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The Potency of Four Plant Extracts in Stimulating the Physiological and Yield Parameters of Okra (*Abelmoschus Esculentus*)

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ABSTRACT

This study evaluated the impact of plant extracts from Chromolaena odorata, Aspilia africana, Datura stramonium, and Gongronema latifolium on the physiological and yield parameters of okra (Abelmoschus esculentus). The study aimed to assess the potential of these extracts to enhance plant development and productivity. Okra plants were treated with 500 mg/ml of the extracts as a soil drench. Physiological parameters such as shoot length, stem size, number of leaves, and root length were measured at 20-day intervals for 90 days. Yield parameters, including the number of fruits per plant and fruit weight, were also recorded. The results demonstrated that the growth and yield parameters of treated plants were significantly improved compared to the control ($p \leq 0.05$). These findings suggest that applying plant extracts has the potential to influence the growth and yield parameters of okra, offering a sustainable approach to improve crop performance. Further research is needed to optimize application methods and identify the mechanisms behind these observed effects.

1. Introduction

Soil amendment has been a longstanding agricultural practice for several decades, helping to improve the physicochemical, biological, water-holding capacity, and nutrient content of the soil (Mc Sorley, 2011). Soil application, along with seed amendment, is known to alter the population density of soil microflora and microfauna, which can positively impact soil structure (Nyong & Nworgu, 2023). This, in turn, helps to reduce pathogenic effects on plants, thus favoring their growth and development (Ramadan, 2022). The use of plants as soil amendments for managing agricultural pests and promoting growth dates back to ancient times (Desmedt, et al., 2020).

The history on the use of plant as soil amendment for the management of agricultural pest and growth promotion is dated in the ancient time (Akinkurolere et al., 2019). Plants are natural chemical factories that easily transform simple substances like water, air, and inorganic materials into complex organic substances such as protein, carbohydrates, oil, enzymes, gums, and scents. These substances play significant roles in pollination, defense against predators, and photosynthesis. (Yang & Zhou, 2025). Phytochemicals are biochemical substances produced and stored in specialized tissues that play

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significant roles in various activities, boosting plant growth, development, and defense. (Hohmen & Messmer, 2017; Desmedt et al., 2020).

Plants contain both primary and secondary metabolites that function in physiological and biochemical processes like growth, development, photosynthesis, reproduction, and nutrition (Rabizadeh et al., 2022).

Plant based chemical have found favor as alternative to synthetic chemicals in recent time because plants remained the richest supplier of organic chemicals (Rabizadeh et al., 2022).

Plant-based chemicals have recently gained favor as an alternative to synthetic chemicals because plants remain the richest source of organic chemicals (Yang & Zhou, 2025).

Several plant species have been tested to determine their phytochemical composition and potential for nematicidal, herbicidal, pesticidal, and growth regulatory properties (Ebuete et al., 2022; Ramadan, 2021). Plant-based products, such as extracts, have shown stimulating effects on the general physiology of plants when applied as fumigants or as a soil drench (Pylak et al., 2019).

Despite the vast distribution of plants on Earth, many have not been tested for their growth-stimulating qualities, which is the basis for this study. Stimulants are substances derived from living or non-living organisms that catalyze physiological and yield parameters, promote nutrient intake and utilization, and result in root development, improved nutrient quality, and a counteraction of biotic and abiotic stress (Cozzoline et al., 2020). The regulatory effect of stimulants may vary based on plant species, plant part, age, mode of application/formulation, and dose (Pylak; Oszust & Frac, 2019).

The broad range of stimulant activities includes triggering nitrogen metabolism or phosphorus release for root growth and water/nutrient uptake, which leads to improved plant quality and establishment (Jang & Kuk, 2020). These are advantageous activities from both economic and environmental perspectives (Cozzoline et al. 2020). Based on this premise, this paper seeks to uncover the growth-stimulating qualities of extracts from Aspilia africanus, Chromolaena odorata, Gongronema latifolium, and Datura stramonium on okra.

2. Literature review

The application of botanical extracts for enhancing the physiological and biochemical parameters in okra (Abelmoschus esculentus L. Moench) has gained prominence as a compelling and sustainable alternative to conventional chemical fertilizers. This review provides a documented account of the effects of various plant extracts and natural biostimulants on okra's physiological parameters. In seed priming (pre-sowing), Girase (2019) revealed that extracts from Reetha, Amla, Tulsi, Prosopis, and Arrapu (Albizia amara) leaf, along with cow urine, improved seedling quality and increased the germination of the phule vimucta variety of okra. This foundational step ensures rapid and uniform germination, promoting robust root and shoot development from the outset.

Younis et al. (2024) adopted natural lemon and orange juice as sources of organic amendment for the growth and management of okra. In stress mitigation, particularly in regions prone to drought or other abiotic stresses, Ali et al. (2022) evaluated the role of Ascophyllum nodosum extract (ANE) in improving the drought tolerance of okra through the application of an ANE foliar spray.

Furthermore, implementing natural pest control in okra, Nyande et al. (2021) demonstrated the use of Gliricidia sepium, chicken manure, cow dung, and a combination of papaya and neem leaf as biopesticides. Aside from the biopesticidal effect, using neem or bitter leaf extracts also provided a secondary source of nutrients, creating a self-reinforcing system.

For agronomic parameters and nematode control, Nyande et al. (2019) recommended Azotobacter, Azospirillum, and neem seed cake for better okra growth, yield, and nematode control. Mohammadi et al. (2022) applied Arbuscular Mycorrhiza Fungi like Arjuna, Bael, Harad, Bahed, Arrapu, Neem, and Seaweed extract to improve the morphological characteristics of okra transplants. Bunu et al. (2020) also demonstrated the influence of compost tea concentrations on the morphophysiological characteristics and qualities of okra. While the aforementioned research provides a strong foundation in natural biostimulants, more plant extracts are required for further investigation to optimize the use of natural biostimulants in okra, particularly in synergistic interactions. This study, therefore, evaluates the cumulative and synergistic effects of a combination of four plant extracts in a sequential protocol.

3. Materials and methods

Research Design

The study was conducted under field conditions using a randomized complete block design (RCBD). This design was chosen to create homogeneity in each group and limit variation among treated groups, which commonly occurs in research.

Study Area

The study was conducted on a plot of land at the Department of Crop and Soil Science, Faculty of Agriculture, University of Port Harcourt, Nigeria. The location is situated at approximately Long. 6° 92' N and Lat. 4° 32' E.

Population of the Study

A total of twenty-five okra (Abelmoschus esculentus) plants were used in the study. Five beds were prepared, and each bed contained five plants. Each of the four plant extracts was randomly assigned to a bed, with one bed serving as the control.

Procurement and Preparation of Plant Extracts

The plants used in this study were collected from an abandoned farm in Kolo II Community, Kolo Creek, in Ogbia Local Government of Bayelsa State. A plant biotechnologist at the Department of Plant Sciences identified the plants to the species level using standard taxonomic keys, pictures, and voucher specimens available in the department (table 1). Leaves of A. africana, C. odorata, G. latifolium, and D. stramonium were thoroughly washed and air-dried at room temperature for fifteen (15) days. The dried leaves were separately macerated into a powder using a blender. Twenty-five grams (25g) of each powdered material were soaked in a 250 ml flask of 96% ethanol for two days (Duong et al., 2019). The mixtures were then filtered and further agitated in an orbital shaker for four (4) hours before being centrifuged at 1500 rounds per minute (rpm) for 25 minutes to collect the supernatant. The solvents were subsequently evaporated to remove the ethanol using 2% of twenty-five Dimethyl sulfanide.

Experimental Field and Plant Maintenance

The farmland was properly cleared, and all trees were uprooted. Five beds were laid out, and okra seeds were planted (Figure 1). The okra seeds were procured from the Agricultural Services, Ministry of Agriculture, Bayelsa State, Nigeria. The variety used was Baby Buba (Dwarf Cv), an early-maturing variety that produces within 53-60 days of planting. A 500 mg/ml solution of each extract was carefully introduced as a soil drench around the base of the plants two weeks after planting.

Figure 1. Bed preparation and Cultivation

Source: Researcher, 2025

The plants were regularly maintained by weeding and watering to protect them from insects and pests. The fruits were harvested at 3-4 day intervals when they became tender and edible (Figure 2).

Data Collection

Physiological parameters, including shoot length, stem size, number of leaves, and root length, and yield parameters, such as the number of fruits per plant and fruit weight, were measured every 20 days from the date of planting.

Statistical Analysis

Data from the study were managed with statistical software, and the results were analyzed using the analysis of variance (ANOVA). and the differences among the mean were determined for significance at ($P \leq 0.05$) for all the analyses. All the calculation were performed using CSO test by SASS.

Table 1. Plants Used in the study

Local Name	Scientific Name	Family
Wild Sunflower	*Aspillia africana*	*Asteraceae*
Siam Weed	*Chromoleana odorata*	*Asteraceae*
Thorn Apple	*Datura stramonium*	*Solanaceae*
Utazi	*Gangronema latifolium*	*Pipolynaceae*

Source: Researcher, 2025.

Table 2. Quantitative Screening of Phytochemicals in the extracts of A. afrcanus, C. odorata, D. stramonium and G. latifolium

Phytochemicals	Plants			
	A. africana	*G. latifolium*	*C. odorota*	*D. stamonium*
Alkaloid	+	++	++	+++
Flavonoid	+	++	+	+++
Saponin	+	++	+++	+

Phytochemicals	Plants			
	A. africana	*G. latifolium*	*C. odorota*	*D. stamonium*
Tanins	+	++	++	+
Steroid	-	+	-	+
Phenol	++	++	++	+++

Source: Researcher, 2025.

Keys: +++ (Abundantly presents); ++ (Present); + (Detected); – (Not Detected).

4. Result presentation and discussion

The benefits of soil amendment with plants in different forms for crop management are multifaceted (Desmedt et al., 2020). They serve as pesticides and also stimulate the physiological parameters of treated crops, such as shoot length, stem size, root length, number of leaves, and yield parameters.

Table 3. Physiological Parameters and yield of Okra after the application of plants extracts

Plants Extract					
Plant Physiology	*A. aspilia*	*G. latifolium*	*C. odorata*	*D. stramonium*	*Control*
Shoot Length	53	55	58	60	32
Stem Size	10	9.5	12	13.5	5.5
Number of leaf	15	15.5	16	16	7
Root length	17	19	18.5	18.8	14
Fruit Number	9	9.8	10.3	10.6	4
Fruit weight	3	3	3.1	3.5	0.5

Source: Researcher, 2025

Table 3 above presents the effects of plants extracts on the physiological parameters and yield of Okra at 500mg/ml for 80 days treatment period.

Figure 2. Physiological and yield parameters of treated Okra with plants extracts (500 mg/ml) and Control

Source: Researcher, 2025

Figure 2 above present the physiological and yield parameters difference of Okra without treatment and Okra plants exposed to treatments (500mg/ml) on.

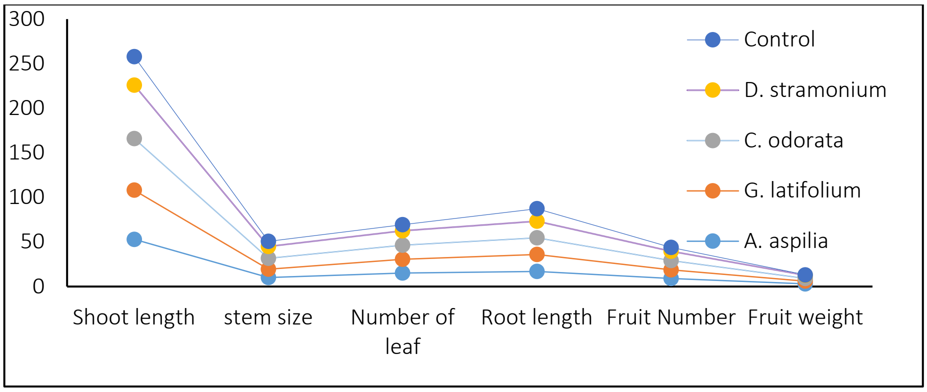

Figure 3. Effects of plant extracts (500mg/ml) on physiological and yield parameters of Okra

Source: Researcher, 2025

Figure 3. Above shows the effect of the plant extract on the growth and yield parameters of Abelmoschus esculentus. The results revealed that, there was a significance difference (P≤0.05) of all the physiological parameters measured such as shoot length, stem size, number of leaves, root length. Measuring the yield parameters, the treated plant recorded a significant difference (P≤0-05) in both number of fruits and fruits weight as compared to the control. The treated plants recorded an average of 9.8 fruits at 3g as against the 4 fruits of 0.5g recorded at the control group.

The study showed a significant difference in all physiological and yield parameters in the treated plants compared to the untreated plants in the control group (Figure 2). This difference could be due to the release of growth-stimulating factors contained in the plant extracts. This finding corroborates the results of Bakr & Ketta (2018) and Hussian et al. (2011), who found that applying D. stramonium leaf extract significantly improved the physiological and yield parameters of tomato and okra plants under field conditions. The significant improvement in the treated plants could also be attributed to the pesticidal potential of the plant extracts, which may have allowed the treated plants to thrive in an environment free from interference. This observation aligns with the findings of Mc Sorley (2011), who reported that applying plant parts as a soil amendment affects soil nematodes and other soil microbes, which can induce plant resistance to pathogenic attacks and improve physiological and yield parameters. Jang and Kuk (2020) also reported a significant increase in the shoot length and stem size of pepper plants treated with plant extracts.

Treated plants also recorded a higher number and size of leaves compared to the control group (Figure 2). This could be attributed to the extracts' activity in inducing the release of soil nutrients responsible for effective photosynthesis. This observation corroborates the findings of Nyong & Nworgu (2023), who reported that the fertilizing properties of C. odorata extracts promote the normal emergence of leaves from seedlings and limit early yellowing. Mohamed et al. (2020) also reaffirmed this by reporting that the application of plant extracts as an amendment promotes the improvement of plants' basic physiological activities, such as the photosynthetic carbon cycle. This directly affects the metabolic process that strengthens plants against biotic and abiotic interference.

The studied plants contain many phytochemicals, as revealed by their direct and indirect effects on the overall improved physiological and yield parameters of treated plants (Figure 3). This agrees with the findings of Cozzoline et al. (2020), who noted that the biostimulating effect of plant extracts is linked not to the micro and macronutrients in the extract, but rather to the content of activating compounds such as small peptides, free amino acids, endogenous hormones, and phenolic compounds. These compounds may affect metabolism, which triggers the activation of glycolytic enzymes, the Krebs cycle, and nitrate assimilation. Wilton (2025) also professed that the primary effect of phenolic compounds is stimulating nutrient uptake, cell division, cell differentiation, elongation, enzymatic activities, protein synthesis, photosynthesis, sink/gene regulations, and plant antioxidant capacity in plant cells.

Pylak, Oszust, and Frac (2019) also reaffirmed the relationship between growth and yield parameters and bioactive substances in their findings, noting that byproducts used as a soil amendment enhance nutrient uptake by activating the genes involved in transportation. Bulgari et al. (2019) also asserted that plant byproducts ameliorate microbial and enzymatic activities in the soil, leading to modification, stabilization, and transportation of nutrients, increased soil and electron exchange, and the provision of nitrogen.

The treated plants had limited above-ground symptoms of plant infection compared to the control group (Figure 2). This could be attributed to the absence of infections, which allowed the treated plants to thrive in unhindered and undisturbed conditions for proper growth and development. This observation corroborates the findings of Sidhu et al. (2017); Nyande et al. (2019) who reported that plant byproducts for soil amendment help suppress plant pathogenic infections and alter the physicochemical and biological composition of the soil for the benefit of plants.

The treated plants recorded an average of 10 fruits compared to the three fruits in the control group (Figure 2), which may be attributed to a direct relationship with the health condition. This enabled the treated plants to thrive with normal physiological processes like nutrient absorption and translocation (Table 3). This assertion aligns with the findings of Zhang et al. (2022), who reported that plant infections interfere with root activity and photosynthesis and can create an energy sink that absorbs photosynthetic products needed for the development of physiological and yield parameters. The yield and products from the control group were of poor quality with a reduced shelf life, which signifies that the health of the plant has a direct relationship with its physiological and yield parameters. This agrees with the findings of Usman & Kundiri (2016), who reported that the quality and quantity of crop yield are directly related to the plant's health in absorption and translocation capacity during its vegetative stage.

5. Conclusions

In conclusion, the study has further amplified the use of plant extracts as powerful and sustainable strategy for enhancing the cultivation of okra. The bioactive compounds within these extracts (A. africana, C. odorata, G. latifolium and D. stramonium), such as polyphenols, flavonoids, and various growth regulators, are shown to positively influence key physiological processes, leading to improved plant vigor, resilience, and overall health. Consequently, this intervention translates directly into significant gains in both the quality and quantity of okra yield, contributing to the meeting of Sustainable Development Goals 2 (Zero Hunger); Goals 12 (responsible consumption) and Goals 15 (Life on Land). Again, the study provided a viable and eco-friendly alternative to synthetic chemicals, were the application of plant extracts underscores a promising path towards more effective and environmentally conscious agricultural practices, ensuring a robust and productive future for okra farming and meeting

Conflict of Interest: The author(s) declare no conflict of interest.

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