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Effect of organic manure on growth and yield of shatavari (*Asparagus racemosus* L.) under teak (*Tectona grandis*) based agroforestry system

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Abstract

The study aims to evaluate how different plant spacing and organic manures affect Shatavari's growth, yield, and economic viability in both open fields and teak agroforestry. Conducted over two years (2022-24) at the Experimental Farm of United University, Prayagraj, India, the research utilized a Factorial Randomized Block Design (FRBD) with twelve treatment combinations across three replications. The subtropical site with alluvial soils was ideal for testing these agro-technological methods. Findings provide crucial insights for optimizing Shatavari cultivation in teak agroforestry, highlighting that strategic interventions can enhance productivity and profitability. The analysis shows that organic manures, especially Vermicompost (M2) and Farmyard Manure (M1), significantly improve growth and yield in both settings, with Vermicompost yielding the highest net returns and cost-benefit ratios. This can be attributed to its rich nutrient content, enhanced microbial activity, and improved soil physicochemical properties, which collectively foster a more conducive environment for root development and overall plant health. The superior economic performance of organically grown Shatavari, commanding a higher market price, solidifies the argument for adopting these sustainable practices.

Keywords: Shatavari, organic manures, randomized block design, vermicompost, farmyard manure and sustainable practices etc

1. Introduction

Agroforestry systems that incorporate teak (*Tectona grandis*) present a highly promising approach for the cultivation of medicinal plants like *Asparagus racemosus*. These systems offer partial shade, which can alleviate environmental stresses such as excessive sunlight and soil erosion, while simultaneously providing opportunities for diversifying farm income, as Saravanan *et al.* (2019) have emphasized. However, the presence of interspecific competition for critical resources—namely light, water, and nutrients—introduces challenges that can influence the performance of understory crops like Shatavari. To address this, the optimization of plant spacing emerges as a crucial factor in achieving a balance between resource allocation, root development, and overall yield. Research by Mahanteshilager *et al.* has demonstrated that closer spacing configurations, such as 1.2 meters by 0.6 meters, can maximize dry root yield per hectare, whereas wider spacing tends to enhance individual plant root traits, including length and girth. The roots of *Asparagus racemosus* are particularly valuable due to their rich content of steroidal saponins, which confer a range of pharmacological benefits, as noted by Joshi and Saran. Beyond saponins, the plant contains an array of phytochemicals, including alkaloids, proteins, tannins, arginine, tyrosine, asparagine, flavonoids, essential oils, and resin, as documented by Joshi (2016). The incorporation of organic manure into cultivation practices further supports sustainable agriculture by enhancing soil health, boosting microbial activity, and improving nutrient availability. This approach can mitigate nutrient depletion

commonly observed in teak-dominated agroforestry systems, thereby fostering robust growth of understory crops such as *Asparagus racemosus*. Comparative studies on other medicinal plants, such as *Coleus forskohlii* and *Withania somnifera*, conducted by Mastiholi *et al.*, have demonstrated the effectiveness of organic amendments in increasing root biomass and the production of secondary metabolites. Nevertheless, there remains a notable scarcity of research specifically examining the combined effects of spacing and organic manure on *Asparagus racemosus* within teak-based agroforestry systems, particularly with respect to optimizing both yield and the biosynthesis of bioactive compounds. In view of the above, this research endeavor is designed to investigate the influence of spacing and organic manure on the growth and yield of *Asparagus racemosus* within a teak-based agroforestry system, blending age-old traditional knowledge with cutting-edge agro-technological practices to formulate sustainable cultivation strategies. The adoption of appropriate agro-techniques, coupled with the development of effective marketing frameworks, is essential to overcoming challenges such as the inconsistent availability and inadequate supply of this valuable medicinal plant in commercial markets. Such measures not only enhance productivity but also improve economic returns and contribute to ecological resilience.

2. Materials and Methods

The experimental site for this study is located at the Research Farm of the Department of Agroforestry, Faculty

of Agricultural Science, United University during the *Kharif* season of 2022-23 and 2023-24. Positioned approximately 25 km from the district headquarters of Prayagraj, Uttar Pradesh 208024, the research farm is readily accessible from Rawatpur. The farm is situated at approximately 25.43° North latitude and 81.84° East longitude in the southwestern plains of Uttar Pradesh. It sits at an altitude of around 150 meters above sea level, falling within the subtropical zone.

The field was effectively leveled, equipped with adequate irrigation and drainage facilities. Prior to the current study, any stubble from the previous crop and weeds were manually removed from the field. The experiment was carried out over two consecutive years, 2022-23 and 2023-24 to account for variations in temperature, humidity, and rainfall, which could influence plant growth.

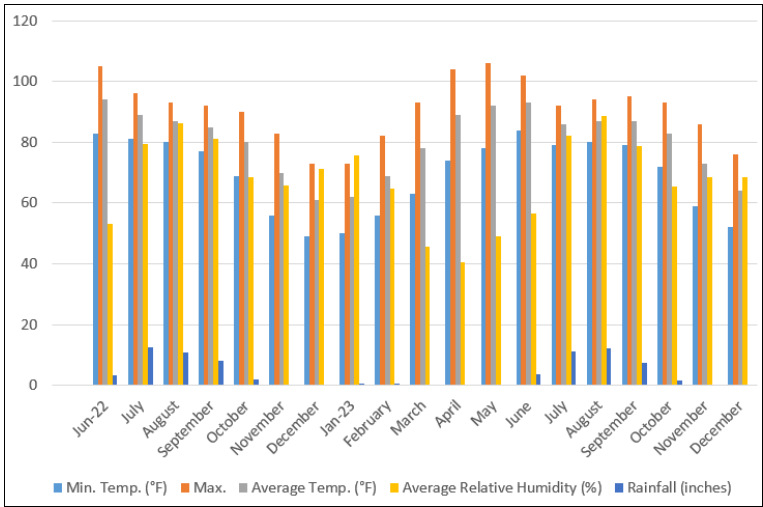


Fig 1: Agro-Meteorological Details of Temperature, Humidity and Rainfall

3. Results and Discussion

3.1 Effect of spacing and different organic manure on plant height of *Asparagus racemosus* L.

During 2022-23, plant height showed a gradual increase with wider spacing. Plants under S3 attained the maximum height (98.47 cm), whereas the lowest value was noted in S1 (92.95 cm). Organic manure application also improved plant growth, with M3 producing the tallest plants (96.01 cm), while the minimum height was observed in M0 (93.63 cm). In 2023-24, a similar response was recorded. Spacing S3 again resulted in the tallest plants (98.66 cm), while S1 maintained the lowest plant height (92.91 cm). With respect to organic manures, M3 gave the maximum mean height (96.09 cm), followed by M2 (95.81 cm), whereas M0

remained the least (93.67 cm). The pooled data of both years confirmed these observations. The highest mean plant height was obtained under S3 (96.94 cm), followed by S2 (93.74 cm), while the lowest was in S1 (92.92 cm). Among the organic manure treatments, M3 (95.99 cm) consistently recorded the greatest height, while M0 (93.36 cm) produced the shortest plants. Overall, the results clearly indicate that wider spacing (S3) combined with higher organic manure application (M3) was most favorable for enhancing plant height in *Asparagus racemosus*. This trend could be attributed to reduced inter-plant competition under wider spacing and the steady nutrient supply from organic manures, which together encouraged better vegetative growth.

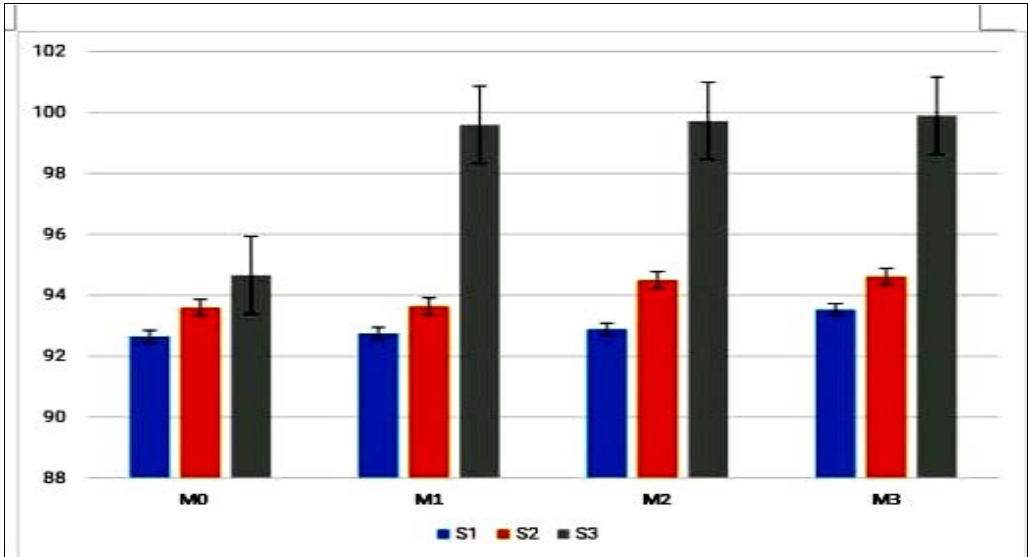


Fig 2: Effect of spacing and different organic manure on plant height of *Asparagus racemosus* L. (2022-23)

3.2 Effect of spacing and different organic manure on the number of branches per plant of *Asparagus racemosus* L.

In 2022-23 (Table 4.1a), the highest number of branches (40.57) was recorded under the wider spacing S3, while the lowest (30.72) was observed in S1. Across manure treatments, M3 produced the greatest mean value (36.70), whereas M0 gave the least (32.86). The interaction effect ($S \times M$) was also significant, with the combination S3 M3 showing a clear superiority (42.95 branches per plant). In 2023-24, a similar trend was evident, though with slightly

lower values compared to the previous year. Spacing S3 registered the maximum mean (32.85), followed by S2 (31.61), while S1 remained the lowest (29.85). Among organic manures, M3 once again produced the highest value (31.89), while M0 gave the minimum (30.68). The pooled analysis further confirmed these observations. Wider spacing (S3) consistently resulted in the maximum number of branches per plant (36.71), while the lowest was obtained in S1 (30.29). Regarding manure treatments, M3 (34.29) was the most effective, followed by M2 (33.99), and M0 showed the minimum (31.77).

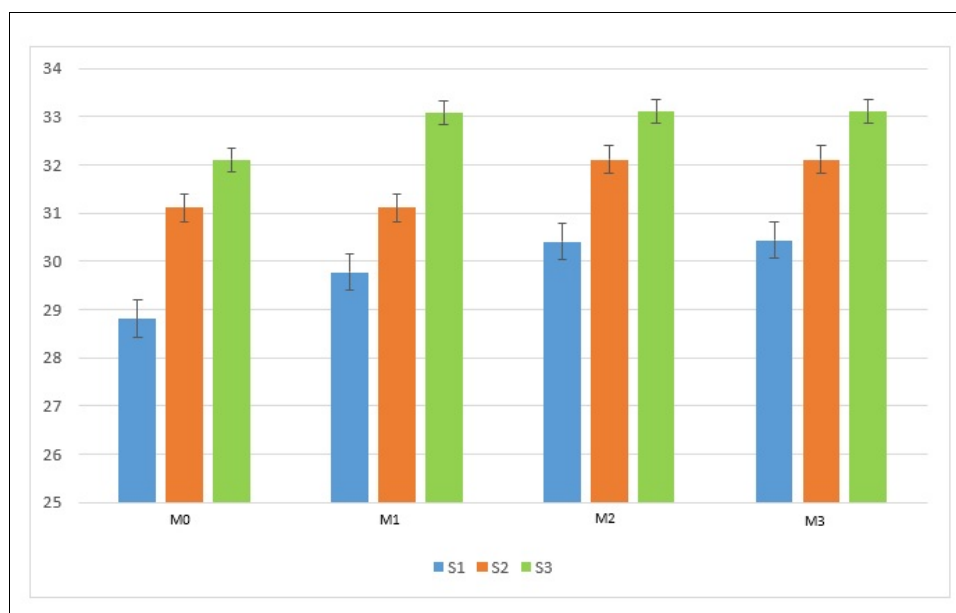


Fig 3: Effect of spacing and different organic manure on the number of branches per plant of *Asparagus racemosus* L. (2023-24)

As per discussions of the paper, S3 spacing produced the tallest plants (120.846 cm in pooled data), significantly more than S1 (98.429 cm). M3 (Neem Cake) and M2 (Vermicompost) were the most effective treatments for height, with M3 showing a pooled mean of 121.149 cm. This suggests that wider spacing mitigated some of the shade-induced elongation, while organic manures provided robust support for vertical growth. Similarly, S3 spacing (widest) consistently led to a higher mean number of branches (33.748 in pooled data) compared to S1 (31.365). M3 (Neem Cake) again resulted in the highest mean (33.164), followed by M2 (Vermicompost, 32.882), underscoring the benefits of these organic inputs even under partial shade.

4. Conclusion

This research provides robust evidence for optimizing the cultivation of Shatavari (L.) within teak based agroforestry systems, offering critical insights for both ecological sustainability and economic prosperity. The comprehensive analysis of growth parameters, yield components, and economic viability under varying spacing and organic manure applications unequivocally demonstrates that thoughtful agro-technological interventions can significantly enhance productivity and profitability. Furthermore, the research highlights the unparalleled efficacy of organic manures, particularly Vermicompost (M2) and Farmyard Manure (M1), in improving Shatavari's growth and yield

parameters across both open-field and under-teak conditions. Vermicompost, in particular, consistently emerged as the most beneficial organic amendment, leading to the highest net returns and cost-benefit ratios. This can be attributed to its rich nutrient content, enhanced microbial activity, and improved soil physicochemical properties, which collectively foster a more conducive environment for root development and overall plant health. The superior economic performance of organically grown Shatavari, commanding a higher market price, solidifies the argument for adopting these sustainable practices.

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