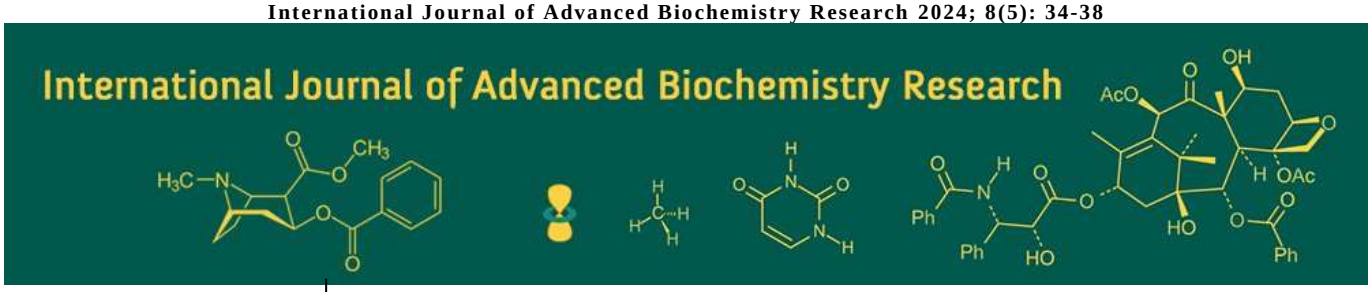

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Effect of azotobacter and organic manure on germination and seedling growth on ber (*Ziziphus mauritiana*) cv. Gola

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Abstract
The present investigation entitled "Effect of Azotobacter and Organic manure on Germination and Seedling growth on ber (*Ziziphus mauritiana*) cv. Gola" was conducted during February-July 2023 at the Central Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj (Uttar Pradesh) Which was carried out in Statistical Design adopted for the experiment was RBD having three replications, ten treatments combinations. The results reflect that treatment T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) outstands in all the aspects with significant results in Germination and Seedling growth. Parameters like Germination percentage (88.92), Days to Germination (7.67) was minimum, seedling height (55.25 cm), Stem girth (1.51 cm), Number of leaves (39.17), Number of Branches (2.92), Survival Percentage (84.50), Leaf area (84.50 cm2) and Chlorophyll content (35.74) Which was followed by Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, minimum effect observed in T_0 control. Application of Farm Yard Manure, azotobacter, vermicompost with soil improves Germination and Seedling growth of Ber cv. Gola, From above results we could say this treatment can be used as best to grow Ber seedling.

Keywords: FYM, Azotobacter, vermicompost, ber, seedling, Gola

Introduction
Ber also known as Indian jujube with Botanical name (*Ziziphus mauritiana* Lamk.), is a widespread, ancient fruit native to India, Fruit of the Rhamnaceae family. It is a significant commercial fruit crop that is raised in Arid environments. Also referred to as the Chinese apple or Indian plum, it is the king of dry fruits. Because fruits are readily available, inexpensive to produce, and a great source of protein, minerals, and vitamin C, they are known as the "poor man's apple." (Najeebullah *et al.*, 2020) [9]. Ber is spread as commercial crop over the North- Indian states of Uttar Pradesh (UP), Haryana, Madhya Pradesh (MP), Rajasthan, Punjab, and Rainfed Subtropical Regions of India with Good Economics. It has 52,000 hectares of total cultivated land, with an annual production of 5,59,000 MT (PIB Delhi 2020-21).

Fruit is commonly used to make products like preserves Murabba, Candy, Dehydrated ber, Pulp, jam and beverages. It has medicinal properties to control blood sugar level, promoting digestion, weight loss, boost immunity, etc.

Ber is commercially grown by budding on *Z. rotundifolia* seedling rootstock. In order to obtain seedling rootstock for budding, the seed stones are utilized. Within the endocarp of the drupe, each seed stone contains two to three seed kernels. The aeration and water drainage of nursery plants are essential for their survival rate. Without these, root development is inhibited and diseases such as damping off may potentially arise. (Beattie and White, 1992) [4]. The growing media, which serves as both a growing environment and a source of nutrients for plant growth, additionally impacts seed germination. The growth of seedlings is contingent upon what is inside of the growing substrate. (Wilson *et al.*, 2001) [11].

Vitamin C in ber Fruit is (70-165 mg/100 g pulp) and sugar (10%) with fair amount of mineral constituents (Jawanda and Bal, 1978) [7]. Ber has more protein than an apple (0.9%), phosphorus, calcium, β-carotene (70 IU) and excel in phosphorus, iron, calorific

values and carbohydrates (Sen *et al.*, 2016) [10]. The daily diet of an adult man should contain 30 mg ascorbic acid as per FAO/WHO recommendation, which can easily be met by three ber fruits in daily diet.

The prerequisite or necessity for producing high-quality horticulture crops is appropriate growing substrate. The growth media is the primary source of development and maintenance for the roots system (Bhardwaj, 2014) [5]. The potting medium used at nurseries determines the quality of the seedlings that are produced there (Agbo and Omaliko, 2006) [1] and influences he renewal of an orchard's growth and its ultimate yield in the field (Baiyeri, 2006) [3].

Materials and Methods

The present investigation entitled "Effect of Azotobacter and Organic manure on Germination and Seedling growth on ber (*Ziziphus mauritiana*) cv. Gola" was conducted during February - June 2023.

Experimental site

The site of the investigation comes under subtropical zone located at Central Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj (Uttar Pradesh) during the year 2022-2024. This location is located 78 meters above mean sea level in South east of Uttar Pradesh. The temperature might fall to as low as 4 °C in winter and as high as 47 °C during the summer. This region experiences over 1013.4 mm of rainfall on average from July to September during the monsoon, with a few rare showers during the winter.

Treatments

Symbols	Treatment Details
T_0	Control
T_1	Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:1:1)
T_2	Azotobacter @ 48 gm + Soil × Farm Yard Manure × Vermicompost (1:1:1)
T_3	Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:1:1)
T_4	Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (2:1:1)
T_5	Azotobacter @ 48 gm + Soil × Farm Yard Manure × Vermicompost (2:1:1)
T_6	Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (2:1:1)
T_7	Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1)
T_8	Azotobacter @ 48 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1)
T_9	Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1)

Parameters recorded

Germination Percentage

The number of seeds planted and the number of seeds that germinate, represented as a percentage, will be used to compute the germination percentage.

$$\text{Germination percentage} = \frac{\text{Number of germinated seeds}}{\text{Number of seeds sown}} \text{x } 100$$

Days required for germination

Total no. of days was counted from the seed sown days to first emerge of radical out from the sowing media.

Seedling height (cm)

From each treatment, four seedlings chosen at random were measured in centimeter at 30, 60 and 90 days following seeding, the seedling's mean height was determined.

Stem girth (cm)

The stem girth measured in cm by selecting 4 random same seedlings from there base using vernier caliper at days interval of 30, 60, and 90.

Number of leaves per seedlings

Four randomly selected seedlings, were counted at 30, 60, and 90 days following seeding in each treatment, and the mean number of leaves per seedling was computed.

Number of branches

The numbers of branches of same four randomly selected seedlings in each treatment were counted at 100 days following seeding, and the average number of branches was determined.

Survival Percentage

The survival percentage was measured as the total no. of seedlings observed from each treatment. the number of surviving seedlings from the total seeds were germinated.

$$\text{Survival percentage} = \frac{\text{Total no. of survived seedlings}}{\text{Total germinated seed}} \text{ x } 100$$

Leaf Area (cm^2)

Random sample of 3 leaves from each selected seedling was picked from every direction. Thus, there was 30 leaves from each treatment were usedThis was measured in centimeters squared using a leaf area meter (LICOR-USA).

Chlorophyll

Randomly the chlorophyll was measured using the portable device names as (SPAD Chlorophyll meter). The chlorophyll was measured on the leaves of seedling at 100 days from days of sowing of seeds.

Results and Discussion

Germination percentage

It is expressed through the layout of the table that there was significant effect of Azotobacter and Organic Manure with various treatments on Germination %. However, the maximum (88.92) Germination was recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (87.83) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, minimum (62.92) germination was recorded in T_0.

Days to Germination

It is expressed through the layout of the table that there was significant effect of Azotobacter and Organic Manure with various treatments on Initiation of Germination. However, the minimum (7.67) days to Germination was recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (7.83) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, maximum (16.50) days to germination was recorded in T_0.

Survival percentage

It is expressed through the layout of the table that there was significant effect of Azotobacter and Organic Manure with various treatments on Survival percentage. However, the maximum (84.50) percentage was recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (82.58) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, minimum (70.75) percentage were recorded in T_0.

Leaf area (cm^2)

It is expressed through the layout of the table that there was significant effect of Azotobacter and Organic Manure with various treatments on leaf area. However, the maximum (84.50) area was recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (82.58) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, minimum (70.75) area were recorded in T_0.

Chlorophyll

It is expressed through the layout of the table that there was significant effect of Azotobacter and Organic Manure with various treatments on chlorophyll. However, the maximum (35.74) chlorophyll was recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (35.68) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, minimum (23.28) chlorophyll were recorded in T_0.

Seedling height (cm)

It is expressed through the layout of the table that there was significant effect of Azotobacter and Organic Manure with various treatments on seedling height at days interval of 30, 60, 90 days are given as follows. Height of seedling at 30 days after seed sowing was maximum (13.13) recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (12.62) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, the minimum (10.72) height was recorded in T_0. Height of seedling at 60 days after seed sowing was maximum (27.42) recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (26.53) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, the minimum (23.12) height was recorded in T_0. Height of seedling at 90 days after seed sowing was maximum (55.25) recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (54.73) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, the minimum (49.76) height was recorded in T_0.

Stem girth (cm)

It is expressed through the layout of the table that there was significant effect of Azotobacter and Organic Manure with various treatments on stem girth at days interval of 30, 60, 90 days are given as follows Girth of stem at 30 days after seed sowing was maximum (0.88) recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (0.84) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, the minimum (0.70) girth was recorded in T_0. Girth of stem at 60 days after seed sowing was maximum (1.27) recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (1.21) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, the minimum (0.96) girth was recorded in T_0. Girth of stem at 90 days after seed sowing was maximum (1.51) recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (1.38) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, the minimum (1.15) girth was recorded in T_0.

Number of leaves per seedling

It is expressed through the layout of the table that there was significant effect of Azotobacter and Organic Manure with various treatments on number of leaves per seedling at days interval of 30, 60, 90 days are given as follows. Number of leaves per seedling at 30 days after seed sowing was maximum (8.17) recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (7.92) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, the minimum (5.83) leaves were recorded in T_0. Number of leaves per seedling at 60 days after seed sowing was maximum (22.33) recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (22.08) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, the minimum (17.92) leaves were recorded in T_0. Number of leaves per seedling at 90 days after seed sowing was maximum (39.17) recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) was followed by T_7 (37.08) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, the minimum (30.75) leaves were recorded in T_0.

Number of branches per seedling

It is expressed through the layout of the table that there was significant effect of Azotobacter and Organic Manure with various treatments on Number of branches. However, the maximum (2.92) branches were recorded in T_9 Azotobacter @ 52 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1) and T_7 (2.92) Azotobacter @ 44 gm + Soil × Farm Yard Manure × Vermicompost (1:2:1). Whereas, the minimum (2.00) Branches were recorded in T_0.

Table 1: Shows the No. Tr Germination Percentage Days to Germination Survival percentage Leaf area and its Chlorophyll

No. Tr	Germination Percentage	Days to Germination	Survival percentage	Leaf area	Chlorophyll
T_0	62.92	16.50	70.75	10.79	23.28
T_1	68.48	12.25	74.00	12.82	34.36
T_2	70.42	12.92	74.67	14.84	30.09
T_3	71.25	11.92	74.67	15.32	34.14
T_4	76.42	8.92	76.42	15.59	34.51
T_5	80.67	9.42	74.50	15.38	32.63
T_6	81.52	11.58	76.25	15.39	30.51
T_7	87.83	7.83	82.58	15.85	35.68
T_8	84.42	11.83	80.17	14.07	31.40
T_9	88.92	7.67	84.50	16.85	35.74
SE.d	1.51	0.80	0.82	0.67	1.49
C.D. at 5%	3.17	1.68	1.72	1.41	3.13

Table 2: Shows the No. of Tr. Seedling height (cm) Stem girth (cm) leaves per seedling and Number of branches

No. of Tr.	Seedling height (cm)			Stem girth (cm)			leaves per seedling			Number of branches
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	
T_0	10.72	23.12	49.76	0.70	0.96	1.15	5.83	17.92	30.75	2.00
T_1	11.79	24.63	53.02	0.78	1.04	1.30	6.67	19.00	34.83	2.25
T_2	12.11	25.12	52.38	0.80	1.05	1.24	6.67	18.42	34.58	2.33
T_3	11.65	24.39	51.73	0.79	1.08	1.25	6.75	18.08	33.17	2.42
T_4	12.47	26.06	53.23	0.83	1.17	1.38	7.67	21.00	35.42	2.83
T_5	11.83	25.03	52.71	0.78	1.08	1.28	6.83	19.75	34.67	2.42
T_6	11.81	25.14	52.24	0.78	1.08	1.30	7.33	19.58	34.58	2.75
T_7	12.62	26.53	54.73	0.84	1.21	1.38	7.92	22.08	37.08	2.92
T_8	12.28	25.55	53.07	0.80	1.08	1.35	7.58	20.92	36.67	2.67
T_9	13.13	27.42	55.25	0.88	1.27	1.51	8.17	22.33	39.17	2.92
SE.d	0.36	0.82	1.00	0.03	0.04	0.04	0.40	0.96	1.51	0.17
C.D. at 5%	0.76	1.73	2.10	0.06	0.09	0.08	0.85	2.01	3.17	0.35

Discussion

For fruit crop seedlings, the medium typically consist of organic matter, Soil, pond soil, & sand. With, the intention of increasing porosity, sand will be supplemented and organic matter specifically, FYM and vermicompost will be introduced to enhance sufficient nutrients that the seedling needs. Conventional soil mixes have occasionally been blamed for spreading soil-borne illnesses and pests, however the primary function of media may be comprehended by analyzing the connection between manure and roots, which indicates that manure promotes stronger rooting. (Akanbi and Togun, 2002) [2]. Farm Yard Manure (FYM) can influence crop development directly through multiple methods, such as enhanced respiration, increased cell permeability, hormone growth action, or a mix of these. It gives the plants readily available types of nitrogen, phosphorus, potassium, and sulfur through biological breakdown. It indirectly enhances the physical characteristics of soil, including soil aggregation, permeability, and water-holding ability. Farm animal feces is used to make FYM, which is complete with all necessary elements. It is prepared from the dung of farm animals and includes all of the necessary components, such as potassium (0.5–0.9%), phosphorus (0.4–0.8%), and nitrogen (0.5–1.5%). Vermicompost is a naturally occurring fertilizer that is rich in macro and micronutrients and is made from organic waste that decomposes biodegradably. (Kaur, 2017) [8]. Biofertilizers are like Azotobacter, PSB, Azospirillum, Azolla, Blue Green Algae, VAM is a material that is alive with microorganisms that colonize the rhizosphere, or the inside of the plant, and stimulate growth by making primary nutrients more available to the host plant. (Hazarika and Ansari, 2007) [6].

Conclusion

From the results which came in front that treatment with in T_9 Azotobacter @ 52 gm + Soil × FYM × Vermicompost (1:2:1) recorded as the best treatment in terms of germination Percentage (88.92%) and seedling growth of Ber. Azotobacter and Organic manure application in Ber, this treatment believed to be most suitable in this region which is economic with a benefit cost ratio of (1.90).

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