Analysis of Plant Extracts' Influence on Coriander Plant Development (*Coriandrum sativum*): Exploring Potential for Improvement

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This study aimed to assess the impact of a formulation containing plant extracts from castor bean (*Ricinus communis L.*), garlic (*Allium sativum*), and aloe vera (*Aloe vera*) at varying concentrations (0%, 0.5%, 1.0%, 1.5%, 5%, and 10%) on the growth and germination rate of coriander seedlings (*Coriandrum sativum*). The seedlings were cultivated in a prototype greenhouse under room temperature conditions to shield them from external weather factors. Notably, the 5% concentration exhibited significant variation, while the 10% concentration showed modest growth compared to the control group. These findings underscore the potential of natural fertilizers in enhancing the growth of herbaceous plants and advocate for exploring plant-based formulations as an ecofriendly alternative for fertilization practices.
Keywords: Plant Extracts. Coriander. Allelopathy.

The utilization of plant extracts as a sustainable source of nutrients and bioactive compounds has garnered considerable attention in the realm of agriculture. The amalgamation of extracts derived from castor bean, garlic, and aloe vera holds promise in fostering beneficial effects on the development of coriander seedlings. Each plant possesses unique properties that can synergize and facilitate the healthy growth of vegetables. While the current agricultural production model is economically feasible and extensively established, it imposes significant negative repercussions on the environment and human health. In light of this, there is a pressing need to explore and embrace comparably efficient yet more sustainable technologies. This paradigm shift is foundational in shaping future agriculture [1].

Transitioning towards sustainable agricultural practices contributes to environmental preservation and ensures the well-being of all stakeholders involved [1].

Rural farmers frequently turn to chemical fertilizers as a quick fix to address various issues concerning soil fertility and quality. However, this approach poses significant environmental risks, adversely impacting soil, water, and air quality, besides posing concerns for human health [2]. For instance, the predominant cost associated with transgenic soybean production lies in fertilizers, averaging R$570.42 per hectare [3]. The primary objective of this study was to assess the impact of a consortium of plant extracts from castor bean (*Ricinus communis L.*), garlic (*Allium sativum*), and aloe vera (*Aloe vera*) on the growth of coriander (*Coriandrum sativum*) seedlings. The study aimed to explore the potential for creating a completely natural and sustainable fertilizer while also developing a greenhouse suitable for cultivating coriander seedlings.

The analysis involved parameters such as shoot growth, root development, and other health indicators of coriander seedlings. These parameters were used to evaluate the interaction between the plant extracts to promote significant plant development without the need for synthetic chemical fertilizers. The results underscore natural fertilizers' potential to enhance herbaceous growth and highlight the exploration of vegetable formulations as a viable alternative to fertilization. This research advances sustainable agriculture by providing eco-friendly alternatives for cultivating healthy and efficient plants.

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Materials and Methods

Preparation of Natural Fertilizer

Preparing the plant-based fertilizer involved several steps, including processing and decontamination. Equipment such as a blender, sieve, and spoon were utilized. Disinfection was done using a 1% concentration of sodium hypochlorite for 15 minutes.

To prepare the extracts, the plant parts were ground in a blender according to the proportions: 25g of castor bean, 25g of aloe vera, and 10g of garlic. The ground materials were then macerated with 100mL of distilled water. The consortium of extracts was subsequently stored in an amber bottle until ready for use [4,5].

Seedling Production for Bioassays

The soil utilized in the experiment underwent autoclaving at 120°C for 45 minutes to ensure sterility. Subsequently, this soil was filled into 200mL disposable cups previously disinfected with 2% sodium hypochlorite. Approximately 140g of topsoil was added to each cup. A greenhouse was then constructed to house the seedlings, maintaining controlled humidity, temperature, and atmospheric pressure conditions. The greenhouse dimensions were 70 cm in height and 90 cm in width.

One coriander seed was placed in each cup at approximately 1-1.5 cm depth for sowing. After sowing, irrigation was carried out using a single-channel micropipette (Olen) with a volume range of 1000-10000µL, applying 5mL of distilled water to each cup. During the pre-test phase, the seedlings received 5 mL of the fertilizer on the 11^{th} and 24^{th} days after sowing. In contrast, the control group received 5 mL of distilled water [6].

Place of the Experiment

The experiment occurred in the outdoor area of SENAI-CIMATEC, the Integrated Center for Manufacturing and Technology located in Salvador Bahia. It was conducted under room-temperature room-temperature conditions between March and May 2023.

Seedling Biometry

Seedling biometry involves measuring the height of the seedlings, which was determined by measuring the distance from the base to the apex. Additionally, the length of the primary root was measured by assessing the distance from the base to the tip after removing all substrate adhered to the root. These measurements were conducted using a caliper from Digimess [6].

Results and Discussion

The experiments showed that after applying the extract on the 11^{th} and 24^{th} days following planting, there was a decrease in the growth of coriander seedlings following the first application.However, no loss of seedling viability was observed at this stage, and a similar trend was observed after the second application of the plant extract.

These results suggest that the substances in the consortium extracts may have caused a negative allelopathic effect. This phenomenon is consistent with findings reported by Silva and colleagues [5], where the germination of cowpea seedlings (*Vigna unguiculata*) was inhibited as the concentration of dried castor bean leaf extract increased, ranging from 1% to 10%.

The root growth and stem length to the apex did not show significant differences between the 5% and 10% concentrations. However, Figures 1 and 2 indicate a more robust development in the 10% concentration compared to the 5% concentration. This difference may be attributed to the seeds' size and growth rate (Table 1). Previous research by Gatti and colleagues [7] has shown that the allelopathic effect can influence the speed of seed germination. This factor holds ecological importance, as plants with slower germination rates often exhibit smaller sizes and may be more vulnerable to stress, reducing their competitiveness for resources.

Figure 1. Biometrics of stems (base to apex) in coriander seedlings under different concentrations of plant extract (natural fertilizer).

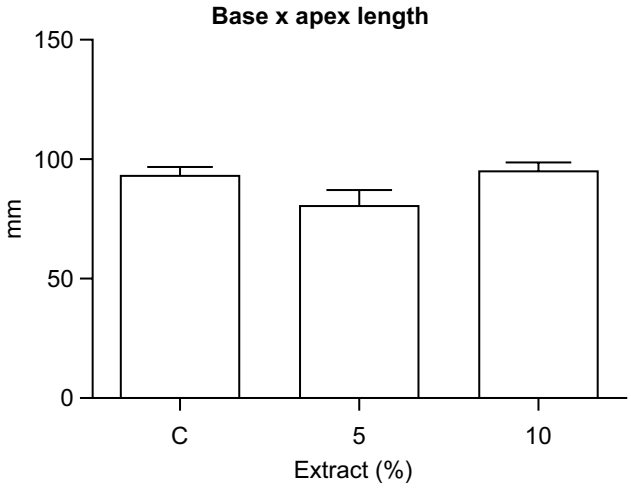


Figure 2. Biometry of roots (total length) of coriander seedlings under different concentrations of plant extract (natural fertilizer).

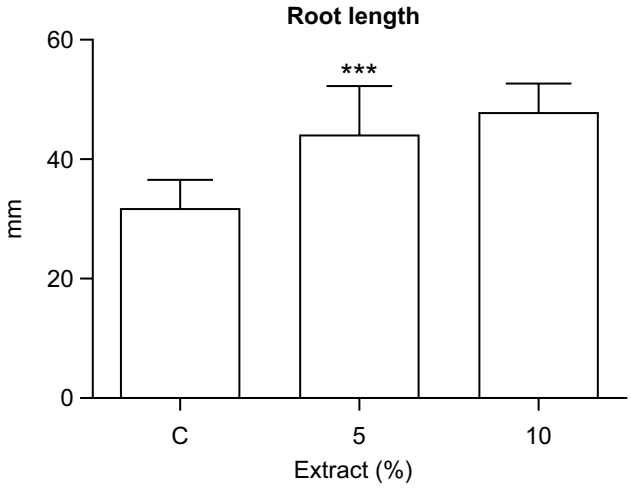


Table 1. Standard deviation of root length and length from base to apex of *Coriandrum sativum* seedlings submitted to different extract concentrations (0, 5, and 10%).

Samples (%)	Root Length (mm)	Length from Base to Apex (mm)
0	± 20.55	±14.65
5	± 33.25	± 24.23
10	± 19.22	± 16.10

According to Gatti and colleagues [7], the allelopathic effect typically impacts the speed of seed germination rather than the germination percentage. This factor carries substantial ecological significance, as plants with slower germination rates tend to be smaller in size and, thus, more susceptible to stress. Consequently, they may need more opportunities to compete effectively for resources.

In light of the potential allelopathic effects observed, a second set of experiments was conducted using lower concentrations of the plant extract (0.5%, 1%, and 1.5%). The results from this second round of testing demonstrated improved performance in developing coriander seedlings, particularly at concentrations of 0.5% and 1%.

Table 2 and Figure 3 show the root length and length standard deviations from base to apex and data from the second trial.

This indicates a positive effect on plant growth, corroborating with findings from [5], which showed that the dry extract of castor bean significantly influences the development of bean seedlings at the highest concentration (10%).

According to the results obtained by Silva and colleagues [8], a significant difference can be seen in the concentrations of biofertilizers in arugula seedlings regarding the length of the roots and height of the plants.

The data (Figure 4) showed an expressive reduction in the length from the base to the apex

Table 2. Standard deviations of root length and length from base to apex, data from the second trial.

Samples (%)	Root Length (mm)	Length from Base to Apex (mm)
0	± 28.52	±19.98
0.5	± 46.45	± 14.82
1	± 22.30	± 9.22
1.5	± 56.77	± 24.60

Figure 3. Root length data from the second test.

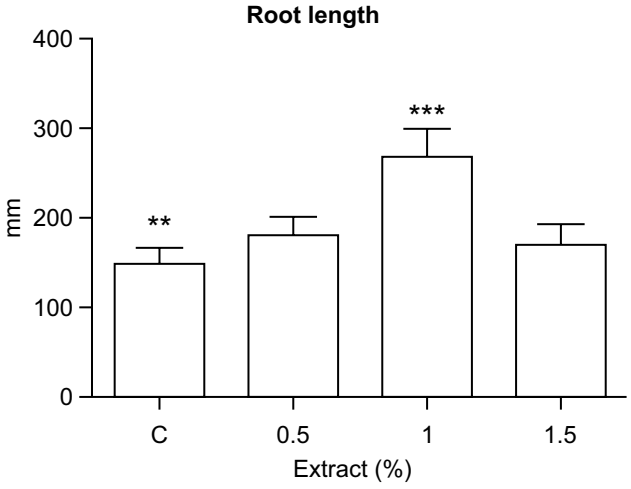
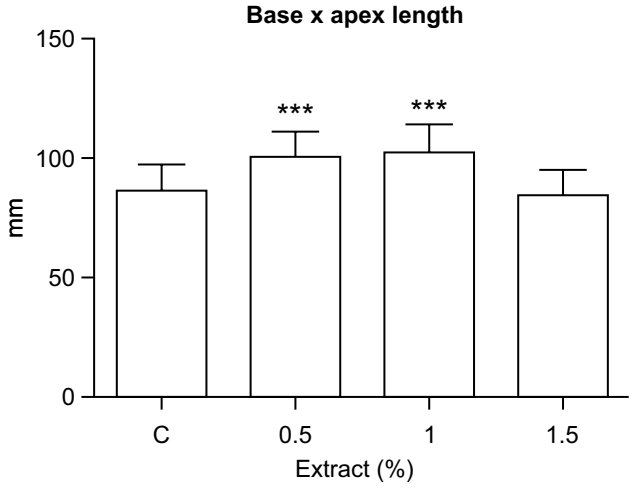


Figure 4, Displays the data referring to the length from the apex to the base.



of the seedlings at 1.5% concentrations. The corresponding means were 92 for the control concentration, 115 for 0.5%, 110 for 1.0%, and 80 for 1.5%.

Conclusion

The seedlings responded positively to the extracts, suggesting potential tolerance in mature plants. The combination of garlic, aloe vera, and castor bean extracts demonstrated promise as a natural fertilizer for coriander seedlings, with concentrations of 0.5% and 1% yielding significant results, particularly at 1%. This sustainable approach offers a means to reduce reliance on chemical fertilizers while promoting robust plant growth. Further research conducted under field conditions and across different crops is recommended to validate these findings. Utilizing these extracts as natural fertilizers could present a promising and beneficial alternative for sustainable agriculture.

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References

1. Santos JLG et al. Cultivo da cenoura submetida à aplicação de doses de biofertilizante. Revista Verde

de Agroecologia e Desenvolvimento Sustentável 2017:12(1):55-60. Available at: http://abmanacional.com.br/arquivo/b6cd193b5e9142a17b7ef973e1517676e0cd6064-33-4-aloe-vera.pdf. Accessed on: September 25, 2023.

2. Oliveira AM. Os principais problemas ambientais que ameaçam a preservação do meio rural do povoado Maritá em Paripiranga (BA). 2022. Available at: https://repositorio.animaeducacao.com.br/bitstream/ANIMA/31762/1/TCC%20ANDRE%20MELO%20DE%20OLIVEIRA.pdf. Accessed on:June 11, 2023.
3. Pavão JA, Voese SB. Análise dos custos e da produtividade da sila convencional e transgênica no Brasil nos anos de 2017 e 2018. Singular. Sociais e Humanidades 2020;1(3). Available at:http://ulbra-to.br/singular/index.php/SingularSH/article/view/70/43. Accessed on: June 20, 2023.
4. Peron F, Ferreira G. Potencial inseticida de extrato de sementes de mamona (*Ricinus communis L.*) no controle da lagarta-do-cartucho (*Spodoptera frugiperda*). Anais VI Mostra Interna de Trabalhos de Iniciação Científica, 2012.Available at:https://www.unicesumar.edu.br/mostra-2012/wp-content/uploads/sites/93/2016/07/franciele_peron_2.pdf. Accessed on: October 24, 2022.
5. Silva RR et al. 12403-Efeito alelopático de extrato seco de mamona (*Ricinus communis L.*) no desenvolvimento inicial de feijão (*Vigna unguiculata* (L.) Walp.). Cadernos de Agroecologia 2011;6(2). Available at:https://revistas.aba-agroecologia.org.br/cad/article/view/12403/7820.
6. Ramírez-Cariño HF et al. Biofertilizing effect of putative plant growth promoting rhizobacteria *in vitro* and in tomatillo seedlings (*Physalis ixocarpa Brot.*). Scientia Horticulturae 2023;308:111567, jan. 2023. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0304423822006859. Accessed on: February 24, 2023.
7. Gatti AB et al. Avaliação da atividade alelopática de extratos aquosos de Folhas de espécies de cerrado. Revista Brasileira de Biociências 2007;5(S2):174-176. Available at: https://www.seer.ufrgs.br/rbrasbioci/article/download/115052/62349. Accessed on: May 28, 2023.
8. Silva C, Crivelari AD, Correa JS. Desenvolvimento de midas de alface e rúcula tratadas com biofertilizante de extrato de algas.2021.Científic@-Multidisciplinary Journal 2021;8(1):1-10. Available at: http://periodicos.unievangelica.edu.br/index.php/cientifica/article/view/5652/4070. Accessed on: September 24, 2023.
9. Lima BM. Doses de torta de mamona aplicadas ao solo para desenvolvimento de *Moringa oleifera*. 2022. Available at: https://repositorio.ufc.br/bitstream/riufc/69249/3/2022_tcc_bmlima.pdf.Accessed on: June 13, 2023.