Research Article

Growth potential of primed *Moringa oleifera* varieties under nursery and field conditions of Potohar region-Pakistan

Sami Ullah^{1,3*}, Shah Fahad¹, Noman Latif¹, Sarwat Naz Mirza², Haroon Shahzad¹, Muhammad Rizwan³ and Muhammad Arshad Khan¹

1. Pakistan Agricultural Research Council, Arid Zone Research Centre, DI Khan-Pakistan

2. PMAS, Arid Agriculture University, Rawalpindi-Pakistan

3. Department of Agronomy, University of Agriculture, Faisalabad-Pakistan

*Corresponding author's email: samiullahms89@yahoo.com

Citation

Sami Ullah, Shah Fahad, Noman Latif, Sarwat Naz Mirza, Haroon Shahzad, Muhammad Rizwan and Muhammad Arshad Khan. Growth potential of primed *Moringa oleifera* varieties under nursery and field conditions of Potohar region-Pakistan. Pure and Applied Biology. Vol. 8, Issue 1, pp813-319. <http://dx.doi.org/10.19045/bspab.2019.80023>

Received: 06/08/2018

Revised: 05/01/2019

Accepted: 09/02/2019

Online First: 20/02/2019

Abstract

Moringa oleifera is a fast emergent multiuse tree. It is protein rich and is used as human food, cattle fodder and medicine. Present research study was carried out to know growth and germination potential of untreated, tap water and hot water treated seeds of four varieties of *Moringa oleifera* in nursery and field conditions in field area of Koont research farm, Peer Mehar Ali Shah (PMAS), Arid Agriculture University Rawalpindi. After treatment seeds were sown in polythene bags in nursery. Germination of seed was recorded for three weeks in laboratory as well as in nursery conditions and statistically analyzed using ANOVA techniques. Simple water, hot water and control enhanced 60%, 71.5% and 41.75% germination in this experiment. Hot water treatment has shown maximum germination percentage in all varieties i.e 80 % in Kumasi Middle Ghana, 85 % in Sunyam Middle Ghana, 62 % in Northern Ghana and 59 % in Tehiman Middle Ghana. Maximum plant height 17.12 cm was recorded in T₂ followed by 14.9 cm and 10.8 in T₁ and T₃, respectively. In nursery conditions, T₂ treated plants had maximum stem diameter which was 2.52 mm followed by T₁ and T₃ that was 2.1 mm and 1.8 mm, respectively. *Moringa* plants of T₁ in field condition had maximum 4.71 mm diameter significantly greater than 3.87 mm (T₂) and 3.79 mm (T₃) respectively.

Keywords: Growth; *Moringa*; Nursery; Priming

Introduction

Moringa oleifera, local name “Sohanjna”, is a native species of India and is widely distributed in many tropical regions; Pacific region [1], West Africa [2], Central America and the Caribbean [3]. It belongs to an onogeneric family (Moringaceae) of shrubs and tree, originated from Agra and Oudh, the northwest region of India, south of the

Himalayan Mountains. The people of India knew its edible characterization, that's why it can be used as fodder [4] vegetables [5] and medicinal purpose [6]. Agronomic characteristics with slightly basic soils makes it fit to grow in hilly areas but not in waterlogged areas in less fertile acidic soils. However, information about growth of *Moringa oleifera* in the acidic soil is almost

absent [7]. *Moringa oleifera* can grow naturally at an elevation up to 1,000 m above sea level. It can grow well on hillsides but is more frequently found growing on pastureland or in river basins. It is drought resistant and fast growing (5 – 7 m) in one year in arid areas [4].

Moringa oleifera is a multipurpose tree. It has medicinal value and use as a food and fodder for cattle. Oil and curry powder is extracted from seeds of *Moringa oleifera*. Seeds of *Moringa oleifera* are also used for cleaning of water. In many regions of the world like in Vietnam, *Moringa oleifera* leaves are used for food [8]. *Moringa* foliage is known for its rich protein source, low anti-nutritional factors [7]. For goat production, the use of grasses as a source of protein is not appropriate because most of the grasses are low in protein. Therefore, *Moringa oleifera* foliage is a cheap protein source [9].

In Pakistan, pre-sowing seed treatment with different kinds of material i.e. chemicals, salts and other plant growth regulators brings various biochemical changes in germination [10] of seed which are necessary to break seed dormancy. They were used in seed priming to enhance the seed germination, plant growth, and the crop yield [11] but to make process cost effective. Scientists have induced plant extracts for seed priming [12] e.g. *Moringa* (*Moringa oleifera* L.) leaves extract (MLE) that not only promotes seed germination but also improves vigor and growth of plants [13, 14].

The present study was carried out to determine growth potential of *Moringa oleifera* in Pothwar region of Pakistan. This study was investigated to assess the germination and growth potential of different varieties of *Moringa oleifera* in nursery and field conditions.

Materials and methods

Study area

Area selected for field experiment was research field of Forestry Department at

Koont Research Farm, PMAS Arid Agriculture University Rawalpindi, situated at Mandra Chakwal Road. It is representative of rainfed areas of Potohar tract. Elevation of the farm is up to 1200 feet. Mean annual rainfall ranges from 450-550 mm.

Research design

Research work consisted of lab and field experiments

For laboratory experiment CRD Design was used with three treatments i.e simple water (T₁), Hot water (T₂), control (T₃) and four varieties i.e (1) Kumasi Middle Ghana (2) Sunyam Middle Ghana (3) Northern Ghana (4) Tehiman Middle Ghana. For field study randomized complete block design was used.

Germination tests in laboratories

Healthy and vigorous seeds were taken from Forestry Department of Bahauddin Zakariya University, Multan. Seeds were treated with three different treatments and were sown in soil of uniform composition to identify seed germination rate.

To determine Cumulative germination percentage, the following formula was used

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

Control

Seeds of *Moringa oleifera* were placed in petri dishes without any treatment and germination was noticed every other other day for three weeks [16].

Simple water treatment

Seeds of *Moringa oleifera* were submerged in normal water for 24 hours. Seeds were placed in petri dishes. Germination of seeds was noticed every other day for three weeks [16].

Hot water treatment

Seeds of *Moringa oleifera* were submerged in 80°C boiled water for 5 minutes and soaked in lukewarm water for 12 hours. Seeds were placed in petri dishes. Germination was noticed every other day for three weeks [16].

Field experiment

Seed sowing

Seeds were sown in 8 × 4 inches' polythene tubes filled with soil at the end of June at the depth 3 times of seed size.

Seed germination

Seed germination was recorded for three weeks. Seedlings were watered according to soil condition. At the end of July (monsoon season), seedling were shifted from nursery to field and growth parameters were recorded on weekly basis for two months.

Growth parameters

- 1) Number of Leaves
- 2) Plant Height
- 3) Stem Diameter

Number of leaves

Leaves of *Moringa oleifera* were counted manually at weekly basis.

Stem diameter and plant height

Measuring tape was used for diameter and height measurement of all plants. Diameter of plant stem was determined by the following formula.

Diameter = Girth/ π where ($\pi = 3.14$)

Girth = Circumference of plant stem

Statistical analysis

The data was analyzed by using statistical software (Statistix 8.1) for windows. The most significant seed treatment and its effects on growth parameters were determined by applying statistical test (ANOVA) on data. Means of significant effects were determined by using LSD at 5 percent probability level [17].

Results and discussion

Germination test in laboratory

In figure 1 indicates effect of treatments on germination percentage of *Moringa oleifera*. Mean germination percentage differs statistically in all treatments. Maximum germination percentage (72%) was recorded in hot water treated seeds that was statistically higher than (48.5%) of tape water and (42.5%) control respectively.

In figure 2 elaborates germination percentage of different varieties of *Moringa oleifera*. Sunyam Middle Ghana have 78.5% seed germination that was significantly greater than Kumasi Middle Ghana (67.3%), Northern Ghana (56.5%) Tehiman Middle Ghana i.e. 28.33%.

In figure 3 depicts that seed treated with hot Water treatment had germination @ 85 % in Sunyam Middle Ghana, which was at par 80 % in Kumasi Middle Ghana was significantly greater than 62 % in Northern Ghana and 59 % in Tehiman Middle Ghana. Seed treated with water had 70 % germination while Middle Ghana had only 48% germination. These results have close junction with [13], who have increased germination percentage with pre sowing seed treated.

Field experiment

Plant Height

In figure 4 illustrates variation in plant height with seed treatments. Maximum plant height was (17.12 cm) recorded in T₂ that was significantly higher than 14.9 cm and 10.8 in T₁ and T₃, respectively in lab while 23.94 cm long plants were found in T₁ that was literally at par with 21.9 and 21.15 cm in T₂ and T₃ respectively. The reason of more plant height in field is explained by [8, 10] relating more moisture, nutrients availability due to field system and availability of organic carbon.

Figure 1. Germination percentage of *Moringa oleifera* under different treatments

Figure 2. Germination percentage of different varieties of *Moringa oleifera*

Figure 3. Effect of different treatments on germination percentage of different varieties of *Moringa oleifera*

Figure 4. Height of *Moringa oleifera* in different treatments

Number of leaves

In figure 5 shows the data recorded for effects of different seed treatments on number of leaves of plant. Simple water treated plants have maximum number of *Moringa* leaves 52 followed by 46 that was followed by 33 leaves in nursery. In field conditions, the leaf count of T₁ was 301 leaves and then followed by 224 leaves, while T₃ plants produced 172 leaves after two months of growth. This data also shows that maximum number of leaves (301) were reported in field conditions while minimum number of leaves (33) at nursery level. Seed soaking helps in germination and root extension in fields helps plant to uptake more nutrients [10, 15] that ultimately result in production of more leaves in *Moringa oleifera*.

Diameter

Different treatments effect on mean diameter of *Moringa oleifera* plant is shown in figure 6. Different treatments gave statistically different stem diameter plants in nursery and field conditions at 5% significance level. In nursery conditions, T₂ yielded 2.52 mm diameter followed by 2.1 mm T₁ and T₃ 1.8 mm. In field conditions, T₁ produced maximum diameter of 4.71 mm that was significantly higher than T₂ and T₃ which gave diameter of 3.87 mm and 3.79 mm respectively. Environmental conditions, soil conditions, nutrients availability in field is main cause of increase in plant girth in field condition [8, 10].

Figure 5. Number of leaves of *Moringa oleifera* in different treatments

Figure 6. Diameter of *Moringa oleifera* in different elements

Conclusion and recommendations

Moringa oleifera is a fast growing multipurpose tree species. It can grow and survive in water stress conditions, all type of soil except acidic soil, water logging, highly susceptible to frost, grow well on foothills up to 1000 m elevation. It can be used as a food and fodder, having medicinal value and used for cleaning of water. It can be easily grown in hilly areas of Pakistan, pothwar region and southern districts of Khyber Pakhtunkhwa. Seed treatments have a beneficial effect on the germination of seeds and other growth parameters. Hot water treatment is easy and fruitful method for breaking seed dormancy.

Authors' contributions

Conceived and designed the experiments: S Fahad, N Latif & SN Mirza, Performed the experiments: S Fahad & SN Mirza, Analyzed the data: H Shahzad, M Rizwan & MA Khan, Wrote the paper: S Ullah.

Acknowledgments

Contribution of Department of Forestry and Range management, PMAS, Arid Agriculture University, Rawalpindi, Pakistan for providing field, pots and other research material.

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