INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD
ISSN(O): 2455-0620 [Impact Factor: 7.581]
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value : 86.87
Volume - 9, Issue - 11, November - 2023 Publication Date: 10/11/2023

DOIs:10.2015/IJIRMF/202311001 --:-- Research Paper / Article / Review

Sustainable fertilization through application of organic inoculants improves growth and yield of Kalmegh (*Andrographis paniculata* Nees.) in sandy soil

[1]Rajat P. Singh, [2]Sunita Devi [3]Akhilesh Kumar

[1]Research Scholar, Herbal Extraction Laboratory, Department of Botany, Dayalbagh Educational Institute (Deemed to be University), Agra, India

[2]M.Sc. Botany Student, Herbal Extraction Laboratory, Department of Botany, Dayalbagh Educational Institute (Deemed to be University), Agra, India

[2]Assistant Professor, Herbal Extraction Laboratory, Department of Botany, Dayalbagh Educational Institute (Deemed to be University), Agra, India

Email – [1]rajatsirsaganj@gmail.com, [2]sk8930130@gmail.com, [3]akhileshkumar@dei.ac.in

Abstract: *Multiple reports have highlighted the usefulness of the Andrographis paniculata Nees plant in various industries, particularly in pharmaceuticals and Ayurvedic formulations. Recognizing its significance, we embarked on an experimental project at the Dayalbagh Educational Institute in Agra, aiming to cultivate high-quality herbs. Our study focused on assessing the impact of organic inoculants on the growth and yield of kalmegh during the 2021-22 period. To achieve this, we conducted a pot experiment with different treatments, including 75:75:50 kg NPK + FYM (15 t/h), VC (15t/h), FVC (15t/h), and FYM (15t/h) per hectare. After a 105-day growth period, we evaluated the results at the time of harvest. Surprisingly, the combination of FVC (15t/h) demonstrated comparable effectiveness to the NPK treatment. This finding suggests that organic inoculants can be a viable alternative to conventional fertilizers in cultivating kalmegh. By conducting this research, we contribute to the understanding of the potential benefits of Andrographis paniculata Nees in pharmaceutical and medical fields. Furthermore, our findings shed light on the efficacy of organic inoculants, paving the way for sustainable and environmentally friendly cultivation practices.*

Key Words: *Kalmegh, organic inoculants, growth, yield, FYM.*

1. INTRODUCTION:

Kalmegh (*Andrographis paniculata* Nees) is a valuable herb belonging to the Acanthaceae family, native to India. It has been utilized in Indian medicinal systems for centuries. The fresh and dried leaves of Kalmegh, as well as the extracted extract from the herb, are recognized as official medicines in the Indian Pharmacopoeia. However, it is now crucial to establish standardized cultivation practices for this herb. Kalmegh is known by various names across different regions. In the West Indies, it is referred to as bitter rice, while in England, it is known as the king of bitters or chiretta. In Indian languages, it is called Kirata in Sanskrit, Kirayat in Hindi, and Kalmegh in Bengali. This herb is renowned for its bitter taste and has traditionally been used to treat a wide range of ailments, including the common cold, dysentery, fever, tonsillitis, diarrhea, liver disease, inflammation, and herpes [1]. However, the excessive use of inorganic fertilizers, pesticides, and fungicides without the incorporation of organic fertilizers can lead to environmental pollution, particularly in the soil, ultimately affecting its long-term fertility [2]. Kalmegh is a highly valued herb with a rich history in Indian medicinal practices. Establishing standardized cultivation methods is crucial to ensure its continued availability and effectiveness. Additionally, it is important to be mindful of the potential environmental consequences of using inorganic fertilizers and pesticides excessively. Therefore, organic fertilizers can serve as an alternative to mineral fertilizers in order to enhance soil structure [3,11] and microbial biomass, thereby promoting optimal soil productivity and fertility. It is widely recognized that the availability of organic fertilizers in agriculture is currently limited [4,12]. However, the utilization of vermicompost holds great potential in the agricultural sector, as it can be employed as a growth medium for plants or as a soil conditioner [5]. Researchers are actively engaged in studying the impact of organic inoculants on the growth, yield, and disease resistance of medicinal plants [6,7,8,9,10,13]. The objective of this study

was to explore the use of organic inoculants such as vermicompost, floral vermicompost, and farmyard manure to provide plant nutrition in an environmentally friendly manner, devoid of synthetic chemicals. Furthermore, the study aimed to investigate the effects of these inoculants on various parameters, including plant growth and yield.

2. MATERIALS AND METHODS:

The Experiment was carried out at the Department of Botany, Dairy Campus (Latitude 27.22°, Longitude 78.01°) of Dayalbagh Educational Institute (Deemed to be University) Agra, India located at 99.2 m above mean sea level. The experimental site was classified as a subtropical region with hot summers and cool winters. The experiment was performed in cylindrical plastic pots to avoid organic inoculants and soil nutrient exchange between treatments so as to properly assess the effectiveness of organic inoculants without any disturbance or contamination from other sources. Experimental pots were arranged in a completely randomized block design with five replicates of *A. paniculata*. In this study, CIM-Megha (a high-yielding variety with one seedling per pot) was used. Following table depicts the data revealing the physico-chemical characteristics of the soil, vermicompost, floral vermicompost and farmyard manure before the commencement of the experiment.

Table 1. The physico-chemical characteristics of the soil, vermicompost, floral vermicompost and farmyard manure

Characteristics	Soil	Vermicompost (VC)	Floral vermicompost (FVC)	Farmyard Manure (FYM)
Texture	Sandy	-	-	-
pH	6.4 ±0.50	7.78 ±0.50	7.8 ±0.50	7.6 ±0.50
EC(dSm^{-1})	2.6 ±0.10	3.6 ±0.10	3.5 ±0.10	3.3 ±0.10
Organic carbon (%)	1.8 ±0.30	17.3 ±0.30	16.0 ±0.30	9.0 ±0.30
Total Nitrogen (%)	0.88 ±0.10	2.5 ±0.10	2.1 ±0.10	0.87 ±0.10
Phosphorus (%)	0.22 ±0.10	0.71 ±0.10	0.98 ±0.10	0.49 ±0.10
Potassium (%)	0.15 ±0.05	0.65 ±0.05	0.96 ±0.05	0.77 ±0.05
Calcium (%)	0.08 ±0.01	0.09 ±0.01	0.08 ±0.01	0.04 ±0.01
Magnesium (%)	0.09 ±0.01	0.06 ±0.01	0.07 ±0.01	0.02 ±0.01

Treatment details: The treatment details of the experimental setup were: Gross pot size: 16cm (wide) x 13cm (height) x 9cm (base), Season: Kharif 2022.

The details of the factors in the experiment are given below.
T1: NPK at 75:75:50 kg/ha + FYM at 10t/ha (RDF- Recommended dose of Fertilizer)
T2: Vermicompost (VC) - 15 t/ha
T3: Floral Vermicompost (FVC) - 15 t/ha
T4: Farmyard manure (FYM) - 15 t/ha

Healthy seedlings, 45 days old and of uniform size, were carefully chosen for transplantation into the pots. To ensure optimal growth, a week prior to sowing, generous amounts of farmyard manure (FYM), vermicompost (VC), and floral vermicompost (FVC) were added and thoroughly mixed with the soil. For the essential nutrients, nitrogen, phosphorus, and potassium fertilizers were applied in the form of urea, single superphosphate (P_2O_5), and potassium salt (K_2O) respectively. Nitrogen was administered in two separate doses. Before transplanting, 50% of the nitrogen, along with sufficient phosphorus and potassium, was added to the pot. The remaining 50% of nitrogen was top dressed 45 days after sowing. The crop was harvested at the full flowering stage, precisely 105 days after planting. During the harvest, the entire plants, specifically 10 cm above the potting soil level, were pruned and left to dry in the shade for 3-4 days before storage. To monitor growth, parameters such as height and number of leaves per plant were recorded every 15 days from each replicate of the treatments. The averages were then calculated and analyzed accordingly.

3. GROWTH AND YIELD ESTIMATION :

Growth responses of *A. paniculata* under the treatments was estimated by measuring number of leaves, plant height (cm) and herbage yield as fresh weight & dry weight (gm) of the whole plant (Fig 1-4).

Fig 1. Average number of leaves

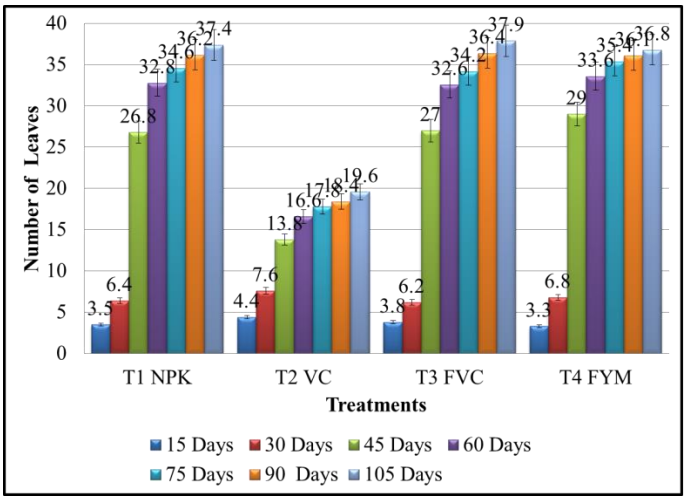


Fig 2. Average height (cm) of plants

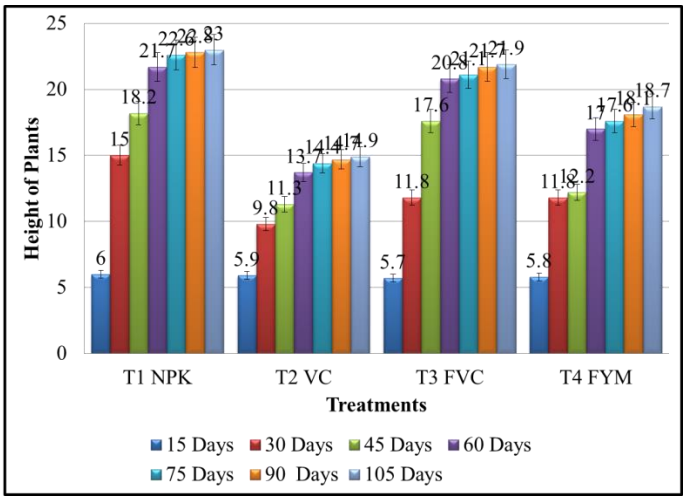


Fig 3. Average of fresh herbage yield (gm)

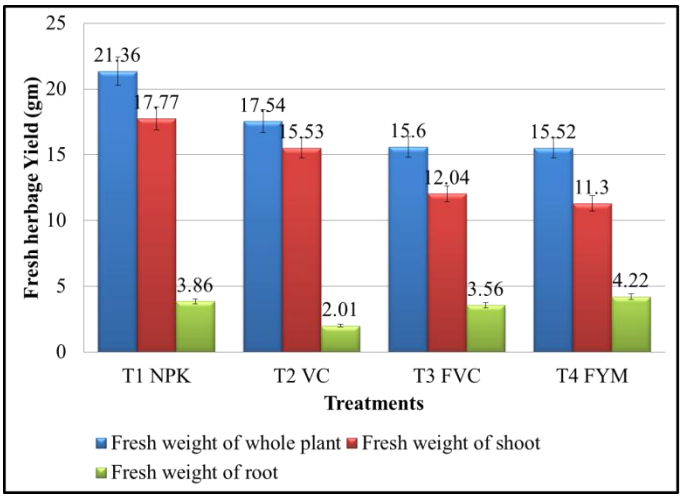
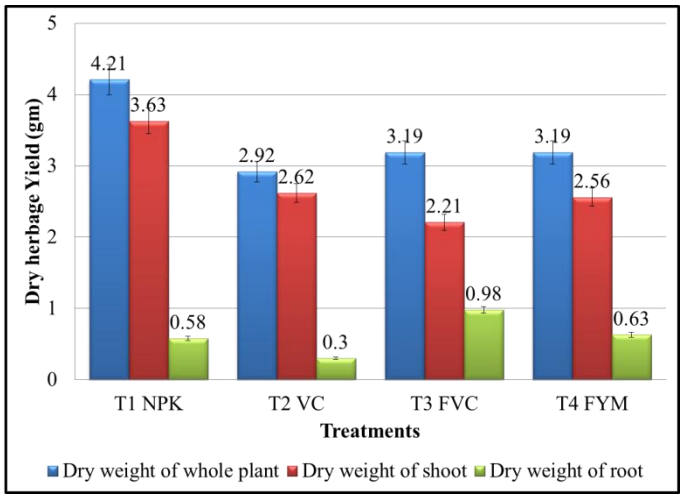


Fig 4. Average of dry herbage yield (gm)



4. RESULT & DISCUSSION:

The study yielded the following results: the plant reached its maximum height in T1 (NPK) compared to T2 (VC), T3 (FVC), and T4 (FYM). T4 (FYM) had the highest number of leaves compared to T2 (VC), T3 (FVC), and T1 (NPK). The recommended dose of synthetic fertilizer in T1 (NPK) resulted in the highest dry herbage biomass yield, although T3 (FVC) was more effective than T4 (FYM) and T2 (VC). These findings suggest that floral vermicompost (FVC) can provide more effective results compared to other organic fertilizers (FYM and VC). It can serve as a better alternative to synthetic fertilizers, not only promoting growth but also enriching the soil with natural minerals. Therefore, this approach could offer a dual solution to the current issues in agriculture, namely the contamination caused by harmful chemicals and the destruction of the soil's natural microbial flora.

5. CONCLUSION:

During the Green Revolution, farmers and agriculturists believed that the only way to meet the growing population's demand for food was by using fertilizers and synthetic treatments. Unfortunately, these methods harmed the soil by contaminating it with chemicals, which had a negative impact on the soil's microbial flora. As a result, there was a pressing need to find an alternative solution that was cost-effective, readily available, and could serve the same purpose as synthetic fertilizers. Researchers and experts in the field began exploring natural approaches to address this problem. They aimed to discover a set of applications that could effectively solve the issue while maintaining the same level of productivity. Our study is focused on *A. paniculata*, a medicinal plant, and its response to various organic additives. The results were promising, indicating that organic production techniques could be utilized to enhance the value of Ayurveda or traditional medicine. Additionally, this approach emphasized the importance of natural resource management and

maintaining harmony with nature. By embracing these natural alternatives, farmers and agriculturists can not only mitigate the negative impact on soil health but also contribute to the preservation of traditional medicine practices. This shift towards organic production techniques offers a sustainable and environmentally friendly solution to the challenges faced by the agricultural industry. However, further studies are required for standardization of doses of organic inoculants.

ACKNOWLEDGEMENT:
The author would like to express his gratitude to the Dayalbagh Educational Institute in Agra for nurturing his scientific curiosity, providing him with the necessary resources, and offering optimal mentorship through his guide, Dr. Akhilesh Kumar.

CONFLICT OF INTEREST: The authors declare that there is no conflict of interest.

REFERENCES:

1. Mishra, S. K., Sangwan, N. S., & Sangwan, R. S. (2007). Phcog rev.: Plant review Andrographis paniculata (Kalmegh): A review. *Pharmacognosy Reviews*, *1*(2), 283-298.
2. Subramanian, K. S., Sivasamy, N., &Thangaraj, T. (2001). Integrated nutrient management for turmeric. *Spice India*, *14*(12), 25-26.
3. Dauda, S. N., Ajayi, F. A., &Ndor, E. (2008). Growth and yield of water melon (Citrullus lanatus) as affected by poultry manure application. *J. Agric. Soc. Sci*, *4*(3), 121-124.
4. Annadurai, K., Kavimani, R., Masilamani, P., &Rangaraju, G. (2001). Controlled application of treated distillery effluent (TDE) and organic amendments on soil fertility status and rice yield. In *Proc: Natl. Seminar on use of poor quality water and sugar industrial effluents in agriculture, held at ADAC & RI, Tiruchirapalli* (Vol. 88).
5. Edwards, C. A., &Arancon, N. Q. (2004). The use of earthworms in the breakdown of organic wastes to produce vermicomposts and animal feed protein. *Earthworm ecology*, *2*, 345-380.
6. Singh, R., Divya, S., Awasthi, A., & Kalra, A. (2012a). Technology for efficient and successful delivery of vermicompost colonized bioinoculants in Pogostemoncablin (patchouli) Benth. *World Journal of Microbiology and Biotechnology*, *28*(1), 323-333.
7. Singh, R., Kalra, A., Ravish, B. S., Divya, S., Parameswaran, T. N., Srinivas, K. V. N. S., &Bagyaraj, D. J. (2012b). Effect of potential bioinoculants and organic manures on root-rot and wilt, growth, yield and quality of organically grown Coleus forskohlii in a semiarid tropical region of Bangalore (India). *Plant pathology*, *61*(4), 700-708.
8. Singh, R., Soni, S. K., & Kalra, A. (2012c). Synergy between Glomus fasciculatum and a beneficial Pseudomonas in reducing root diseases and improving yield and forskolin content in Coleus forskohliiBriq. under organic field conditions. *Mycorrhiza*, *23*(1), 35-44.
9. Singh, R., Paramaeswarn, T.N., Prakasa Rao, E.V.S., Puttanna, K., Kalra, A., Srinivas, K.V.N.S., Bagyaraj, D.J., Divya, S. (2009). Effect of arbuscular mycorrhizal fungi and *Pseudomonas fluorescens* on root-rot/wilt, growth and yield of *Coleus forskohlii*. Biocontrol Sci. Technol. 19(8), 835–841.
10. Awasthi, A., Bharti, N., Nair, P., Singh, R., Shukla, A. K., Gupta, M. M., ... & Kalra, A. (2011). Synergistic effect of Glomus mosseae and nitrogen fixing Bacillus subtilis strain Daz26 on artemisinin content in Artemisia annua L. *Applied Soil Ecology*, *49*, 125-130.
11. Shaji, H., Chandran, V., & Mathew, L. (2021). Organic fertilizers as a route to controlled release of nutrients. In *Controlled Release Fertilizers for Sustainable Agriculture* (pp. 231-245). Academic Press.
12. Kilic, N., Burgut, A., Gündesli, M. A., Nogay, G., Ercisli, S., Kafkas, N. E., ... &Szopa, A. (2021). The effect of organic, inorganic fertilizers and their combinations on fruit quality parameters in strawberry. *Horticulturae*, *7*(10), 354.
13. Yatoo, A. M., Ali, M., Baba, Z. A., & Hassan, B. (2021). Sustainable management of diseases and pests in crops by vermicompost and vermicompost tea. A review. *Agronomy for Sustainable Development*, *41*(1), 1-26.