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# Effect of Botanical Extracts on Seed Germination and Seedling Growth and Adult Plant Growth of Lady-Finger (okra)

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**Abstract**

Lady-finger (*Abelmoschus esculentus L.*) is a vital vegetable crop native to Africa and extensively cultivated in tropical and subtropical regions around the world. The success of lady-finger cultivation depends on the efficient management of key growth stages, particularly seed germination and seedling growth. This study aimed to assess the impact of two plant extracts, neem (*Azadirachta indica*) and garlic (*Allium sativum*), on the seed germination, adult plant growth and flowering of lady-finger plants. A total of six pots were employed in the experiment, divided into two groups: one treated with 50 ml of garlic extract per pot, the other treated with 50 ml of neem extract per pot, while two pots served as control. The study revealed noteworthy findings regarding the influence of these plant extracts on lady-finger plants. The results indicate that the highest seed germination rate was observed in the pots treated with neem extract, followed by those treated with garlic extract, while the control pots exhibited the lowest germination rate. Subsequently, the growth of lady-finger plants was most pronounced in the pots treated with garlic extract, with neem-treated pots exhibiting intermediate growth, and control pots displaying the least growth. Furthermore, in terms of flowering and fruiting, lady-finger plants treated with neem extract exhibited the highest flowering and fruiting rates, compared to those in the control pots. However, the flowering process in garlic-treated pots was delayed or suppressed compared to neem treated pots. These findings suggest that the application of neem and garlic extracts can significantly affect the germination, growth, and flowering of lady-finger plants.

**Keywords**

Plant Extracts; Seed Germination; Plant Growth; Lady Finger (okra)

## Introduction

Lady-finger, scientifically known as *Abelmoschus esculentus L.* and commonly referred to as okra or bhindi in India, plays a votal role in global agricultural production. India stands as one of the world's largest producers of okra, accounting for a substantial 67.1% of the crop (with an expansive cultivation area of 0.53 million hectares and a crop yield of 11.9 million metric tons), followed by Nigeria (15.4%) and Sudan (9.3%) (*Das and Mal, 2023*). The significance of ladyfinger cultivation is underscored by its role in providing sustenance and economic stability to a considerable portion of the world's population. This crop holds substantial importance due to its dual role as a vegetable for human consumption and its utilization in various industrial applications (*Banvasi et al., 2020*). The nutritional composition of okra is notably diverse, encompassing saturated fats, carbohydrates, proteins, and a spectrum of essential vitamins such as A, B6, B12, folate, riboflavin, niacin, pantothenic acid, C, and E. Additionally, it is rich in essential minerals, including magnesium, phosphorus, potassium, zinc, sodium, copper, manganese, and selenium. Notably, okra seeds are a source of dietary fiber and sugars, and their utility extends to applications such as coffee additives and industrial use (*Girase et al., 2019; Banvasi et al., 2020*).

Seed germination and seedling growth are fundamental stages in the life cycle of plants, setting the foundation for their future development. The journey from a germinating seed to a thriving, mature plant is intricate, influenced by various factors, including soil quality, water availability, and sunlight. However, certain overlooked factors, such as the hard seed coat of okra, can significantly impact germination rates. The rigid seed coat limits water absorption and impedes the uniform growth of embryos, contributing to lower germination percentages (*Moosavi et al., 2009*).

This study explores the often-neglected influence of natural plant extracts on the growth and development of ladyfinger plants. Traditional farming practices and anecdotal evidence have long suggested that certain plant extracts can augment plant growth.

In the pursuit of understanding these dynamics, we focused on two readily available plant extracts: neem (*Azadirachta indica)* tree, and garlic. Neem has a centuries-old history in traditional medicine and agriculture, particularly in the Indian subcontinent, and is renowned for its properties as a natural insect repellent. Garlic, a

staple in many kitchens, is celebrated for its culinary and medicinal value and originates from Central Asia but has achieved global recognition. While the health benefits of garlic's allicin compound are well-documented, its effects on plant growth represent a promising avenue for exploration.

Hence, the study was focused on the understand the effect of botanical extracts on seed germination, seedling growth and adult plant growth of lady-finger (okra) through a systematic experimental approach.

## Materials and Methods

### Procurement of Materials

The experiment was carried out in the research laboratory of the Department of Botany at Meerut College, Meerut, Uttar Pradesh. The study employed two distinct varieties of lady-finger seeds, namely, Anamika S-51 and Krishama, which were procured from the local market of Meerut city. Seed germination experiments were conducted from 30 April 2022 to 15 May 2022, to assess the initial phase of seed germination. Subsequently, from 20 March 2023 to 15 June 2023, further investigations were conducted to evaluate seed germination, seedling growth, and the impact of plant extracts on plant growth and flowering in a pot experiment.

### Preparation of Crude Extracts

### Plant Material Collection and Preparation

Neem leaves and garlic bulbs were meticulously cleaned by washing them with a 5% sodium hypochlorite solution, followed by thorough rinsing with distilled water. Subsequently, the cleaned plant materials were air-dried by placing them on blotting paper. Once dried, the samples were finely ground using a pestle and mortar in the presence of liquid nitrogen and stored in Falcon tubes at -20 °C for subsequent utilization.

### Extraction Process

For the extraction process, an equivalent volume of distilled sterilized water (1:1 w/v) was combined with the prepared plant material. The mixture was agitated on a mechanical shaker at a rate of 100 rotations per minute (rpm) for a period of 2 hours, at room temperature (28 °C). Afterward, the mixture was subjected to centrifugation at 4500 rpm, separating the supernatant from the solid residues.

The supernatant was collected and further refined by passing it through Whatman no. 1 filter paper. This refined extract was subsequently employed in both *in-vitro* and *in-vivo* studies, using various concentrations as required for the experimental investigations.

**Experimental Design**

Prior to sowing, 20 seeds of ladyfinger were subjected to a 5 ml (concentration) treatment with neem extract, and another 20 seeds were treated with garlic extract with the same concentration (5 ml) for a duration of 6 hours. Following the treatment, the seeds were air-dried on sterilized blotter paper for a period. Further, the germination percentage was calculated for the treated seeds. The germination was calculated based on the below given formula.

$$\text{Germination Percentage (\%)} = \frac{Number\ of\ Normal\ Seedling\ germination}{Total\ number\ of\ seeds\ kept\ for\ germination} X100$$

Six pots, each containing 10 seeds of lady-finger were utilized in this study. After 15 days from the date of sowing, two pots were subjected to a 50 ml neem extract treatment, while another two pots received a 50 ml garlic extract treatment. The remaining two pots were designated as untreated controls. Plant growth was assessed at various time intervals, specifically at 15, 25, 35, 45, 55, and 65-days (10 days interval) post-sowing.

**Plant Growth Measurement**

After 65 days, the plants were uprooted, and the root length and shoot length of each plant were measured to determine the final plant growth characteristics.



**Fig 1. Plant growth before giving plant extract treatments.**



**Fig 2. Plant growth after giving plant extract treatments.**



**Fig 3. Plant growth after flowering and fruiting.**



**Fig 4. Plant growth after 65 days.**

## Results and Discussion

### Effect of seed treatments on seed germination

The influence of seed treatments with neem and garlic extracts on seed germination was assessed in this study. The results indicate significant variations in seed germination percentages among the treated and untreated seed groups. Seeds subjected to neem extract treatment exhibited a robust germination rate, with a remarkable 95% germination percentage. In contrast, seeds treated with garlic extract displayed a slightly lower germination rate of 75%. Notably, seeds that received no treatment (untreated) displayed the lowest germination rate, recording a value of 45%. These findings underscore the positive impact of neem extract on seed germination, suggesting its potential as a seed treatment option to enhance germination rates. In contrast, the garlic extract, while still beneficial, yielded slightly lower germination percentages. The lower germination rate observed in untreated seeds emphasizes the importance of seed treatment practices for optimizing germination outcomes, particularly in agriculture and horticulture applications.

**Effect of Pot soil treatment on plant growth**

**Effect of neem and garlic extract on plant shoot length after different time intervals**

The results presented in the dataset below depict the dynamic changes in plant shoot length for different varieties of seeds under these treatments at 10-day intervals. The data clearly illustrate the progressive growth in plant shoot length over the course of 75 days for various treatments and seed varieties.

| Treatment | Varity of seeds | 15days | 25days | 35days | 45days | 55days | 65days | 75days |
|---|---|---|---|---|---|---|---|---|
| Neem extract | Anamika | 4.1 | 7.6 | 7.7 | 11 | 13.9 | 20.3 | 23.2 |
| Neem extract | Krishama | 3.9 | 6.9 | 7.2 | 10.2 | 11.1 | 16.8 | 19.2 |
| Garlic extract | Anamika | 5 | 9 | 9.3 | 12.1 | 14 | 22.5 | 26.3 |
| Garlic extract | Krishama | 4.2 | 8.4 | 8.6 | 9.7 | 15.1 | 21.5 | 26.2 |
| Control | Anamika | 3.3 | 5.9 | 6.1 | 7.4 | 10.2 | 13.1 | 15.7 |
| Control | Krishama | 4.2 | 6,9 | 7.2 | 7.7 | 8.3 | 9.4 | 11.8 |

*Effect of Time Interval:* As expected, the shoot length increased over time for all treatments and seed varieties, reflecting normal plant growth. This time-dependent increase is particularly evident from 15 days to 75 days across all treatments.

*Effect of Neem Extract:* In the neem extract treatment group, both Variety 1 and Variety 2 exhibited consistent growth in shoot length. By the end of the study, Variety 1 had a shoot length of 23.2 cm, while Variety 2 reached 19.2 cm. This suggests that neem extract had a favorable impact on shoot growth over time.

*Effect of Garlic Extract:* Similarly, the garlic extract treatment group displayed notable shoot length increments. Variety 1 and Variety 2 both reached substantial shoot lengths of 26.3 cm and 26.2 cm, respectively, indicating a positive influence of garlic extract on plant growth.

*Control Group:* In the control group, both seed varieties displayed comparatively lower shoot lengths at the end of the study, with Variety 1 and Variety 2 reaching 15.7 cm and 11.8 cm, respectively. These findings emphasize the impact of treatments in enhancing shoot growth compared to untreated controls.

The results suggest that both neem and garlic extract treatments have a positive influence on plant shoot length over time, with garlic extract showing slightly more pronounced effects. These findings have implications for plant cultivation and agricultural practices, highlighting the potential of natural extracts to enhance plant growth.

**Effect of neem and garlic extract on plant root length**

Following a 75-day growth period, plants were uprooted and their root and shoot lengths were measured to assess the effects of neem and garlic extract treatments. The results demonstrate notable variations in root and shoot length among the different treatment groups.

**Root Length:**

The maximum root length was observed in the garlic treatment group, with an average of 18.1 cm for Variety 1 and 17.4 cm for Variety 2. Neem treatment resulted in a slightly lower root length, with an average of 15.3 cm for Variety 1 and 10.1 cm for Variety 2. In contrast, the control group displayed the shortest root length, with an average of 8.4 cm for Variety 1 and 7.6 cm for Variety 2.

**Shoot Length:**

Garlic treatment also demonstrated a substantial impact on shoot length, with the maximum shoot length recorded at 26.3 cm for Variety 1 and 26.2 cm for Variety 2. Neem treatment, although effective, displayed slightly shorter shoot lengths, with an average of 23.2 cm for Variety 1 and 19.2 cm for Variety 2. The control group exhibited the shortest shoot lengths, with an average of 15.7 cm for Variety 1 and 11.8 cm for Variety 2.

These results emphasize the significant influence of neem and garlic extract treatments on root and shoot growth. Garlic treatment, in particular, has demonstrated a substantial positive effect on root and shoot length, suggesting its potential for enhancing plant growth. Neem treatment also showed positive outcomes, albeit to a slightly lesser degree. In contrast, the control group exhibited the least favorable growth parameters.

| Sr.No. | Treatments | Varity of seeds | Root length (cm) | Shoot Length(cm) |
|---|---|---|---|---|
| 1 | Neem extract | Anamika | 15.3 | 23.2 |
| 2 | Neem extract | Krishama | 10.1 | 19.2 |
| 3 | Garlic extract | Anamika | 18.1 | 26.3 |
| 4 | Garlic extract | Krishama | 17.4 | 26.2 |
| 5 | Control | Anamika | 8.4 | 15.7 |
| 6 | Control | Krishama | 7.6 | 11.8 |

**Effect of Plant extract on number of fruits**

To assess the effect of plant extracts on the number of fruits, the total number of fruits per pot was calculated after a growth period of 75 days. The data presented in the table reveal significant variations in the number of pods per pot across the different treatments.

Treatment with neem extract resulted in the highest number of pods, with 16 and 19 pods recorded in two respective varieties used in the study. In comparison, the control group exhibited a relatively favourable fruit yield, producing 10 and 12 pods in two separate observations. In contrast, the garlic extract treatment showed the lowest fruit yield, with only 3 and 5 pods being observed.

These findings underscore the substantial impact of different treatments on fruit production. The neem treatment, in particular, significantly increased the number of pods, suggesting its potential as a means to enhance fruit yield. Conversely, the garlic treatment yielded fewer pods, indicating a less favorable outcome in terms of fruit production. The control group, while intermediate in fruit yield, displayed a notable contrast with the neem treatment.

| Sr.No. | Treatments | Fruits Number |
|---|---|---|
| 1. Anamika | Neem extract | 16 |
| 2. Krishama | Neem extract | 19 |
| 3. Anamika | Garlic extract | 5 |
| 4. Krishama | Garlic extract | 3 |
| 5. Anamika | Control | 10 |
| 6. Krishama | Control | 12 |

## Conclusion

The finding of present study indicates the various soil borne pathogens attack to lady-finger plants. Amongst the seedborne diseases, fusarium wilt is one of the major diseases, Fusarium wilt is one of the major diseases occurs in lady-finger crops and causes a huge loss in the production of crop. The farmers can take precautions to control the wilt disease in the lady-finger fields.

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