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# The effects of spraying with onion and garlic extracts on the growth of the plant *Anethum graveolens* L. and its antioxidant effectiveness

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## *SUMMARY*

*This experiment was conducted during the 2022–2023 agricultural season in a mixed clay soil at one of the fields of the Faculty of Agriculture, Basra University. The aim of the experiment was to investigate the effect of spraying dill plants (Anethum graveolens L) with aqueous extracts of onion and garlic on their growth. The plants were sprayed with garlic aqueous extract at three concentrations (0, 20, 30 g $L^{-1}$) and onion aqueous extract at three concentrations (0, 15, 25 g $L^{-1}$), with three applications at a 15-day interval between each spray. The experiment was designed using a Randomized Complete Block Design (RCBD).*

*The obtained results showed that the plants sprayed with garlic aqueous extract exhibited significant improvements in most characteristics, except for the fruit content of total dissolved carbohydrates and the yield of fruits from volatile oil. Specifically, the plants sprayed with a concentration of 30 g $L^{-1}$ outperformed the other two concentrations in terms of plant height (cm), number of branches per plant, and 1000-seed weight for each experimental unit. On the other hand, the plants sprayed with a concentration of 20 g $L^{-1}$ significantly outperformed in terms of floral inflorescence number per plant and seed yield. Additionally, the plants sprayed with a concentration of 30 g $L^{-1}$ had the highest chlorophyll content and antioxidant effectiveness of dill leaves (%). However, spraying with garlic extract did not have a significant effect on the fruit content of total dissolved carbohydrates and the yield of fruits from volatile oil.*

*Regarding the plants sprayed with onion extract, they showed overall superiority in most traits, except for the chlorophyll content of the leaves. Specifically, the plants sprayed with a concentration of 15 g $L^{-1}$ significantly excelled in plant height, while the plants sprayed with a concentration of 25 g $L^{-1}$ outperformed in terms of floral inflorescence number per plant and seed yield. The plants sprayed with a concentration of 25 g $L^{-1}$ also had the highest content of total dissolved carbohydrates in fruits and the highest antioxidant effectiveness of dill leaves and seeds (%). However, the plants sprayed with a concentration of 15 g $L^{-1}$ had the highest yield of volatile oil. The interaction between the two factors (garlic and onion extracts) had a significant effect on all studied traits, except for the chlorophyll content of the leaves.*

***Keywords:*** *Dill; mixed clay soil; Aqueous extracts; onion; garlic*

## *INTRODUCTION*

Dill, belonging to the Apiaceae family, encompasses over 250 species and holds significant importance as a culinary and medicinal plant (Ihsan, 1999). The plant is considered one of the most important leafy greens as its leaves contain a dry substance between 7.7–10.5 consisting of carbohydrates, proteins and fiber as well as being rich in vitamins (Boras, 2006). The seeds of the current plant contain approximately 3–4% of the weight of the fruits (Jana and Shekhawat, 2010). Dill is grown in many European, Asian and American countries where it is used as a medicinal herb (Singh et al., 2005). Its green leaves, whether fresh or dry in daily meals, are used as taste enhancers or flavor, and used as a seasoning and entire industries such as perfumery and cosmetics, and the decoction of seeds is used as a gas repellent and nerve sedative and is used to improve the work of the heart and lungs (Dajawi, 1996). The plant herb contains many different antioxidants that have a role in eliminating harmful free radicals (Sun et al., 2002; Liu, 2003). It also contains flavonoids, phenolic compounds, and essential oils (Delaquis et al., 2002) and contains alpha-feldrin, carfone and limonene compounds (Shehat, 2000). The reason for the growing interest in the cultivation and study of medicinal plants is due to the large number of collateral damage and high prices for these drugs and the World Health Organization's projections that the volume of trade in medicinal and aromatic plants will rise to more than $5 trillion in 2050 (Noorhusseini, 2011). Due to the medicinal and nutritional importance of the plant, it is therefore necessary to look for agricultural means and coefficients to increase the plant's yield of grass and improve the production of it. The plant is made from petroleum and using natural materials that respect the environment to reduce pollution, which has. Increased its rates in recent times, as the use of fertilizers and industrial growth regulators is one of the important factors in plant production and due to their negative effects on human health and the environment. The trend has been made at present to use natural plant extracts to increase plant growth and productivity of oil and seeds to contain these extracts mineral elements, growth regulators and many vitamins important for plant growth (Ibrahim, 2012). Moursi et al. (1981) found that the aqueous extract of garlic is characterized by a twisting of 31% carbohydrates as well as contains high levels of phosphorus, iron, magnesium, potassium, and many vitamins such as thiamine, riboflavin, niacin, vitamin C and many volatile oils. Significant in all studied qualities represented by plant height, number of branches, percent dry matter, deciduous zone, and total chlorophyll. (Omran, 2004) found that there is a significant increase in the height of the plant and the number of leaves of the cucumber plant when sprayed with garlic extract at a concentration of 50 ml per liter.

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(Hussein, 2006) also found that spraying cucumber with garlic extract in three concentrations 0, 2.5, 5 and 7.5 $cm^3$ $L^{-1}$ at a concentration of 2.5 $cm^3$ $L^{-1}$ led to a significant increase in the height of the plant the total number of leaves and the content of the leaves from total chlorophyll, fruit contract ratio, vitamin C and dissolved solids ratio. (Saadoun et al., 2004) found that the use of garlic extracts at a concentration of 40 ml $L^{-1}$ spraying on the tomato plant led to a significant increase in the qualities of the vegetative total, the fruit contract, and the yield of one plant of fruits. (Khalil and Assaf, 2014) Found when spraying the potato plant with onion extract at a concentration of (40 g $L^{-1}$) that the plants significantly outperformed the comparison treatment in the yield of one plant (g $plant^{-1}$) and the total yield (akg. dunam. Natural antioxidants nowadays have found great interest due to their ability to hunt on free radicals, so emphasis has been placed on natural plant-derived antioxidants to inhibit the effectiveness of lipid peroxide that activates its presence in food products containing unsaturated fatty acids where 13l fat peroxide can lead to the appearance of unpleasant or unwanted flavors in addition to loss of nutrients (Frankel, 1991). Antioxidants have the ability to stabilize or disrupt free radicals before they attack cells, thereby protecting the body from oxidative stress and damage. Aromatic and medicinal plants have gained increasing interest due to their antioxidant properties. The significance of aromatic plants as natural antioxidants lies in their phytochemical content, including flavonoids, carotenoids, terpenoids, phenolic acids, ascorbic acids, and more (Halvorsen et al., 2002).

Extensive research has been conducted on the antioxidant activity of dill seeds and flowers, as demonstrated by Shyu et al. (2009). In their study, extracts from dill leaves, seeds, and flowers were used, and it was found that the flower extracts exhibited higher antioxidant effectiveness compared to the seed and leaf extracts.

The main objective of this study was to treat the plants with natural extracts in order to achieve maximum vegetative growth, high fruit yield, and obtain the volatile oil of the plant. Additionally, the study aimed to evaluate the antioxidant activity of dill leaves and seeds, and explore the potential of dill as a new source of natural antioxidants.

## *MATERIALS AND METHODS*

The experiment was conducted during the 2022–2023 agricultural season in a field within the College of Agriculture at the University of Basra. The experiment followed a randomized complete block design (RCBD) based on the factorial experiment design, with mixed clay soils being used.

*Table 1* provides information on the physical and chemical properties of the soil used for agriculture. The experimental land underwent plowing using two orthogonal tillage methods, and organic fertilizer was added at a rate of 40 kg $hectares^{-1}$ according to Hussein (1981). Following this, the soil was leveled and divided into 2-meter long and 1-meter wide plots. The seeds were then sown in rows within these plots.

*Table 1.* **Some of the chemical and physical qualities of the field soil during the two seasons of the experiment**

| Adjective | PH | EC | Organic matter (%) | N (mg $L^{-1}$) | P (mg $L^{-1}$) | K (mg $L^{-1}$) |
|---|---|---|---|---|---|---|
| Value | 7.34 | 2.45 | 2.9 | 26.0 | 14.51 | 7.71 |

*Soil samples were analyzed in the Central Laboratory Faculty of Agriculture / University of Basra

A month after germination, the plants were treated with garlic and onion extracts at three different concentrations. Garlic extract concentrations used were 0, 20, and 30 g $L^{-1}$, while onion extract concentrations were 0, 15, and 25 g $L^{-1}$. The plants were sprayed three times, with a 15-day interval between each spray.

Preparation of Garlic and Onion Extracts 250 grams of garlic and onion cloves were sourced from the local market and placed in 250 ml of distilled water. The mixture was blended using a blender, and then the resulting solution was filtered through two pieces of gauze cloth. This produced a fully effective solution (100%), from which the required concentrations were prepared.

The extract should be prepared on the same day as the application to the plants, and it is essential to spray within four hours of preparing the spray solution, as the effectiveness of the growth regulator decreases thereafter. The all extracts were prepared on the same day as the treatment.

Throughout the experiment, the plants were provided with the necessary irrigation and fertilization based on recommended practices. At the end of the growing season, measurements were taken from three plants in each experimental unit. The measurements included plant height (measured from the stem-root junction to the top of the plant), number of leaves per plant, number of branches, number of flower inflorescences per plant, and fruit yield per plant.

Additionally, the study analyzed the chemical properties of the leaves, specifically the total chlorophyll content, which was measured in milligrams per 100 grams of fresh weight. How to prepare the extract of seeds and leaves:

1. Take 20 grams of vegetable powder from leaves and separately grind the seeds into a dry powder.
2. Add 200 ml of organic solvent hexane to each of the vegetable powders. Place the mixtures in separate Soxhlet apparatuses and heat them at

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a temperature of 100 ℃ for a total of 24 hours to remove the oils contained within.

3. Remove the samples from the apparatuses and allow them to air dry for 24 hours.
4. Return the dried samples to the Soxhlet apparatuses. Add 200 ml of methanol alcohol to each sample and let them soak for 24 minutes.
5. Use a rotary evaporator device at a temperature of 65 ℃ to evaporate the alcohol from the extracts until complete evaporation is achieved.
6. Leave the samples at room temperature to dry completely. Antioxidant efficacy was estimated according to the Gorinstein et al. (2004) method as follows:
   a. Dissolve 2 mg of plant extract (from leaves or seeds) separately in 10 ml of methanol.
   b. Dissolve 13 mg of 1,1-diphenyl-2-picrylhydrazyl (DPPH) in 500 ml of methanol.
   c. Take 2 ml of the solution prepared in step 1 and add it to 2 ml of the solution prepared in step 2.
   d. Mix well and store the mixture in the dark at room temperature for 30 minutes.
   e. Measure the absorption at a wavelength of 517 nm.
   f. Estimate the antioxidant efficacy using a standard curve with vitamin E as a reference, provided by T and D Pharma GmbH, located at KleineKnopheide 4, 32657 Lemgo, Germany.
   g. Calculate the antioxidant efficacy using the following equation.

$$\text{Percentage inhibition} = \frac{\text{Absorption for comparison (°A) - Absorption by Sample (A1)}}{\text{Absorption for comparison (°A)}} \times 100$$

Note that: °A = 0.184 1A = Absorption of the model

## *RESULTS AND DISCUSSION*

*Table 2* indicates that plants treated with garlic extract exhibited significant superiority in all measured characteristics. Plants treated with a concentration of 30 g $L^{-1}$ outperformed others in terms of plant height (cm), number of branches per plant, and weight of 1000 seeds for each experimental unit. Conversely, plants sprayed with a concentration of 20 g $L^{-1}$ significantly excelled in the number of floral inflorescences per plant and the yield of one plant from the seeds.

Similarly, plants treated with onion extract showcased notable superiority in all traits. The best results were observed in plants sprayed with a concentration of 15 g $L^{-1}$ for plant height, and a concentration of 25 g $L^{-1}$ for the number of floral inflorescences per plant and the yield of one plant from the seeds.

The interaction between the two factors (garlic and onion extracts) had a significant impact on all studied traits. The highest plant height and number of floral inflorescences were observed in plants treated with garlic extract at a concentration of 20 g $L^{-1}$ and onion extract at a concentration of 15 g $L^{-1}$, reaching 62.56 cm and 73.79 inflorescences per plant, respectively. In comparison, the lowest values were obtained from the control treatment.

Plants treated with garlic extract at a concentration of 30 g $L^{-1}$ and onion extract at a concentration of 25 g $L^{-1}$ displayed the highest number of branches per plant (14.443 branches) compared to the lowest number of branches (7.463 branches) in the control treatment. Additionally, the highest yield per plant and weight per 1000 seeds for each experimental unit were achieved in plants treated with garlic extract at a concentration of 30 g $L^{-1}$ and onion extract at a concentration of 15 g $L^{-1}$, with values of 57.29 and 3.780, respectively. In contrast, the lowest values were obtained from plants not treated with garlic or onion extracts at a concentration of 25 g $L^{-1}$.

*Table 3* reveals that plants treated with onion and garlic extracts exhibited higher chlorophyll content (mg 100 $g^{-1}$ fresh weight). Plants sprayed with a concentration of 30 g $L^{-1}$ showed the highest chlorophyll content, while those sprayed with a concentration of 20 g $L^{-1}$ demonstrated the highest antioxidant effectiveness in dill seeds. Garlic extract did not significantly affect the total dissolved carbohydrate content of the fruits or the fruit yield of the fragrant oil Pilot.

On the other hand, spraying with onion extract significantly influenced all qualities mentioned in *Table 3* except for chlorophyll content. Plants sprayed with a concentration of 25 g $L^{-1}$ exhibited the highest total dissolved carbohydrate content in fruits and the highest antioxidant effectiveness in dill leaves and seeds. Plants sprayed with a concentration of 15 g $L^{-1}$ showed the highest yield of volatile oil.

The interaction between garlic and onion extracts had a significant impact on all qualities listed in the table, except for chlorophyll content. Plants treated with garlic extract at a concentration of 30 g $L^{-1}$ and onion extract at a concentration of 25 g $L^{-1}$ displayed the highest fruit carbohydrate content (mg $g^{-1}$) and the highest antioxidant effectiveness in dill leaves, reaching 74.80 and 90.74 percent, respectively. In comparison, the lowest carbohydrate content and antioxidant effectiveness were observed in plants not treated with garlic extract and sprayed with onion extract at a concentration of 15 g $L^{-1}$. The highest yield of fruits from volatile oil (g $plant^{-1}$) was obtained from plants treated with onion extract at a concentration of 25 g $L^{-1}$ and garlic extract at a concentration of 30 g $L^{-1}$.) The highest antioxidant efficacy of dill seeds was 3.737 and 63.39 respectively compared to their lowest value of 0.740 and 36.23 respectively from plants not sprayed with garlic extract sprinkled with onion extract at a concentration of 15 g $L^{-1}$.

The effects of garlic and onion extracts on plant growth are significant due to their rich content of macro

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and micronutrients, which enhance vital activities and metabolic processes within plants (Krejci and Pacurar, 2010). The auxins present in these extracts stimulate cell division and promote leaf growth. As a result, the number of leaves increases, expanding the leaf area and improving the efficiency of photosynthesis. With more leaves available, the photosynthetic process becomes more effective, leading to greater energy production for growth Abou Hussein et al. (1975).

Furthermore, the increased chlorophyll content in the leaves can be attributed to the mineral nutrients found in the extracts, particularly nitrogen and magnesium, which are essential for chlorophyll synthesis. These combined effects contribute to enhanced vegetative growth and improved plant characteristics Pacurar and Krejci (2010).

Garlic extract also exhibits effects similar to auxins, resulting in increased efficacy of the cellulose enzyme, which is crucial for cell expansion, elongation, and enlargement. This leads to enhanced plant height and increased branching. In addition to compounds resembling auxins, garlic extract contains substances that boost the concentration of growth regulators within plants, promoting cell division and increasing the number of branches and leaves Abou Hussein et al. (1975).

The increase in the number of floral inflorescences can be attributed to the presence of compounds in garlic extract that elevate auxin levels, leading to an increase in internal regulatory substances and promoting flower formation. This finding aligns with what Abou Hussein et al. (1975) stated, that foliar application of garlic extract leads to an increase in total yield.

These results are consistent with previous research on tomato plants, where garlic extract was shown to contain sulfur-containing amino acids like methionine and cysteine, which play vital roles in plant physiological processes Saadoun et al. (2003).

Overall, garlic is rich in at least 33 sulfur compounds, as well as enzymes, vitamins B and C, and minerals such as sodium, potassium, zinc, phosphorus, manganese, magnesium, calcium, and iron. It also contains carbohydrates, saponins, alkaloids, and flavonoids, all of which significantly contribute to its beneficial effects on plant growth and development. Free sugars (such as sucrose, fructose, and glucose) also contribute significantly to increased plant productivity (Marza et al., 2015). Flavonoids, for instance, act as potent antioxidants antioxidants (Otunola et al., 2010; Bhandari et al., 1998; Akhtar and Riffat, 1991).

Due to its content of allicin and various sulfur compounds, garlic extract exhibits diverse physiological effects and activities within different metabolic pathways (Atta et al., 1985). This aligns with research demonstrating increased antioxidant efficacy in dill leaves and fruits when treated with garlic extract. Extracts from dill seeds and leaves contain flavonoids such as kirstine and isohermesten, which possess potent antioxidant properties and prevent the formation of free radicals (Husseinzadeh et al., 2002; Mahran et al., 1992; Shyu et al., 2009).

From this study, we can conclude that the growth of dill plants can be improved using plant extracts (such as garlic and onion) through foliar application. These natural extracts serve as a suitable alternative to synthetic chemical compounds, given their positive impact on human health.

*Table 2.* **Effect of spraying with garlic and onion extracts and the interaction between Them on some indicators of vegetative and flowering growth and fruit yield of the dill plant**

| Traits / Treatments | | Plant height (cm) | Number of branches Plant$^{-1}$ | The number of floral inflorescences Plant$^{-1}$ | The yield of 1 plant of fruits (g plant$^{-1}$) | Weight of 1000 seeds (Gm) |
|---|---|---|---|---|---|---|
| **The average effect of spraying with garlic extract** | | | | | | |
| 0 | | 45.47 | 7.782 | 44.03 | 27.10 | 2.193 |
| 20 | | 46.58 | 10.05 | 63.11 | 49.02 | 2.598 |
| 30 | | 54.64 | 11.460 | 53.61 | 34.87 | 2.731 |
| **The average effect of spraying with onion extract** | | | | | | |
| 0 | | 45.45 | 10.203 | 49.16 | 36.48 | 1.741 |
| 15 | | 53.62 | 9.856 | 49.74 | 32.76 | 2.588 |
| 25 | | 47.89 | 9.234 | 61.85 | 41.75 | 3.193 |
| **Interaction between garlic extract and onion extract** | | | | | | |
| 0 | 0 | 36.59 | 7.463 | 30.32 | 25.09 | 2.357 |
| | 15 | 47.14 | 8.363 | 45.55 | 35.58 | 2.513 |
| | 25 | 52.67 | 7.520 | 56.21 | 20.63 | 1.710 |
| 20 | 0 | 57.00 | 9.647 | 51.57 | 35.26 | 3.443 |
| | 15 | 62.56 | 9.400 | 73.79 | 42.39 | 2.503 |
| | 25 | 44.37 | 10.537 | 63.80 | 47.38 | 1.847 |
| 30 | 0 | 37.19 | 8.703 | 43.38 | 27.05 | 2.747 |
| | 15 | 56.73 | 11.803 | 51.91 | 57.29 | 3.780 |
| | 25 | 46.63 | 14.443 | 65.53 | 42.30 | 1.667 |
| **P < (0.05)L.S.d** | | **3.657** | **0.3380** | **5.084** | **4.707** | **0.3651** |

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*Table 3.* **The effect of spraying with garlic and onion extracts and the overlap between them in some chemical qualities, the yield of pilot oil and the antioxidant effectiveness of the leaves and seeds of the dill plant**

| Traits / Treatments | | Leaf content of chlorophyll (mg 100 $g^{-1}$ soft weight) | Fruit content of carbohydrates (mg $g^{-1}$) | Yield of fruits from pilot oil (g $plant^{-1}$) | Antioxidant efficacy of dill leaves (%) | Antioxidant Effectiveness of Dill Seeds (%) |
|---|---|---|---|---|---|---|
| **The average effect of spraying with garlic extract** | | | | | | |
| 0 | | 1.070 | 56.35 | 1.770 | 77.19 | 39.65 |
| 20 | | 1.392 | 54.35 | 2.383 | 81.53 | 53.72 |
| 30 | | 1.477 | 57.22 | 2.360 | 83.74 | 44.51 |
| **The average effect of spraying with onion extract** | | | | | | |
| 0 | | 1.269 | 42.60 | 2.443 | 74.51 | 47.23 |
| 15 | | 1.313 | 46.72 | 2.782 | 83.27 | 37.78 |
| 25 | | 1.357 | 61.60 | 1.288 | 84.68 | 52.88 |
| **Interaction between garlic extract and onion extract** | | | | | | |
| 0 | 0 | 0.480 | 44.03 | 1.080 | 73.26 | 40.81 |
| | 15 | 1.273 | 33.23 | 0.740 | 81.66 | 36.23 |
| | 25 | 1.457 | 40.81 | 1.637 | 86.39 | 41.92 |
| 20 | 0 | 2.413 | 54.34 | 2.593 | 72.89 | 57.40 |
| | 15 | 1.213 | 52.20 | 2.673 | 81.77 | 40.37 |
| | 25 | 1.213 | 44.67 | 3.737 | 78.71 | 63.39 |
| 30 | 0 | 0.913 | 65.98 | 2.513 | 90.03 | 43.48 |
| | 15 | 1.453 | 54.72 | 3.080 | 71.93 | 36.72 |
| | 25 | 1.810 | 74.80 | 1.487 | 90.74 | 53.34 |
| **P < (0.05)L.S.d** | | **NS** | **4.739** | **0.3939** | **3.934** | **4.326** |

## *CONCLUSIONS*

1. The effect of using garlic and onion extract on plant traits: The text indicates that spraying plants with garlic and onion extract improves the studied plant traits, such as plant height, number of branches, seed weight, chlorophyll content, and antioxidant effectiveness.
2. The effect of the used concentration: The text mentions that spraying plants with garlic extract at a concentration of 30 g $L^{-1}$ and onion extract at a concentration of 25 g $L^{-1}$ showed superiority in certain traits, such as total dissolved carbohydrate content and antioxidant effectiveness.
3. The interaction between the two extracts: The text suggests that the interaction between garlic and onion extract leads to further improvement in traits, such as increased total dissolved carbohydrate content in fruits and antioxidant effectiveness in dill leaves.
4. Limited effects of garlic extract: The text indicates that using garlic extract had limited effects on total dissolved carbohydrate content in fruits and fruit yield in Pilot oil.

In conclusion, it can be inferred that using garlic and onion extract at specific concentrations improves plant traits, with additional benefits observed when using a combination of both extracts. However, the effects of garlic extract may be limited on some of the studied traits.

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