



## Botanical boost of the Growth and Yield of Okra (*Abelmoschus esculentus*) through Plant Extracts

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### ABSTRACT

This study investigates the potential impacts of different natural extracts on the growth and productivity of okra (*Abelmoschus esculentus*). The extracts being examined include water, moringa extract, neem extract, rose extract, and onion extract. The study employs a controlled experimental design, exposing okra plants to various botanical treatments in a controlled environment. Observing and studying parameters such as plant height, leaf area, flowering patterns, and fruit yield allows for a deeper understanding of the effects of each treatment. Preliminary findings suggest a notable enhancement in the growth and productivity of okra across various experimental conditions. Research has demonstrated that the application of Moringa extract has yielded notable improvements in plant height and overall biomass, suggesting its promising role as a growth enhancer. Neem extract is widely recognized for its pesticide properties, supporting plant health and mitigating the impact of pests on plants. Through the study of rose extract, we can gain insights into its influence on the flowering process and its potential to enhance reproductive performance. Furthermore, the biochemical composition of onion extract plays a crucial role in influencing fruit development and overall yield. The control treatment using water showcases the fundamental growth parameters, providing a point of reference for comparison with the botanical treatments. This research offers valuable insights into the potential advantages of utilizing plant extracts to enhance okra cultivation. It offers sustainable and eco-friendly options to improve crop productivity. The findings offer valuable insights into the convergence of plant biology and agricultural innovation, resulting in improved approaches to harnessing botanical resources for crop improvement.

## Introduction

With the ever-increasing demands for food production and the need to address the environmental impacts of conventional farming practices, agriculture is facing significant challenges<sup>1,2</sup>. There has been a growing interest in finding sustainable and environmentally friendly solutions, which has led to the development of innovative approaches<sup>3,4,5</sup>. One of these approaches involves studying the use of plants to improve crop growth and increase yields<sup>6,7,8</sup>. One particular crop that holds great significance is okra (*Abelmoschus esculentus*), known for its high nutritional value and its ability to be used in a wide range of cuisines around the globe<sup>9,10</sup>.

Okra cultivation, similar to other crops, can be affected by a range of stressors such as pests, diseases, and changes in the environment<sup>11,12</sup>. Traditional farming methods frequently depend on artificial substances, which can raise worries about the long-term health of the environment and the soil<sup>13,14</sup>. In this context, the potential benefits of utilizing plant extracts, which are abundant in bioactive compounds and growth-promoting substances, have attracted significant attention as a viable and environmentally friendly approach<sup>15</sup>.

Moringa (*Moringa oleifera*) is well-known for its impressive nutritional profile, containing a wide range of bioactive compounds such as vitamins, minerals, and antioxidants<sup>16</sup>. Neem, a plant commonly used in agriculture, is renowned for its pesticidal properties and its potential to enhance growth<sup>17</sup>. Extracts from roses and onions have distinct compositions that can potentially benefit plant physiology<sup>18,19</sup>. The floral composition of rose extract may have positive effects, while the sulphur compounds in onion extract could enhance nutrient uptake and stress resistance. With the growing global population, it is crucial to adopt innovative and sustainable methods for agricultural production in order to ensure food security. Exploring the potential of botanical extracts to improve crop performance is an intriguing area of study that deserves further investigation and practical application. The results of this study have the potential to enhance our knowledge of plant-crop relationships and offer farmers effective and eco-friendly approaches to maximise their yields while maintaining sustainable farming methods.

This study explores the potential of plant extracts to enhance the growth and yield of okra. The use of natural plant extracts is in line with the growing trend towards organic and sustainable agriculture. These botanical interventions, derived from various plant sources, present a promising opportunity to enhance crop productivity while reducing negative effects on the environment. In this

study, we aim to thoroughly assess the effects of these plant extracts on various growth parameters of okra, such as plant height, leaf area, flowering patterns, and fruit development. Additionally, we will evaluate how these effects contribute to the overall yield of okra. Through careful examination of the complex relationships between these plant interventions and the physiology of okra, this study seeks to provide valuable knowledge to the growing field of sustainable agriculture.

## Materials and Methods:

### 1. Experimental Site:

The study was conducted at AZRC DI Khan, where suitable conditions for okra (*Abelmoschus esculentus*) cultivation were maintained. The experimental site was selected based on optimal sunlight exposure, soil quality, and irrigation availability.

### 2. Plant Material:

Okra seeds of a uniform variety (DEK-203) were procured from a reputable supplier. Seeds were pre-germinated in a controlled environment to ensure consistent germination rates. Seedlings with similar vigor were selected for the experimental setup.

### 3. Botanical Extracts:

The botanical extracts used in this study included water (control), moringa extract, neem extract, rose extract, and onion extract. Extracts were prepared using established protocols to maintain consistency in concentration and composition.

### 4. Experimental Design:

A randomized complete block design (RCBD) was adopted to minimize bias and account for potential spatial variability. Each treatment (water, moringa extract, neem extract, rose extract, onion extract) was replicated three times to ensure statistical robustness.

### 5. Soil Preparation and Planting:

The experimental area was prepared by tilling the soil and incorporating organic amendments to enhance fertility. Okra seedlings were transplanted into the prepared soil at uniform spacing, adhering to recommended planting guidelines.

### 6. Application of Botanical Treatments:

The botanical extracts were applied at specific growth stages: seedling establishment, vegetative growth, and flowering. Treatments were administered via foliar spray ensuring comprehensive exposure to the plants.

### 7. Monitoring and Data

## Collection:

Throughout the growth cycle, key growth parameters were meticulously monitored. These included plant height, leaf area, flowering patterns, and fruit development. Regular assessments were conducted to record any observable changes in plant health and vigor.

## 8. Statistical Analysis:

Collected data were subjected to statistical analysis using appropriate software. Analysis of variance (ANOVA) and post-hoc tests were employed to discern significant differences among treatments. The statistical significance level was set at 95%.

## Results:

### 1. Plant Growth Parameters:

- *Plant Height:* Moringa extract significantly promoted plant height,

**Table 1. Effect of plant extracts on plant height and leaf area of Okra**

Plant Extract Treatment	Plant Height (cm)	Leaf Area (cm <sup>2</sup> )
Water (Control)	121.63	13.08
Moringa Leaf Extract	139.87	17.61
Neem Extract	136.11	16.32
Rose Extract	129.54	15.09
Onion Extract	126.13	14.41

### 2. Flowering Patterns:

- *Flowering Time:* Moringa and rose extracts expedited flowering, leading to 5.3 and 4.98% decrease in flowering time compared to the control. Neem and onion extracts also accelerated flowering, albeit at a slightly slower rate (Table 2).

**Table 2. Effect of plant extracts on flowering time and count of Okra**

Plant Extract Treatment	Flowering time (cm)	Flower Count
Water (Control)	78.43	116.18
Moringa Leaf Extract	74.28	167.13
Neem Extract	76.83	149.72
Rose Extract	74.53	158.79
Onion Extract	77.01	143.41

### 3. Fruit Development and Yield:

- *Fruit Set:* Moringa and neem extracts significantly enhanced fruit set, resulting in 23.76 and 18.54% increase compared to the control. Rose and onion extracts also demonstrated positive effects,

resulting in 15.3% increase compared to the control. Neem and rose extracts also exhibited positive effects, albeit to a lesser extent. Onion extract demonstrated a comparable impact, showcasing only 3.7% increase in plant height (Table 1).

- *Leaf Area:* Moringa and neem extracts significantly increased leaf area, indicating enhanced vegetative growth. Rose and onion extracts demonstrated moderate improvements, while the control group exhibited the baseline leaf area (Table 1).

- *Flower Count:* Moringa and rose extracts significantly increased the number of flowers per plant, indicating a positive influence on reproductive development. Neem and onion extracts demonstrated moderate effects, with slight improvements over the control (Table 2).

contributing to 12.3 and 9.67% increase in fruit set (Table 3).

- *Yield:* Moringa and neem extracts led to a substantial increase in okra yield, showing 25.45 and 23.15% increase compared to the control. Rose and onion extracts exhibited moderate improvements in yield, contributing to 8.86 and 8.98%

increase in harvested okra (Table 3).

**Table 3. Effect of plant extracts on fruit set and yield of Okra**

Plant Extract Treatment	Fruit Set	Okra Yield (ton ha <sup>-1</sup> )
Water (Control)	49.53	3.02
Moringa Leaf Extract	61.29	3.78
Neem Extract	58.71	3.71
Rose Extract	55.62	3.29
Onion Extract	54.31	3.29

### Discussion:

The observed enhancements in the growth and yield of okra through the application of plant extracts open avenues for sustainable agricultural practices. The significant increase in plant height and leaf area, particularly with moringa extract, suggests the potential of this botanical treatment as a growth stimulant<sup>20</sup>. Moringa, known for its rich nutrient content and bioactive compounds, likely played a crucial role in promoting cellular division and elongation, resulting in the observed height and leaf area increments<sup>21,22</sup>. Neem extract, recognized for its pesticidal and growth-promoting properties, contributed to both vegetative and reproductive aspects, reinforcing its multifaceted impact on okra physiology<sup>23,24</sup>.

The accelerated flowering time and increased flower count with moringa and rose extracts indicate a positive influence on reproductive processes. Moringa, in particular, demonstrated an exceptional ability to expedite flowering, suggesting potential implications for early fruit development. The promotion of fruit set and the subsequent increase in yield further support the efficacy of these botanical treatments in enhancing okra productivity. Neem extract's role in improving fruit set aligns with its known effects on plant health and resistance to pests, further underlining its potential as a holistic growth promoter.

The observed improvements in okra yield are particularly promising, considering the rising demand for sustainable agricultural practices. The moderate yet consistent effects of rose and onion extracts on various growth parameters demonstrate their potential as supplementary botanical boosters. The unique biochemical compositions of rose and onion extracts likely contributed to their positive impact on plant physiology, influencing flowering, fruit development, and ultimately, yield.

The findings from this study emphasize the feasibility of incorporating plant extracts into agricultural practices to enhance crop performance. Utilizing these natural extracts not only promotes sustainable farming but also aligns with the global

shift towards eco-friendly and organic approaches. Moreover, understanding the nuanced impacts of different plant extracts on okra growth provides a foundation for optimizing application methods, concentrations, and timings for maximum efficacy.

### Conclusion:

This study illuminates the promising potential of plant extracts as a botanical boost for the growth and yield of okra (*Abelmoschus esculentus*). The results showcase the varied impacts of moringa, neem, rose, and onion extracts on key growth parameters and fruit production. Moringa extract, in particular, emerged as a powerful growth stimulator, significantly enhancing both vegetative and reproductive aspects. The findings highlight the multifaceted benefits of these botanical treatments, providing valuable insights for sustainable agricultural practices. Incorporating plant extracts into cultivation strategies presents an eco-friendly and resource-efficient approach to improve crop productivity. This research paves the way for further exploration and application of botanical solutions in enhancing the resilience and yield of important crops, contributing to the broader discourse on sustainable and innovative agricultural practices.

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