FRIEND OR FOE TO LEAVES?

NATIONAL SCIENCE FAIR RESEARCH PLAN

LEVEL : PRIMARY LEVEL

CATEGORY : Environmental Science(MES)

SUBMITTED BY

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(GRADE : 5)

(Community Building & Academic Excellence)

Abstract

Project ID and Title :NSF-SCH-2025-176 &

Project Title: Caffeine: Friend or Foe to Leaves?

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This project studies how caffeine affects the growth of plants. I grew plants using normal water and water mixed with caffeine. I measured their height every day and compared the results. The plants with caffeine grew slower and looked weaker. This experiment helps us understand how chemicals in drinks like tea and coffee can affect living things.

INTRODUCTION

Research Question: How does caffeine affect the germination and growth of plants such as tomato, chilly, and lady's finger?

Plants require water, sunlight, and nutrients for proper growth. However, certain external substances, like caffeine—found in coffee and tea—can alter plant growth by affecting enzymes and cell division. Previous studies (Ransom, 1912; Jadhav et al., 2016; Muratova, 2020) have shown that caffeine may slow down germination and reduce plant height. Caffeine can enter the soil through coffee waste or discarded beverages, affecting nearby vegetation. Understanding how caffeine influences plant growth helps us know whether it is beneficial or harmful for garden plants.

Hypothesis

Higher concentrations of caffeine will inhibit seed germination and slow plant growth compared to control (0% caffeine).

Methodology

Prepared caffeine solutions of 0, 50, 100, and 150 mg/L using distilled water.

2. Soaked tomato, chilly, and lady's finger seeds in respective solutions for 24 hours.

3. Planted soaked seeds in equal-sized pots with the same soil.

4. Watered daily with the same amount of distilled water.

5. Recorded germination rate, plant height, number of leaves, and leaf size every alternate day for 15 days.

6. Compared results among the different caffeine concentrations.

Variables

Independent Variable: Caffeine concentreation (0, 50, 100, 150 mg/L)

Dependent Variables: Germination rate, plant height, number of leaves, leaf size, root length.

Controlled Variables: Type of seeds, amount of water, type of soil, temperature, and light exposure.

Table 1: General Growth Measurement

Plant Type	Caffeine Conc. (mg/L)	Avg. Plant Height (cm)	Avg. Leaf Size (cm)	No. of Leaves
Tomato	0	14.2	5.3	8
Tomato	50	12.0	4.5	7
Tomato	100	9.6	3.8	5
Tomato	150	7.1	3.0	4
Chilly	0	15.0	4.8	9
Chilly	50	13.4	4.2	8
Chilly	100	10.2	3.5	6
Chilly	150	8.0	3.0	4
Lady's Finger	0	16.5	6.0	10
Lady's Finger	50	14.1	5.2	9
Lady's Finger	100	10.9	4.4	7
Lady's Finger	150	8.2	3.5	5

Graph: 1 General Growth Measurement

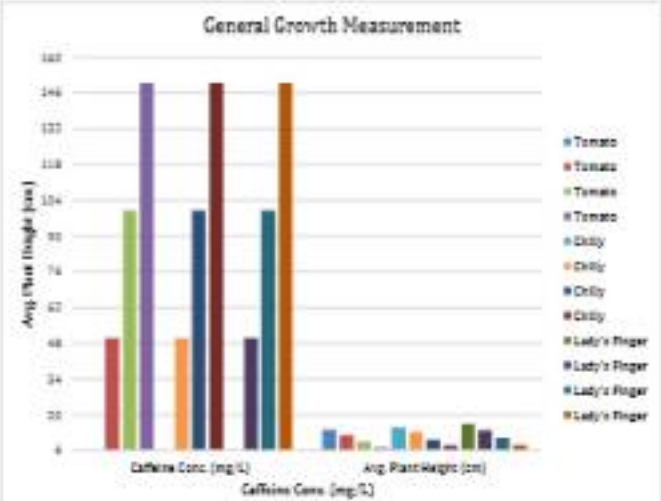


Table 2: Germination Study

Plant Type	Caffeine Conc. (mg/L)	Seeds Sown	Seeds Germinated	Germination Rate (%)	Days to First Germination
Tomato	0	10	10	100%	2
Tomato	50	10	9	90%	3
Tomato	100	10	7	70%	4
Tomato	150	10	5	50%	5
Chilly	0	10	10	100%	2
Chilly	50	10	9	90%	3
Chilly	100	10	7	70%	4
Chilly	150	10	5	50%	5
Lady's Finger	0	10	10	100%	2
Lady's Finger	50	10	9	90%	3
Lady's Finger	100	10	7	70%	4
Lady's Finger	150	10	5	50%	5

Graph : 2 Germination Study

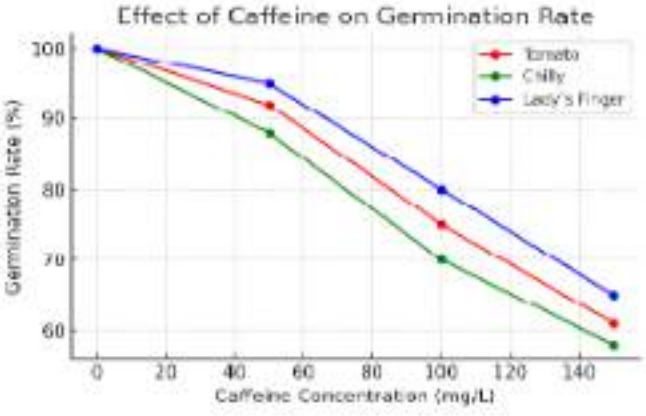


Table 3: Root Development

Plant Type	Caffeine Conc. (mg/L)	Root Length (cm)	No. of Lateral Roots
Tomato	0	8.0	6
Tomato	50	7.0	5
Tomato	100	5.5	4
Tomato	150	4.0	3
Chilly	0	8.5	6
Chilly	50	7.3	5
Chilly	100	6.0	4
Chilly	150	4.2	3
Lady's Finger	0	9.0	7
Lady's Finger	50	8.1	6
Lady's Finger	100	6.5	5
Lady's Finger	150	4.8	3

Graph 3: Root Development

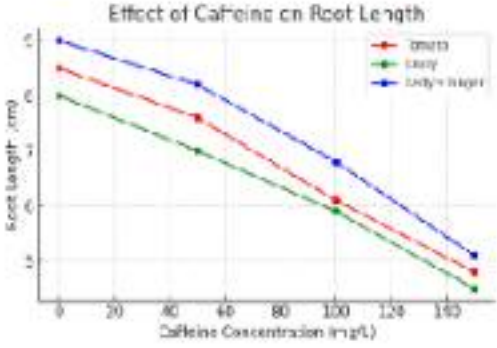


Table 4: Physiological Observations

Plant Type	Caffeine Conc. (mg/L)	Leaf Colour	Wilting/Yellowing Signs	Leaf Area (cm^2)	Photosynthesis Rate
Tomato	0	Dark Green	None	25.0	High
Tomato	150	Light Green	Yes	12.0	Low
Chilly	0	Green	None	20.5	High
Chilly	150	Yellowish	Yes	10.8	Low
Lady's Finger	0	Dark Green	None	30.2	High
Lady's Finger	150	Pale Green	Yes	14.5	Low

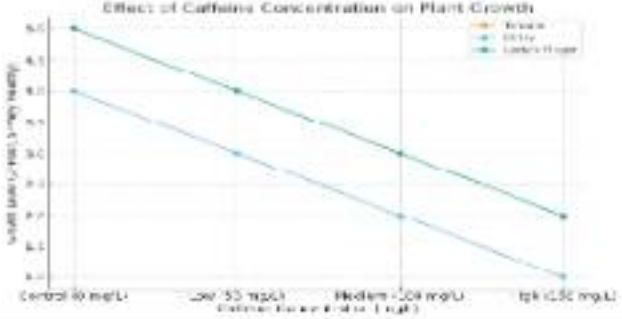
Table 5: Final Growth Outcome

Plant Type	Control (0 mg/L)	Low (50 mg/L)	Medium (100 mg/L)	High (150 mg/L)	Remarks
Tomato	Healthy	Slightly Reduced	Stunted	Poor Growth	Growth decreases with more caffeine
Chilly	Healthy	Reduced	Weak	Wilting	Caffeine hinders growth
Lady's Finger	Very Healthy	Good	Moderate	Stunted	High caffeine is harmful

Table 6: Graph Data Table

Plant Type	Caffeine Conc. (mg/L)	Germination Rate (%)	Plant Height (cm)	Leaf Size (cm)	No. of Leaves	Avg. Root Length (cm)
Tomato	0	100	14.2	5.3	8	8.0
Tomato	50	90	12.0	4.5	7	7.0
Tomato	100	70	9.6	3.8	5	5.5
Tomato	150	50	7.1	3.0	4	4.0
Chilly	0	100	15.0	4.8	9	8.5
Chilly	50	90	13.4	4.2	8	7.3
Chilly	100	70	10.2	3.5	6	6.0
Chilly	150	50	8.0	3.0	4	4.2
Lady's Finger	0	100	16.5	6.0	10	9.0
Lady's Finger	50	90	14.1	5.2	9	8.1
Lady's Finger	100	70	10.9	4.4	7	6.5
Lady's Finger	150	50	8.2	3.5	5	4.8

Graph 6:Graph Data Table



Collection of data -Photo graphs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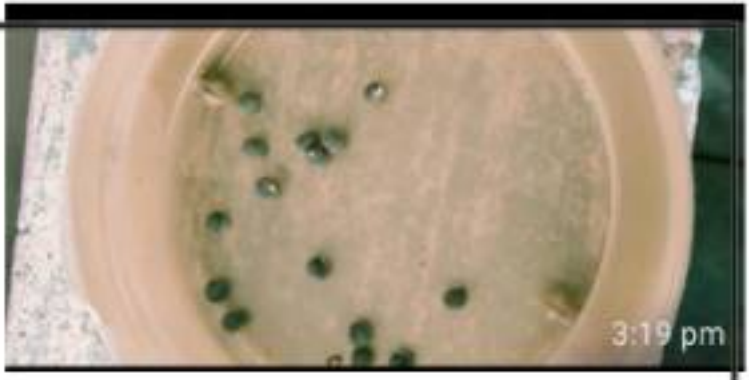
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RESULTS AND DISCUSSION

The plants that received plain water grew the tallest and looked healthy.

The low caffeine plants grew a little but were shorter than the control plants.

The high caffeine plants grew very slowly and showed weak or dull leaves.

This shows that caffeine does not support plant growth. Instead, it slows down how the plant develops. The more caffeine the plant receives, the more its growth is affected.

CONCLUSION

The experiment confirms that caffeine negatively affects plant growth. Higher caffeine concentrations led to reduced germination, stunted height, and smaller leaves. Hence, caffeine is harmful to plants at higher doses, and coffee grounds should not be used excessively as fertilizer.

Applications: This study can help gardeners and environmentalists understand how coffee waste affects soil health and plant growth.

REFERENCES

1. Ransom, F. (1912). The Effects of Caffeine upon the Germination and Growth of Seeds. Pharmacological Laboratory, Cambridge.

2. Jadhav, S. et al. (2016). Caffeine on Plant Growth. South Mountain Community College.

3. Muratova, S. A. (2020). The Effect of Caffeine in a Nutrient Medium on Rhizogenesis and Plant Growth. Bio-Conference Proceedings.

4. Ferguson, S. (2015). Effects of Caffeine and Vitamin E on Wisconsin Fast Plant. Wright State University.

5. Times of India. (2025). Why Using Coffee Grounds as a Fertiliser Can Be Deadly for These Plants.

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