## THE EFFECTS OF CAFFEINE ON GARLIC (ALLIUM SATIVUM) GROWTH

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#### ABSTRACT

Caffeine is a chemical substance that can be found in a variety of items, including coffee, coffee beans, tea, soft drinks, cocoa, and chocolate, as well as in several prescription and over-the-counter medications for colds, allergies, and pain. It has a variety of purposes, although it is said to be most frequently used to increase mental alertness. Caffeine affects the central nervous system, acting as a stimulant and the effects in the body might start 15 minutes after taking it and last for up to 6 hours. The effects of caffeine on plants are less well documented. This research followed the effects of caffeine on garlic plants. A coffee solution of 0.02% was used to evaluate the caffeine effects on plant growth. The average length of the garlic plants, which were previously planted, was 9.4 cm. There were eight pots in all; four were used as the control and four were utilized for the experiment. When the seeds were first planted, coffee solution was used to hydrate each one of them. Every day, the length of the experimental and control plants was measured to assess how they differed from one another. The garlic plants grew faster in the "experimental" pots. They grew at this accelerated rate for 16 days. A substantial difference was seen throughout this period, compared to the "control" pots that received water without caffeine, whose growth was slower ( $36.837 \pm 2.4178$ , p< 0.05). Another 12 days were spent to measure their length. The "experimental" pots' rate of development significantly slowed down over this time ( $29.157 \pm 6.75272$ , p<0.05).

Keywords: caffeine, effects, coffee, germination, growth, plants, Allium sativum.

#### **INTRODUCTION**

The most popular psychostimulant in use today is caffeine (Fredholm et al., 1999). It is present in foods and beverages as well as occurring naturally in coffee beans, tea leaves, cocoa beans, and kola nuts. Coffee, tea, yerba mate, caffeinated soda (like cola), and energy drinks are significant dietary sources (Zucconi et al., 2013). The possible health effects of routine consumption of these caffeine-containing drinks (CCB) are gaining more attention from the general public and scientists. In healthy adults, consumption of up to 400 mg of caffeine per day is not linked to negative effects, according to thorough assessments of caffeine toxicity (EFSA, 2015; Nawrot et al., 2003; Wikoff et al., 2017). According to epidemiological research, drinking coffee in moderation can lower your chance of developing several chronic diseases, but excessive use is probably bad for your baby's health (Poole et al., 2017). Regular mate, tea, and energy drink consumption have unclear health effects, whereas caffeine-containing soda consumption currently raises the most concerns due to its sugar content and link to obesity (Breda et al., 2014; Hayat et al., 2015; Heck et al. 2014; Higgins et al., 2014; Vuong et al., 2014; Ruanpeng et al., 2017). It is reported that caffeine use is generally safe for healthy adults, but that it may be hazardous for select vulnerable populations, including deficits in cardiovascular function, sleep quality, and substance use (Jennifer et al., 2017). Many research articles report about the caffeine effects on human health but much less is known regarding the effects of caffeine on plants. *Allium sativum* is a plant that has been widely used in Albania for different purposes for many years and plays a key role in our everyday diet. This is closely related to the antibiotic properties of this plant. It is reported that caffeine has a mutagenic effect on *Ophiostoma multiannulatum* (Fries and Khilman, 1948), and also found that caffeine has a weak mutagenic effect in *E. coli* (Gezelius and Fries, 1952). Caffeine induces also chromosomal aberrations in mammalian cells (Kato, 1973). It was discovered that the effects of caffeine on the Bambara nut's growth parameters depended on concentration (Gbenga et al., 2018). Higher caffeine concentrations have unfavorable effects on bambara nut growth that are proportionately greater (Gbenga et al., 2018). The focus of our study is to draw attention to the influence of caffeine on plant growth, which is less well recognized since the effect of caffeine and the products with it as their principal component on humans is already known and has been studied for a long time.

## **METHODS**

8 pots were filled with soil and 1 garlic clove was planted in each of them. After one month we noticed that the garlic had germinated. During this period all the pots were only watered. For 20 days after germination, the plants were watered only with water. Pots were divided into two groups: The first four pots were named "control" and the others "experimental". A mixture of distilled water with 200 mg coffee (0.02%) for each "experimental" pot was prepared and it was used to water the plants in their 21st days. The observation and growth of the plants were made under a constant 15OC temperature (Gbenga et al., 2018; adapted by Qyli M., 2023).



"control" pots



"experimental" pots

Figure 1: Plants after 20 days watering with water

## RESULTS

After the germination process, plants start to grow and their length was measured for 20 days. The results are shown in table below.

Pots	1	2	3	4	5	6	7	8
Length in cm	10	10	10	7,5	10	10	10	7,5

Table 1: Length of 8 pots with Allium sativum for 20 days after germination

After 20 days of watering only by water, plants are watered with the coffee solution and the results obtained are shown in the figure below.



Figure 2: Plants after 28 days

The garlic plants were watered regularly each day and the measurements were made using a millimetric ruler. We recorded the progress each plant had made in a table of data. The same procedure was followed for the remaining 12 days:



Figure 3: Plants after 34 days

Days			"Contro	ol" Pots	"Experimental" Pots				
		Pot 1	Pot 2	Pot 3	Pot 4	Pot 5	Pot 6	Pot 7	Pot 8
1		10	10	10	7.5	10	10	10	7.5
2		10	10	10	7.5	10	10	10	7.5
3		10	10	10	7.5	10.5	10.5	10.2	7.5
4	T	10.3	10.3	10.3	7.6	10.7	10.7	10.7	8
5	E	10.4	10.7	10.7	7.8	11.5	11.7	11.4	8.2
6	N G	11	11.1	10.9	8	12	12.1	12.2	8.5
7	T	11.2	11.3	11.7	8.2	12.5	12.7	12.8	9
8	Н	11.4	11.7	11.9	8.5	13	13.1	13.3	9.2
9	Ι	11.9	12.5	12.8	8.7	13.5	13.7	13.8	9.8
10	Ν	12.5	13	13.5	8.9	14.5	14.4	14.7	10.4
11	С	13	13.5	14	9.3	15	14.9	15.4	10.9
12	M	13.7	13.9	14.5	10.6	15.5	15.7	16	11.5

13	14.2	14.7	15.2	11.8	16	16.3	16.5	12.5
14	14.8	15.6	15.7	12.6	16.5	16.4	17.1	13.2
15	15.3	16.4	16.6	13.2	16.7	17.2	17.9	14
16	16.7	17.8	17.9	13.9	17.1	17.8	18.9	14.9
17	16.9	18.9	19.2	15.9	17.5	18.5	20	16
18	18	20	22	17.8	17.8	19.2	21	17
19	23.4	23.8	24	19.5	17.9	20.5	22.3	18.5
20	25.4	25.8	25.6	22.5	18.9	21.4	23.7	19
21	27.5	27.7	26.5	24.5	19.5	22.5	24.5	19.5
22	29.2	29.3	27.5	26.2	20.2	23.2	25.2	20
23	30.9	30.1	28.3	27.5	20.6	24.1	26.2	21.2
24	34.4	32.6	29.9	29.9	21.4	25.6	28.2	23.2
25	36	33.8	30.7	31.1	21.8	26.8	29.4	24.1
26	37.7	35.2	31.3	32.5	22.1	27.7	30.2	25.3
27	38.5	36.5	31.9	33.6	22.3	28.5	31.2	26
28	39.5	37.5	32.5	34.5	22.5	29	32.3	27.2

 Table 2
 length of plants measurement for 28 days, after watering with the coffee solution



Graph 1: Growth rate of plants

Statistical analysis

Quantitative data obtained were subjected to One- Sample Test and the results obtained were significant ( $p \le 0.05$ ).

## **Discussions and conclusions:**

Plants germinated after 20 days and after treatment with the coffee (coffee contains caffeine) mixture, garlic plants grew faster in the "experimental" pots. During their first 12 days, their growth accelerated while in the "control" pots, which received merely watering, the growth process was slower. All plants were observed for another 16 days and during this period the "experimental" pots' growth rate slowed considerably. After the first 14 days, it was observed that the growth rate of experimental plants was affected negatively as a result of the added amount of coffee by the continuous mixture watering. While the growth process of the control plants continued normally (Watered only by water). The coffee concentration of 0.02%, 20 days after germination increased the growth rate of the experimental while the continuous watering of plants with the coffee mixture, reduces the growth rate. This is a result of the extra amount added to coffee in the respective pots. Khursheed et al., (2009) also reported that lower doses of caffeine reduce the stimulatory influence on growth and yield of Helianthus annuus and vice versa. This research implies that caffeine may improve cellular activity at lower concentrations, which may increase shoot height (Gbenga et al., 2018). However further measurements with different caffeine concentrations should be done to find the 'ideal' caffeine concentration which induces the highest growth rate of garlic plants. Also, the next experiments should perform with pure caffeine to avoid any effect of other coffee nutrients on the growth rate of the Allium sativum. This experiment might also be conducted by starting the caffeine watering during the germination phase to evaluate its effects even for the germination process. To compare different types of plants, we suggest monitoring different plant species under the caffeine effects. So, we may conclude that the growth rate of Allium sativum depends on the concentration of caffeine. If the concentration is increased, the growth rate slows down.

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