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Effect of different concentrations of organic manures with *Azotobacter* on seed germination and early seedling growth of *Moringa oleifera* L.

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Abstract

The present investigation was conducted at Dry Land Horticulture Research Farm Sirsod, Department of Horticulture, College of Agriculture, Gwalior during the year 2018-19 to study the effect of different concentrations of organic manures with *Azotobacter* on seed germination and early seedling growth of drumstick. The experiment was laid out in Completely Randomized Design (CRD). All the 14 treatments were replicated thrice. Maximum survival percentage of seedlings (89%) was recorded under T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) and found was significantly superior over other treatments while minimum survival percentage of seedling 74% was recorded under T₀. maximum gross return of Rs.1335.00 was received from the treatment of T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) followed by Rs. 1290 under T₁ (75% Soil + 25% Vermicompost + *Azotobacter*). among all the treatment, the maximum net return of Rs. 544.8 was obtained from the treatment T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) followed by Rs. 505.2 under T₁ (75% Soil + 25% Vermicompost + *Azotobacter*). The lowest net return Rs. 381.00 was received under T₁₃ (25% Sand + 75% Sheep manure + *Azotobacter*). The economic analysis in terms of B: C ratio of all the treatment combinations revealed that T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) is 1:1.68 proved to be the most economic treatment.

Keywords: Organic manures, *Azotobacter*, seed germination, early seedling growth, drumstick, *Moringa oleifera*

Introduction

Moringa oleifera L. synonym *Moringa pterygosperma* is one of the most useful multipurpose plants. It is the most widely cultivated species of the family moringaceae. Drumstick (*Moringa oleifera* L.) is alternatively known as *Sahjana*, Horse radish, Muringa tree, Ben oil tree, paradise tree and miracle tree. *Moringa* is native to the southern foothills of the Himalayas in North-Western India and many parts of Africa with adaptability to tropical, semi-arid climate. India is the largest producer of drumstick globally and Andhra Pradesh is the largest producing state of India followed by Karnataka and Tamil Nadu in both area and production.

A hybrid variety, PKM-1 was derived from *Moringa oleifera* and it is grown for its heavy biomass and tender leaves. Characteristic features of this hybrid variety include wide and dark green leaves, long and tender pods, bushy habit and rapid growth after cropping. Moringa PKM-1 seeds were developed at Periya Kulam horticultural college and research institute, Tamil Nadu. This gives largest yield in the shortest time period. PKM-1 has better taste than other hybrid varieties. Length of each pod is 45-75 cm. Each plant yield 300-400 sticks.

In the management of drumstick seedlings, the application of fertilizers has a major role in germination and growth. there is a need to think of alternate sources of safe fertilized which may enhance crop yields without having adverse effects on soil properties, the use of bio-fertilizers seen to be a hope in this direction. Biofertilizers are the carrier-based preparations containing mainly effective strains of micro-organisms in sufficient number, which are useful for nitrogen fixation. If they are used in association with macronutrients, the expected yields per unit area may be much higher. Amongst these nutrients, nitrogen is the only nutrient, which play major role in synthesis of chlorophyll, amino acids and protein building blocks, which is ultimately responsible for higher source to sink ratio.

Growing media also plays important role in seed germination. It not only acts as a growing place but also as a source of nutrient for plant growth. The pond soil is usually used as a basic medium because it is the cheapest and easy to procure. Supplementing of the sand is aimed to make media more porous while the organic matter (FYM, sheep manure and vermicompost) is added so as to enrich adequate nutrient for the seedling.

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Material and Methods

The present investigation was conducted at Dry Land Horticulture Research Farm Sirsod, Department of Horticulture, College of Agriculture, Gwalior during the year 2018-19. Gwalior is located at 26° 22' N latitude and 78° 18' E longitude and 197 meters above mean sea level. The city of Gwalior has a geographical area of 5214.00 sq km, situated at the bank of Chambal River. The climate of Gwalior is subtropical with hot and dry summers where maximum temperature exceeds 45 °C in May and June. The winters are cool and minimum temperature reaches as low as 2 °C in December and January. The occurrence of frost is expected from the last week of December to the first week of February. Usually the monsoon arrives in the second fortnight of June and lasts till September. The meteorological data (min. to max.) were recorded as Temperature (3.5 °C to 36.7 °C), Relative humidity (27.5 to 99.3), Rainfall (0.0 mm to 84.0 mm) and Evaporation (6.6 to 1.0) during the experimental period as per meteorological observatory, College of Agriculture, Gwalior. Fresh drumstick seeds of PKM-1 were obtained from the nursery at College of Agriculture, Gwalior, M. P. for conducting the germination study. The seeds were sun dried and moisture was around 8.0 percent.

The experiment was laid out in Completely Randomized Design (CRD). All the 14 treatments viz., T₀, 100% soil, T₁, 75% Soil + 25% Vermicompost + *Azotobacter*, T₂, 50% Soil + 50% Vermicompost + *Azotobacter*, T₃, 25% Soil + 75% Vermicompost + *Azotobacter*, T₄, 100% Sand, T₅, 75% Sand + 25% Vermicompost + *Azotobacter*, T₆, 50% Sand + 50% Vermicompost + *Azotobacter*, T₇, 25% Sand + 75% Vermicompost + *Azotobacter*, T₈, 75% Soil + 25% Sheep manure + *Azotobacter*, T₉, 50% Soil + 50% Sheep manure + *Azotobacter*, T₁₀, 25% Soil + 75% Sheep manure + *Azotobacter*, T₁₁, 75% Sand + 25% Sheep manure + *Azotobacter*, T₁₂, 50% Sand + 50% Sheep manure + *Azotobacter*, T₁₃, 25% Sand + 75% Sheep manure + *Azotobacter* were replicated thrice. 20 seeds per treatment were taken. Poly bags of length 20 cm and diameter of 30 cm having 200 gauge thicknesses were used. The bags were filled with the media according to treatments. Seeds were sown in the media at depth of 1.5 cm. Poly bags were watered immediately after sowing and subsequently once on alternative days. Weeding was done by hand roughing of the weeds as they emerged. The sowing of drumstick seed was done on 20 September, 2018. The seeds were hand dibbled at 1.2 cm depth in each Poly bags. Watering and other operation were done as per requirements. Optimum moisture of germinating media was maintained during the period of seed germination. Five plants were selected from each treatment per replication and mean value was considered to be the correct value for the parameters studied. Germination parameters viz., days taken to initial germination, days taken to 50% germination, Growth parameters viz., Height of seedling (cm), No. of leaves per seedling, Girth of stem (cm). Root parameters viz., Girth of roots (mm), Total fresh weight of roots (g), Dry weight of roots (g) and Survival % at 100 days after sowing were observed.

Result and Discussion

The minimum days taken to initiate germination 6.4 were recorded in T₂ (50% soil + 50% vermicompost + *Azotobacter*), which was significantly at par with T₁ (75% soil + 25% vermicompost + *Azotobacter*), T₃ (25% soil + 75% vermicompost + *Azotobacter*), and T₉ (50% soil + 50% sheep manure + *Azotobacter*). It is significantly superior to over rest

treatment and maximum days taken to initiate germination was observed in control T₀. The minimum days taken to 50% germination i.e. 9.7 days was observed in treatment T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) which was significantly at par with T₁ (75% Soil + 25% Vermicompost + *Azotobacter*), T₃ (25% Soil + 75% Vermicompost + *Azotobacter*), which took 10 days. T₉ (50% Soil + 50% Sheep manure + *Azotobacter*), and which took 10.7 days. Maximum days taken to 50% germination was recorded in T₀ (100% soil), which took 18 days. The maximum height of seedling (10.5 cm) was found in T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) which was significantly at par with (8.83 cm) in T₁ (75% Soil + 25% Vermicompost + *Azotobacter*) and (8.78 cm) in T₈ (75% Soil + 25% Sheep manure + *Azotobacter*). The minimum height of seedling (6.43 cm) was observed in control (100% soil) in T₀. At later stage (100 DAS), among all the treatments, the maximum height of seedling (33.00 cm) was recorded in T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) which was significantly at par with (32.33 cm) in T₁ (75% Soil + 25% Vermicompost + *Azotobacter*) and (31.66 cm) in T₃ (25% Soil + 75% Vermicompost + *Azotobacter*). The minimum height of seedling (21.20 cm) was observed in control (100% soil) in T₀. Among all the treatment at early stage of observation (20 DAS) maximum number of leaves per seedling (3.3) was found in T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) which was significantly at par with T₁ (2.5) in (75% Soil + 50% Vermicompost + *Azotobacter*). Whereas the minimum number of leaves per seedling (0.8) was found in control T₀ (100% soil). At final stage (100 DAS), among all the treatments, the maximum number of leaves per seedling (17) was found in T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) and it was significantly at par with T₁ (16.3), T₃ (16), T₉ (15.6), T₈, and T₁₀, both (15.6). whereas the minimum number of leaves per seedling (8.0) was found in control T₀ (100% soil).

at early stage of observation (20 DAS) maximum girth of stem (0.33 cm) was found in T₂ (50% Soil + 75% Vermicompost + *Azotobacter*) which was significantly at par with T₁ (0.30 cm), T₃ (0.30 cm), T₉ (0.29 cm), T₈ (0.28 cm). Whereas the minimum girth of stem (0.16 cm) was found in T₀ control. At final stage (100 DAS), maximum girth of shoot (2.62 cm) was found in T₂ (50% Soil + 50% Vermicompost + *Azotobacter*). Whereas the minimum girth of stem (1.04 cm) was found in T₀ control. At (100 DAS) Maximum girth of root of (35.9 mm) was recorded under T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) which was significantly superior to other treatments. The minimum girth of root (25.96 mm) was recorded under control T₀. Different concentrations of organic manures with *Azotobacter* show significant effect on total fresh weight of roots. At (100 DAS), the maximum fresh weight of root (24g) was recorded under T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) which was significantly at par with T₁ (23.6g), and T₉ (21.6g). The lowest fresh weight of root (15.1 g) was recorded under control T₀. Maximum dry weight of root (5.2 g) was recorded under T₂ (75% Soil + 25% Vermicompost + *Azotobacter*) which was significantly at par with T₁ (5.1g) and T₃ (4.7g). Whereas the lowest dry weight of root (1.9 g) was recorded under control T₀. Maximum survival percentage of seedlings (89%) was recorded under T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) and found was significantly superior over other treatments while minimum survival percentage of seedling 74% was recorded under T₀. The highest total cost of cultivation (Rs. 799.8) was incurred

under T₁₀ (25% Soil + 25% Sheep manure + *Azotobacter*) followed by (Rs.799.2) T₇ (25% sand + 75% Vermi-compost + *Azotobacter*) and T₁₂ (Rs. 797) in (50% Sand + 50% Sheep manure + *Azotobacter*) respectively. maximum gross return of Rs.1335.00 was received from the treatment of T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) followed by Rs. 1290 under T₁ (75% Soil + 25% Vermicompost + *Azotobacter*). among all the treatment, the maximum net return of Rs. 544.8

was obtained from the treatment T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) followed by Rs. 505.2 under T₁ (75% Soil + 25% Vermicompost + *Azotobacter*). The lowest net return Rs. 381.00 was received under T₁₃ (25% Sand + 75% Sheep manure + *Azotobacter*). The economic analysis in terms of B: C ratio of all the treatment combinations revealed that T₂ (50% Soil + 50% Vermicompost + *Azotobacter*) is 1:1.68 proved to be the most economic treatment.

Treatment	Days taken to initiate germination	Daystaken to 50% germination	Girth of root (mm) at (100) DAS	Survival % of seedling at 100 DAs
T ₀	11	18.0	25.96	74.00
T ₁	7	10.0	34.97	86.33
T ₂	6.4	9.7	35.9	89.00
T ₃	7.4	10.0	34.48	85.66
T ₄	9.4	12.0	32.49	80.33
T ₅	8.4	12.0	33.10	81.33
T ₆	8.4	12.0	33.42	82.33
T ₇	8.7	12.0	32.46	80.33
T ₈	8	11.4	34.83	84.33
T ₉	7.4	10.7	34.69	85.00
T ₁₀	8.4	11.7	33.62	82.66
T ₁₁	9.4	12.0	31.58	80.33
T ₁₂	9.4	12.0	30.38	79.00
T ₁₃	10	14.4	29.52	78.66
SE(m)±	0.48	0.37	0.21	0.7
CD at 5%	1.39	1.06	0.61	2.8

Conclusion

After critical consideration of data, it is concluded that:-

- All the concentrations of organic manure with *Azotobacter* showed better results when compared with control.
- Among the different concentration of 50%soil+ 50% vermicompost with *Azotobacter* was the best treatment among all treatments of other organic manure with *Azotobacter* which recorded viz. minimum days taken to initial germination, 50% germination, maximum girth of stem, maximum no. of leaves, maximum girth of root, maximum root fresh weight and dry weight at 100 DAS, and survival % at 100 DAS.
- As regards 50% soil + 50% vermicompost with *Azotobacter*, significantly encourage germination and early seedling growth of *Moringa oleifera* L.

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