pakistan. These genetic diversities can be improved to enhance their multipurpose usage (Shahzad et al., 2018). Moringa concanensis and Moringa oleifera Lam. are indigenous to Pakistan, with three landraces: white-seeded Moringa from Faisalabad, black-seeded Moringa from Multan, and PKM1 Indian landrace (Khan et al., 2017; Batool et al., 2019).

Moringa oleifera does not require much fertiliser; a standard amount, especially organic fertiliser for long-term fertilisation, might help it grow more quickly. It has been demonstrated that organic matter enhances soil characteristics, including aggregates, water-holding capacity, hydraulic properties, bulk density, compaction, fertility, and resilience to water and wind erosion (Abukari & Nasare, 2020) Sowing and cuttings are the two most common methods for obtaining M. oleifera plants. Sowing is recommended for seed production because improved varieties can be chosen for growth, ensuring proper and sustainable production (Mishra et al., 2012). Moringa oleifera viability rapidly degrades over time. The majority of germination tests take place between 7 and 21 days, and seeds germinate in 5 to 10 days. Given that germination was measured three days after imbibition began, the quality of the seeds utilised in the experiment can be regarded as high. Moringa oleifera dried leaves have 7 times the vitamin C of an orange, 10 times the vitamin A of a carrot, 17 times the calcium of milk, 15 times the potassium of bananas, 25 times the iron of spinach, and 9 times the protein of yoghurt (Ashfaq et al., 2011). Moringa leaf is high in several essential elements for human health, including lipids and proteins, as well as critical minerals. Moringa leaves are used to make a variety of significant and tasty economic products, including moringa powder and moringa juice (Rajput et al., 2019).

Although many studies have been published on the attributes of Moringa species, published literature is inadequate regarding seed treatment of Moringa oleifera trees in the Pothohar region. There is a need to evaluate different seed treatments to optimise germination and growth performance of Moringa trees in the Pothohar region. The ultimate outcome of this study might help to ensure food security.

Materials and Methods

Experimental Site

The area chosen for the experiment was a research field of the Forestry Department at the Koont Research Farm of PMAS Arid. Agriculture University Rawalpindi which is located in Dhudial, a village of district Chakwal. This experimental site is situated on elevation of up to 1200 ft. It is situated at about 32˚N latitude and about 72ºE longitude and 70 kilometer from Pakistan, capital Islamabad. The Mean annual rainfall ranges from 450 - 550 mm.

Experimental Treatments

This study consists of treatment in laboratories and fields. Three treatments, i.e. hot water (T_1), simple water (T_2), control (T_0) and four landraces, i.e. L_1, L_2, L_3, and L_4 were used for the CRD

Concept laboratory experiment. The landrace of Moringa PKM-1, white seeded, black seeded and Ghana was used. The healthy and sturdy seeds were taken from NARC and other sources. Seeds were treated with three separate treatments to determine the rate of seed germination and were sown in soil with a standardized composition. The total germination percentage were calculated by the following formula.

$$\text{Total Germination\%} = \frac{\text{Total number of seeds that germinated}}{\text{Number of seeds sown}} \times 100$$

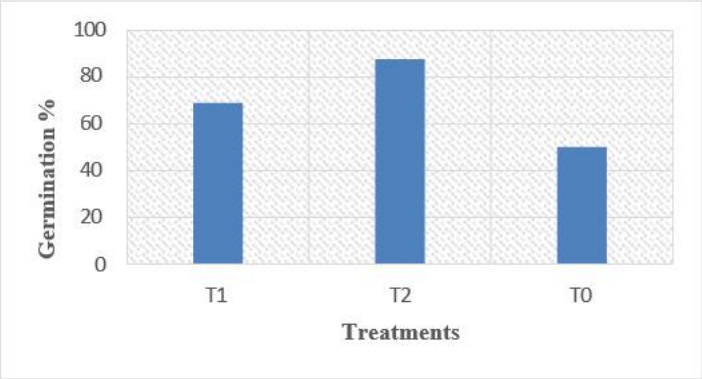
Results and Discussion

Germination Rate

Figure 1 demonstrated the effect of seed treatment on Moringa oleifera landraces. The mean germination percentage showed significantly different for all treatments. The maximum germination percentage was recorded in simple water treated seeds (87.5%) that was significantly higher than hot water treated seed (68.7%) and control (50%).

Figure 2 explains germination percentage of different Moringa oleifera landraces. White seeded Moringa landrace recorded significantly greater seed germination percentage 83.3% than PKM-1 75%, Black seeded 62.5% and Ghana landrace 54.17%. Figure 3 illustrate that seed treated with water recorded 100% germination in Pkm-1 and white seeded Moringa landraces while 75% in black seeded and Ghana landraces.

Figure 1: Effect of seed treatment on germination percentage



Seed Treatments

Before initiating the germination tests, all seeds were immersed in a beaker of water and those that floated were eliminated. Then the following seed treatment was done. Control (T0), Moringa oleifera seeds were put in petri dishes without any care. The seeds of Moringa oleifera were immersed for 24 hours in natural water (T2). The seeds of Moringa oleifera were immersed for 5 minutes in boiling water at 80 °C and soaked for 24 hours in lukewarm water (T1).

Parameters Studied

The germination rate, plant height, number of leaves and stem diameter parameter were studied to determine the effect of seed treatment on landraces of Moringa oleifera in term of the following parameters.

Data Collection

The Moringa oleifera leaves were counted manually on monthly and bi-monthly basis. For each treatment, the average was calculated. Measuring tape and vernier caliper was used for the measurement of the diameter. The following equations were specify the diameter of the plant stem. Diameter = Girth/π where (π = 3.14). Girth = Circumference Measuring tape was used for the measurement of plant height. By using a measuring tape, the height of each plant was calculated from below the soil surface to its tip in centimeters, and thus the average was then obtained. At the end of July, seeds were planted in 8 × 4 inch polythene tubes packed with soil at a depth of three times the seed size. Seed germination were recorded for three weeks. Seedlings were watered according to soil condition. Then, growth parameters was recorded on weekly basis for two months.

Statistical Analysis

The data was analyzed through ANOVA techniques by using statistical software (Statistix 8.1) under complete randomized block design. The means of significant effects were determined by using LSD at 5 percent probability level.

Figure 2: Germination percentage of different Moringa landrace

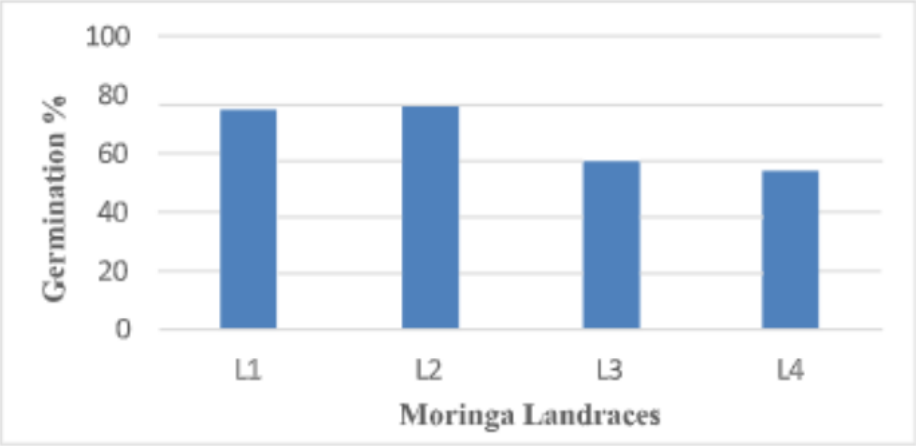
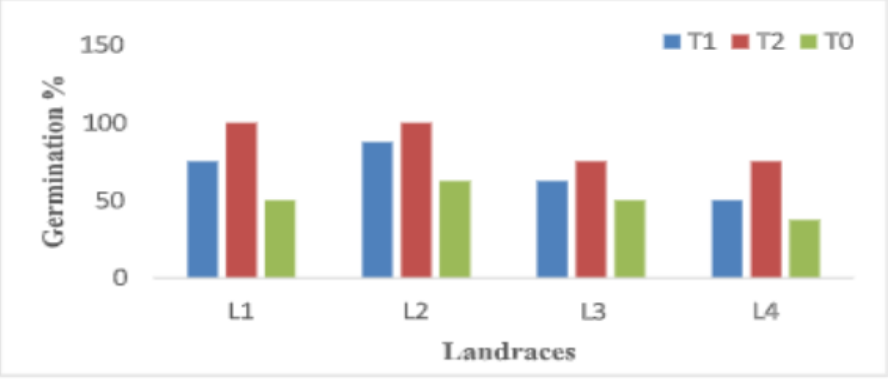


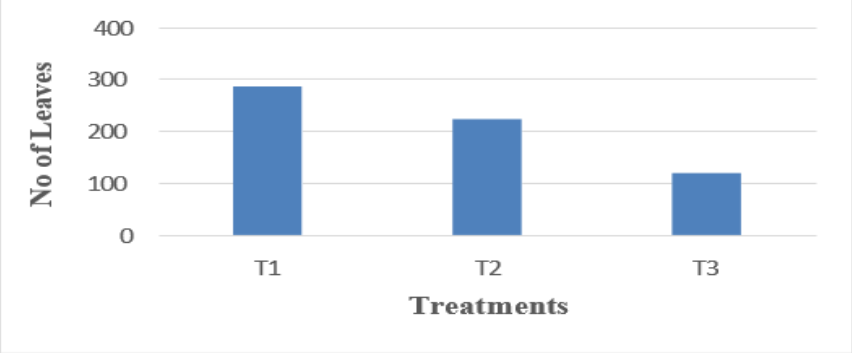
Figure 3: Effect of different seed treatment on germination percentage of Moringa landraces



Number of leaves

Figure 4 shows the recorded data for effects of different seed treatments on number of leaves. The mean value recorded for hot water treated seed shows a significantly different 286.3 number of leaves as compared to other seed treatments simple water 223.06 and untreated seed 119.5.

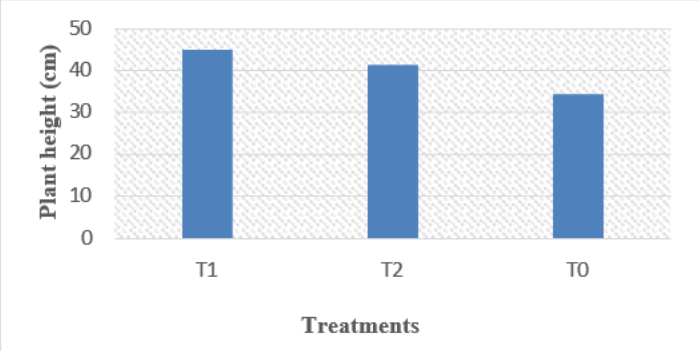
Figure 4: Effect of seed treatments on number of leaves of Moringa oleifera landraces



Plant Height

Figure 5 explain that the data recorded for plant height of different treatments shows statistically different values. Seeds treated with hot water shows significantly different value (44.7cm) as compared to simple water (41.18cm) and control seeds (34.18cm).

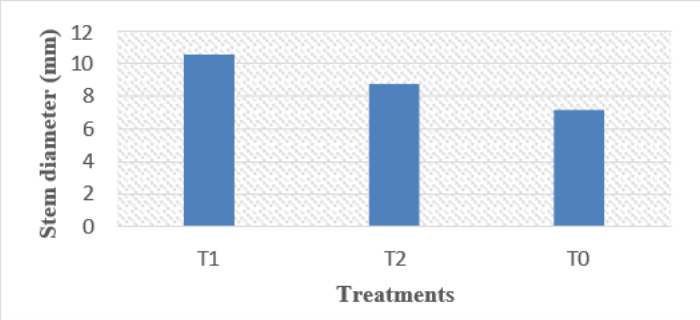
Figure 5: Effect of seed treatments on Moringa plant height



Stem Diameter

Figure 6 illustrates that different treatments affect the average diameter of Moringa oleifera plants. At a 5% level of significance, different treatments results in plants with statistically different stem diameters. Hot water treatment (T_1) yielded stem diameter
10.51 mm diameter, which is followed by simple water (T_2)8.7 mm and control (T_0)7.1 mm.

Figure 6: Effect of seed treatments on stem diameter



Discussion

The variations across seed treatments show that the efficiencies by which the treatments effected seed germination varied. This observation is significant because it shows that the treatments may allow Moringa oleifera seedlings to grow rapidly. The effective seed treatments, such as simple, hot water, and untreated, could be used to rapidly yield Moringa oleifera seedlings for communities. It is acknowledged that poor pre-sowing seed treatment might result in inadequate germination (Pérez-García & Benito, 2006). Other than dormancy and hard-seed coatings, there may be other factors that influence seed germination. The maturity stage at which seeds are taken from the pod is one factor that significantly affects both the lifetime and the viability duration of seeds (Epkong, 2008). The finding of this research was that different seed pre-sowing treatments improved the germination and growth of Moringa oleifera seeds is significant because it demonstrates the possibility of promoting the rapid propagation and cultivation of Moringa oleifera landraces through the mass production of seedlings using the most effective seed treatments examined in this study. The current research are relevant with the studies of Materechera, 2017 who observed that there is potential to promote the quick propagation and cultivation of M. oleifera by mass producing seedlings from the most effective seed treatments examined in this work. Treatments varied in their effectiveness in enhancing seed germination. Our results effect of seed treatment on growth parameter also confirmed from the observation of Ullah et al. (2019).

Conclusion

It is concluded on basis of findings that growth of Moringa trees in the environment of Pothohar region was found optimum in response to hot treated seeds. Whereas, adequate germination was observed in cold water treated seeds.

The germination, growth of seeds, and nutritional parameters were beneficial from seed treatments. Seed treatments enhance the germination, and growth of *Moringa oleifera*. The simple and effective way of breaking seed dormancy is hot water treatments. It is recommended that seed treatment is very effective in the Pothohar region, so it can be enhanced in other regions of the country. More research is required to authenticate this study.

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