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A COMPARATIVE STUDY OF ORGANIC MANURES ON GROWTH, YIELD AND PHYTOCHEMICAL QUALITY OF WITHANIA SOMNIFERA

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ABSTRACT

Withaniasomnifera, commonly known as Ashwagandha, is an important medicinal plant valued for its therapeutic properties and diverse bioactive compounds. The present study will comparatively evaluate the influence of different organic manures on the growth, yield, and phytochemical quality of Withaniasomnifera. Various organic manure treatments, such as farmyard manure, vermicompost, compost, and other suitable organic amendments, will be applied to assess their effects on plant height, number of branches, leaf development, root growth, fresh and dry biomass, and root yield. The study will further examine important phytochemical constituents, including total phenolics, flavonoids, alkaloids, and withanolides, to determine the quality of harvested plant material. Comparative evaluation of the treatments will help identify the most effective organic manure for enhancing both productivity and phytochemical content. The findings will contribute to the development of sustainable, eco-friendly, and economically viable cultivation practices for improving the growth, yield, and medicinal quality of Withaniasomnifera.

KEYWORDS-Withaniasomnifera, Ashwagandha, organic manures, farmyard manure, vermicompost, plant growth, root yield, biomass production.

INTRODUCTION

Traditional medicine makes extensive use of the WithaniasomniferaDunal plant, most often known as Ashwagandha. It is a member of the Solanaceae family and is an essential medicinal herb. Withanolides, alkaloids, flavonoids, and phenolic compounds are among the physiologically active substances found in the plant's roots and other sections that contribute to its medicinal usefulness. Crop management, soil fertility, nutrient availability, weather, and other environmental factors affect Ashwagandha's yield and therapeutic efficacy. Soil structure, nutrient availability, microbial activity, and general plant development may all be improved using organic manures like compost, vermicompost, or farmyard manure, and synthetic fertilisers can be reduced. The impacts on plant growth, biomass generation, root output, and phytochemical accumulation may vary, however, depending on the organic manure source. Because of this, the current research will compare and contrast how various organic manures affect the development, production, and phytochemical profile of Withaniasomnifera. In order to cultivate Ashwagandha sustainably and increase its medicinal quality, this research will aid in identifying appropriate organic nutrient-management techniques.

REVIEW OF LITRETURE

Rajan, Giridharan & Sindhu, P (2025) In order to maximise the production and quality of ashwagandha (Withaniasomnifera (L.) Dunal), researchers at Kerala Agricultural University examined the influence of organic amendments and phytostimulants. Fifteen different combinations of farmyard manure, vermicompost, foliar phytostimulants (seaweed fertiliser, humic and fulvic acids, and chitosan) utilising the JawaharAshwagandha 20 (JA-20) variety were tested in a randomised block design (factorial) experiment. Vermicompost applied at a rate of 5 t/ha considerably enhanced plant height, branch density, fresh biomass, and dry biomass. By combining seaweed fertiliser with vermicompost at 5t/ha, we were able to improve root properties and achieve a fresh root yield of 614 kg/ha, which in turn improved growth metrics. The findings were similar when using 10 t/ha of seaweed fertiliser with farmyard manure; the fresh yield was 590 kg/ha and the total alkaloid content was 2.43% higher. The best benefit-cost

ratio of 2.25 was likewise achieved by this combination. According to the research, ashwagandha may have its root development and alkaloid content improved by using organic amendments and seaweed fertiliser. So, using farmyard manure at a rate of 10 t/ha with seaweed fertiliser is a viable strategy for growing ashwagandha.

Rajan, Giridharan et al., (2024) An important medicinal herb in Ayurvedic and Unani medicine, ashwagandha (Withaniasomnifera (L.) Dunal) was the subject of this research, which aimed to determine the impact of biostimulants and organic manures on the plant's development and root production. The years 2023–2024 saw the execution of a field experiment at Vellanikkara, the Kerala Agricultural University. Sixteen different treatment combinations were tested in triplicate using a Factorial Randomised Block Design (FRBD). Both biostimulants and organic manures were included of the treatment plans. Part A, the organic manures, was composed of four tiers: A1, A2, A3, and A4: 5 t/ha of vermicompost, 2.5 t/ha of FYM, and 10 t/ha of FYM, respectively. A total of four biostimulant concentrations were used in Factor B: a water spray (B1), seaweed extract (B2), humic and fulvic acid (B3), and chitosan (B4). The concentrations of these substances were varied and were applied at different times (MAP1, 1, and 3). In comparison to other treatments, the results showed that applying vermicompost at a rate of 5 t/ha led to much higher plant height (59.34 cm), biomass (141.35 g fresh and 53.98 g dry), and root growth. With a root biomass increase of 28.5%, seaweed extract outperformed all other biostimulants in terms of root development and plant biomass. Research shows that ashwagandha grows and yields far better when farmed organically, which means there's a lot of room for expansion and export.

Velu, Suresh et al., (2023) The 2019 field experiment was place at Dindigul, Tamil Nadu, at RVS Padmavathy College of Horticulture. This study was designed using the Factorial Randomised Block Design (FRBD). It consists of two parts: the soil application part, which includes S1-farmyard manure at a rate of 25.0 tonnes/hectare, S2-vermicompost at a rate of 2.50 tonnes/hectare, S3-VAM at a rate of 25.0 kilograms/hectare, and S4-phosphobacteria at a rate of 2.0 kilograms/hectare. The second part, which comprises eight treatments, is the treatment combinations. Plant stature, secondary branching, leaf size, leaf breadth, and stem girth were all significantly affected by soil-biostimulant interactions. Among the treatments, S2F1 (vermicompost at 2.50 tonnes/hectare + 0.3 percent humic acid) produced the tallest plants

(26.14 cm at 60 DAS and 40.67 cm at 120 DAS), the most secondary branches (4.95), the longest leaves (7.50 cm), the widest leaves (4.50 cm), and the thickest stems (1.45 cm).

Kaliyadasa, Ewon et al., (2018) For as long as anybody can remember, the roots of the ashwagandha plant (WithaniasominiferaDunal) have been important to the herbal business as a therapeutic crop. This herb is well-known for its stress-reduction, energy-boosting, and overall health-promoting properties. Various agronomic approaches in conjunction with harvest stage mostly determine the variations in plant development and root quality. For yield analysis, plants were cultivated using both organic and inorganic fertiliser sources up to twelve months after planting. Tubers were analysed for alkaloid, total fibre, and withaferine A contents up to ten months after sowing. Except for crude fibre content, all of the aforementioned phyto constituents were more abundant in tubers of organically grown plants as compared to inorganically fertilised plants. The optimal time to harvest high-quality tubers is six months following seeding. The biochemical standardisation of Ashwagandha tubers for commercial processing is a key area of focus in this work.

Manohar, S et al., (2012) The roots of the medicinal plant ashwagandha (WithaniasomniferaDunal.) are used to treat a variety of conditions, including erectile dysfunction, gastrointestinal issues, inflammation of the lungs, TB, arthritis, skin disorders, and bronchitis. Finding the optimal amount of organic manures and fertilisers to use with ashwagandha was the goal of the current experiment. Two levels of farm yard manure (FYM) and vermicompost, as well as combinations thereof, were used in the treatments, along with a control. The nitrogenous and phosphatic fertilisers were applied at 20 and 40 kg ha-1, respectively. The Randomised Block Design was used three times to mimic the treatments. Soil physical properties such as organic carbon, hydraulic conductivity, and water retention at 33 and 1500 kpa, along with the highest B:C ratio (2.57), were found to be significantly affected by the application of 40 kg ha-1 of N and P as urea and SSP plus 2.5 t ha-1 of vermicompost. This treatment also had a positive effect on plant height, branching per plant, leaf area, yield attributing traits, roots (8.60 q ha-1), and seed yield (85.6 kg ha-1).

EFFECT OF ORGANIC NUTRIENT SOURCES ON THE ACCUMULATION OF PHYTOCHEMICALS IN WITHANIA SOMNIFERA

The phytochemical profile and therapeutic efficacy of Withaniasomnifera are heavily influenced by its organic nutrition sources. Ashwagandha is a helpful medical herb since it includes several bioactive components, such as withanolides, alkaloids, flavonoids, phenolic compounds, and others. These chemicals' production and accumulation may be controlled by the growth medium's necessary nutrient availability and balance, which in turn affects plant metabolism. Soil structure, water retention, microbial activity, and nutrient-use efficiency may all be enhanced with the progressive addition of nutrients from organic manures like compost, vermicompost, farmyard manure, and other decomposed organic materials. These alterations may pave the way for physiological development and the synthesis of secondary metabolites in W. somnifera. While compost and manure from farms may help increase soil fertility and organic matter over time, vermicompost's comparatively high nutrient content and beneficial microbial populations may promote plant nutrient absorption. Therefore, the concentration of essential phytochemicals may vary across organic manure treatments due to differences in nutrient availability. Enzymatic activities, energy metabolism, protein synthesis, and biochemical pathways linked to secondary metabolite creation all rely on nitrogen, phosphorus, potassium, and micronutrients. In a well-balanced nutritional supply, plants may develop and produce useful therapeutic chemicals, but in other cases, too much nutrition can promote vegetative growth and stunt the accumulation of secondary metabolites. Organic manures have the potential to impact microbial communities in the root zone, which in turn may alter metabolic processes and nutrient cycling via interactions with plant roots. The capacity of various organic nutrient sources to improve Ashwagandha's phytochemical quality may be better understood by conducting comparative assessments of these sources. In order to find the best manure treatment, it is helpful to evaluate factors such total phenolic content, flavonoid concentration, alkaloids, and withanolide content. These results might lend credence to the idea of environmentally friendly farming methods that increase yields and medicinal efficacy of Withaniasomnifera with no impact on soil quality or the use of artificial fertilisers.

ROLE OF ORGANIC MANURES IN IMPROVING SOIL FERTILITY, NUTRIENT AVAILABILITY, AND MEDICINAL PLANT PRODUCTIVITY

Organic manures are great for medicinal plants like Withaniasomnifera because they increase soil fertility, nutrient availability, and overall production. Applying chemical fertilisers without correct management may have negative effects on soil structure, microbial diversity, and long-term fertility, even while it supports quick plant growth. Soil organic manures, such as compost, vermicompost, farmyard manure, and other decomposed plant or animal leftovers, provide organic matter and nutrients over time. Soil aggregation, porosity, aeration, water-holding capacity, and moisture retention may all be enhanced with their use, leading to an environment that is more conducive to root growth and nutrient absorption. Soil microbes that break down organic matter, cycle nutrients, and convert them into plant-useful forms are all dependent on organic matter for their survival. Vermicompost has the potential to feed soil with easily accessible nutrients, physiologically active chemicals, and beneficial microbes, while farmyard manure may enhance soil physical qualities and offer critical macronutrients. Increased soil organic matter and more even nutrient release during crop growth are two benefits of composting. Plant height, branching, leaf development, root formation, biomass accumulation, and root production are all significant growth characteristics that may be improved by increasing the availability of micronutrients, phosphorus, potassium, and nitrogen. Because of the equal importance of bioactive component concentration and quality, biomass alone should not be used to estimate production in medicinal plants. Beneficial phytochemicals such withanolides, alkaloids, phenolics, and flavonoids may accumulate differently in W. somnifera depending on the organic nutrients that are managed. This is because secondary metabolism is influenced by these nutrients. Proper nutrient balance promotes robust plant development while preserving therapeutic properties. In addition to enhancing soil sustainability, applying organic manure may recycle animal and agricultural waste, cut down on nutrient losses, and lessen the need for synthetic fertilisers. It is possible to maximise soil fertility, plant growth, root output, and medicinal quality by comparing various organic manures to find the best nutrient sources. Scientifically sound, commercially viable, and ecologically friendly methods of growing medicinal plants are possible with the use of such strategies.

CONCLUSION

To better understand how to manage nutrients sustainably while growing Ashwagandha, it would be helpful to compare the effects of organic manures on the development, production, and

phytochemical profile of Withaniasomnifera. Soil fertility, nutrient availability, water retention, and microbial activity are all factors that organic manures like compost, vermicompost, and farmyard manure aim to enhance. This, in turn, should help plants grow and build strong roots. Variations in manure treatments have the potential to affect key growth indicators, biomass output, root yield, and bioactive chemical accumulation. The effects of organic nutrition on medicinal quality may be better understood by conducting an evaluation of phytochemicals including withanolides, alkaloids, flavonoids, and phenolic compounds. To achieve a suitable balance between plant productivity and phytochemical richness, the research is intended to determine the most efficient organic manure treatment. In sum, with the right organic manure management practices in place, growing Withaniasomnifera may become more economically viable and medicinally valuable, while also improving soil health and decreasing reliance on synthetic fertilisers.

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