

Effects of Varying Levels of Caffeine on Seed Germination and Plant Growth in Cucumber Plants

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Abstract

For our experiment, we wanted to see how varying levels of caffeine would affect both the germination of seeds as well as plant growth, because of the careless habit that exists in society of pouring drinks out onto different species of plant life. Our hypothesis states that when varying concentrations of caffeine are imposed on cucumber plants, they will show decreased levels of germination and plant growth. We chose to use the plant *Cucumis sativus* because of its durability under experimental conditions as well as its quick germination and growth rate. In addition, cucumber plants are able to grow in soilless solutions, making it easier to impose the different caffeine levels effectively. To examine caffeine's effect on plant growth, we comprised three treatments with varying levels of caffeine that correspond to the average caffeine amounts in coffee, soda, and decaffeinated coffee, the fourth treatment being the control that consisted of deionized water. Based on our hypothesis, the higher the caffeine levels the harsher the effect the solutions will have on the cucumber plants' growth. The results of our experiment could call attention to one of the daily effects humans are having on plant life. If our hypothesis is supported, it will provide evidence that could be extended to many similar species that we encounter on a more regular basis.



Figure 3



Figure 4

Background & Introduction

What do you do when you don't want to finish your drink? I can bet nine times out of ten you pour it out into a nearby patch of grass or plant system. Am I right? Have you ever wondered if your drink was helping or hurting the plant? We want to know the daily affect humans are having on plant life.

Based on some prior research, the four average drinks we as humans often drink is water, soda, decaffeinated coffee, and caffeinated coffee. In order to create constant results, we used pure caffeine concentrations which were equal in composition to each of these drinks.

Methods: Plant Growth

- "Seedlings' roots rinsed with deionized water to remove pretreatment solution.
- Seedlings transplanted into clean jar containing one of the 4 caffeine solutions
- Caffeine content treatment:
 - 0 mg
 - "water-like" solution
 - 7 mg
 - "decaf-like" solution
 - 29 mg
 - "soda-like" solution
 - 95 mg
 - "caffeine-like" solution
- Leaf area measurements (mm) are collected, root and shoot dry weights obtained

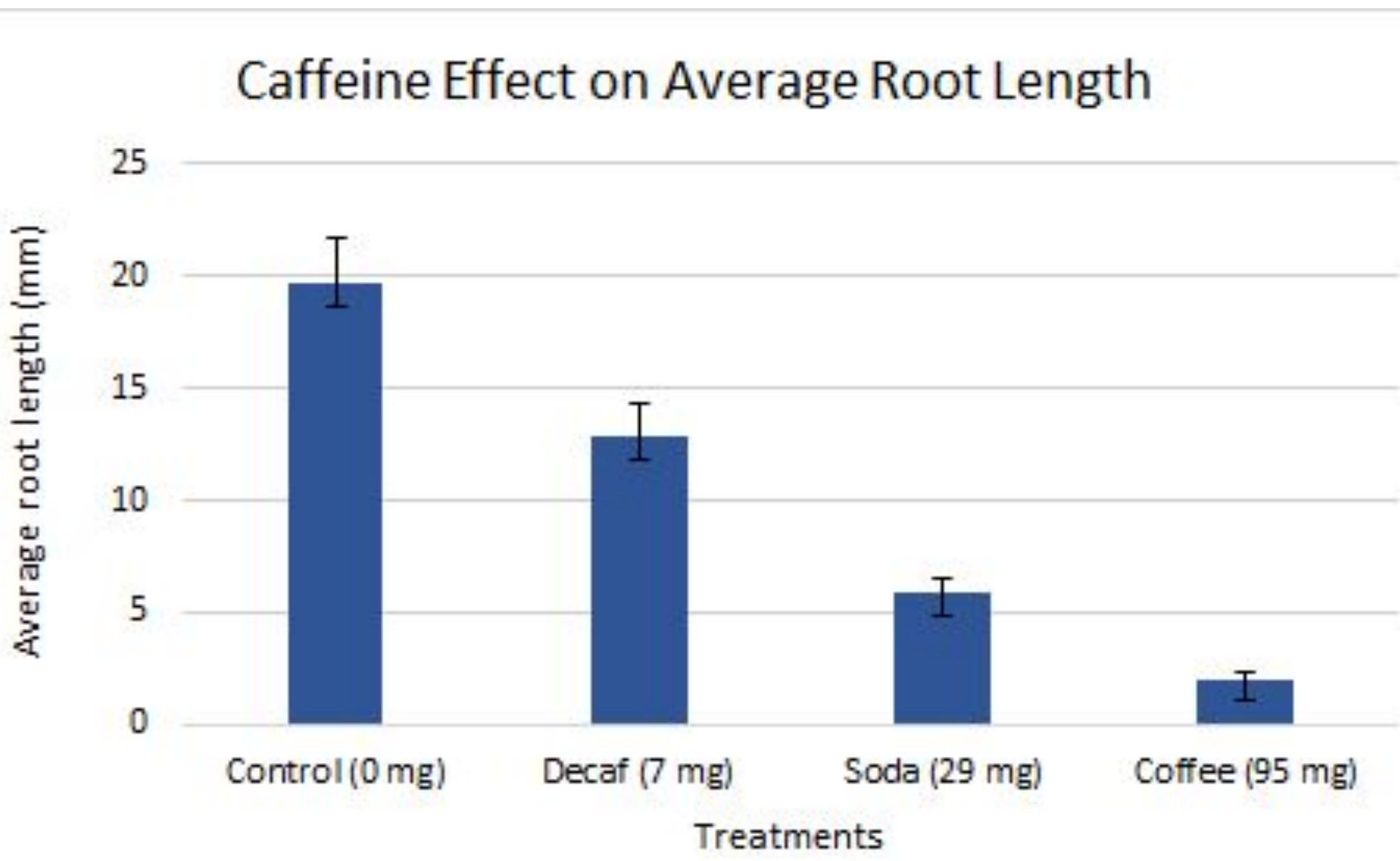


Figure 1: This graph illustrates the average root length (mm) measured after the cucumber plants were grown in the different levels of caffeine treatments. The standard error bars show the level of uncertainty or room for error in each reported measurement.

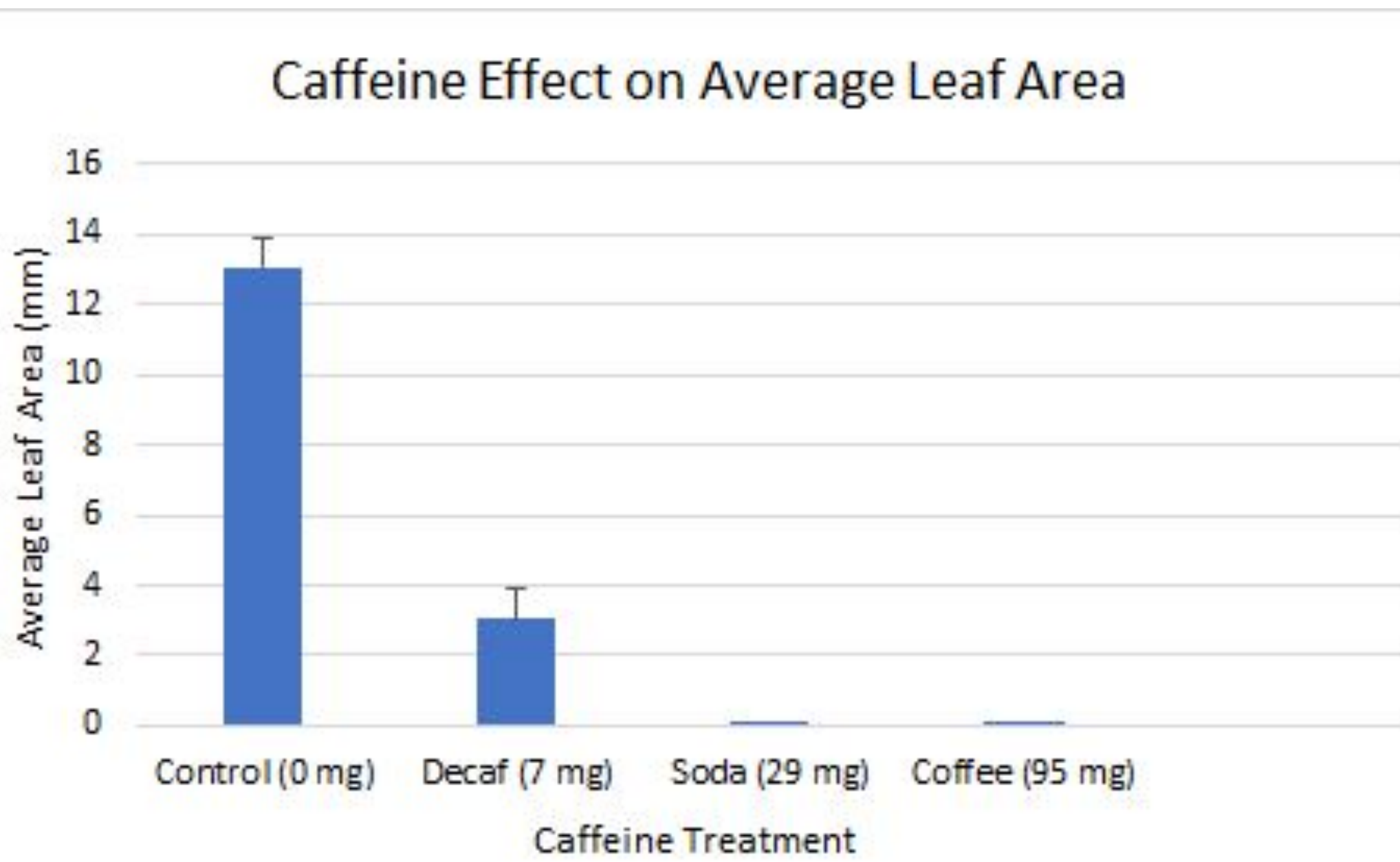


Figure 2: This graph illustrates the average leaf area that was recorded from each of the treatments. Both the soda and caffeine treatment were so damaged by the high level of caffeine that neither sprouted leaves.

Hypothesis

When varying concentrations of caffeine are imposed on cucumber plants, they will show decreased levels of germination and plant growth.

Results & Discussion

- Our hypothesis was supported in that the addition of varying levels of caffeine did negatively impact plant growth.
- In the experiment, it was found that the caffeine concentrations found in soda and regular coffee are damaging enough to stunt the growth of plants, and can even cause plants to die.
- Germination rates were not significantly affected by any of the caffeine concentrations, but the root length of germinated seedlings was reduced.
- The use of the cucumber plant for the experiment would work very well in the classroom. It is very durable and reacted well to the different treatments.
- If a teacher wanted to replicate this in the classroom, we recommend it be in a high school environment because of its use of materials and meticulous process in both setting up and carrying out.
- An alternative to this experiment that could be used in elementary or middle school could be if the teacher focused specifically on the plant growth portion. The teacher would need to do all the set up with making the caffeine solutions, but then place the plants near a window so the children could watch them grow or not. After, the children could look at the different root lengths and leaf areas and discuss the benefits of having long roots or wider leaves.

Methods: Germination

- Filter papers were placed into 20 petri dishes
- 10 seeds were placed on top of the paper in each dish
- The filter papers and seeds were saturated with one of four different caffeine solutions by use of pipettes
- The seeds germinated for four days without any manipulation
- Root length was measured in millimeters

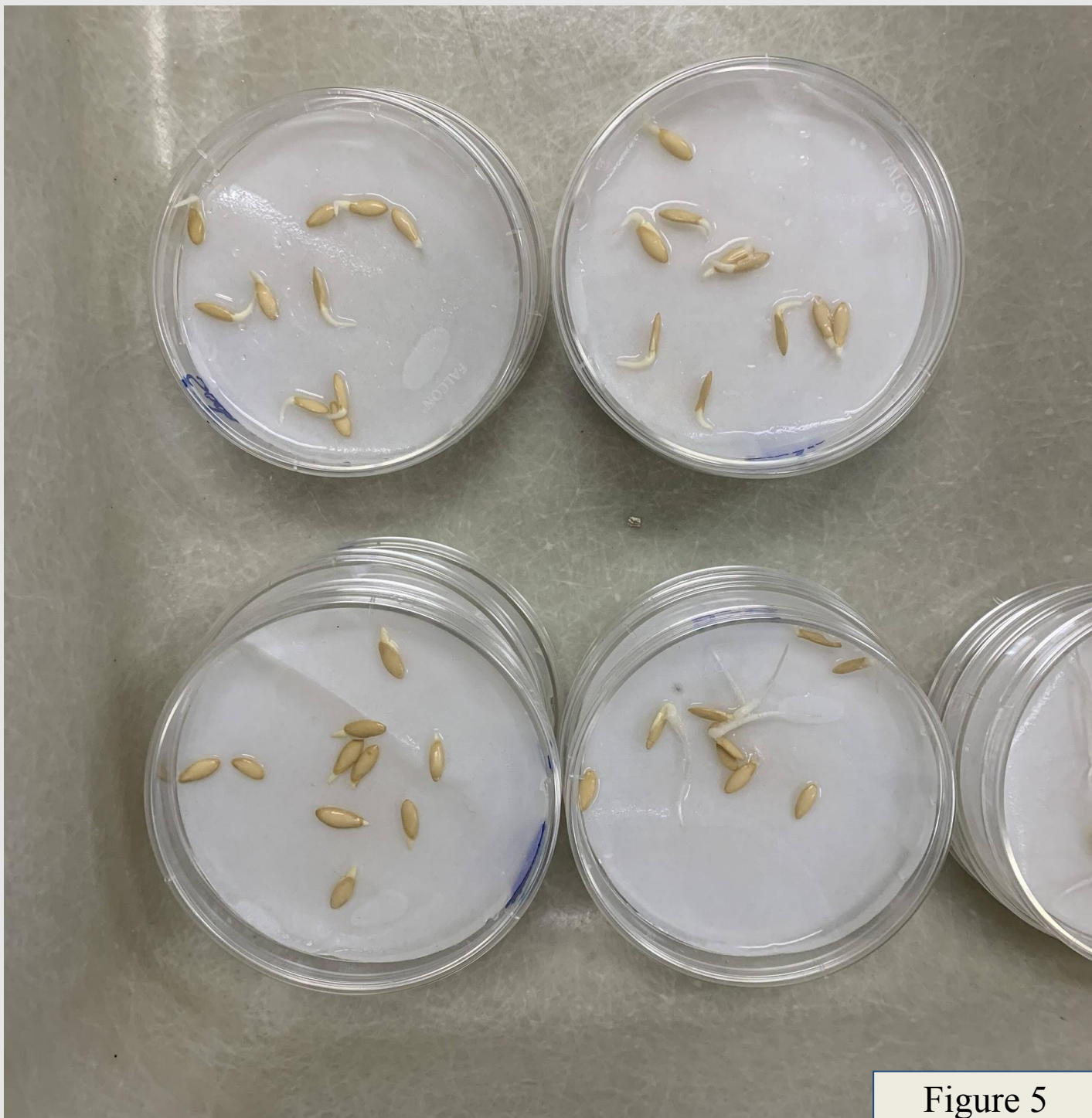


Figure 5

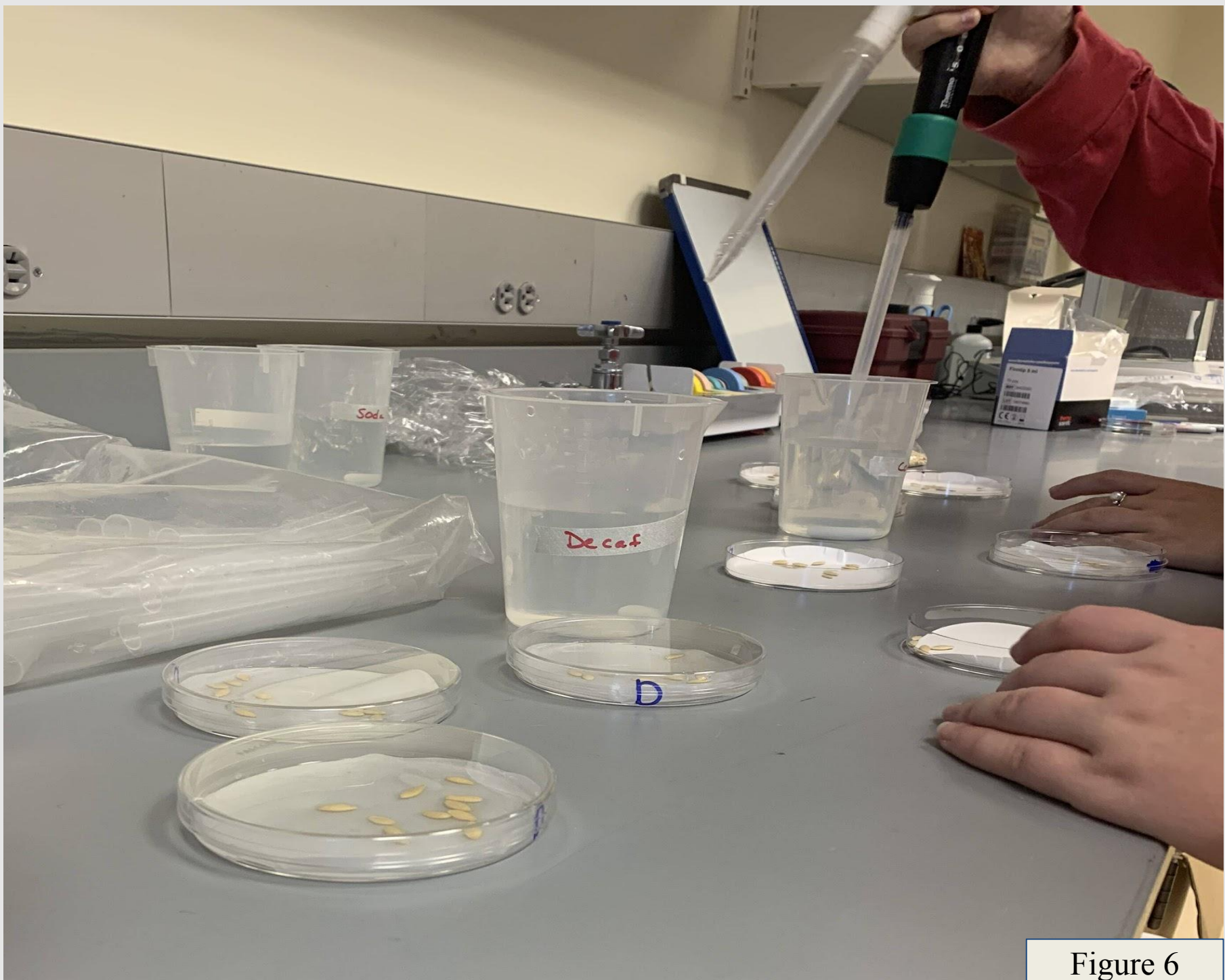


Figure 6

Figure 3: The containers used to put the plants in order to impose the different caffeine solutions.

Figure 4: Starting from left to right, one can see the effects the different levels of caffeine, lowest concentration to highest, had on leaf area.

Figure 5: These are the plant seeds after four days of germination.

Figure 6: Pipettes were used to gather 0.5 mL of each solution to saturate the groups of seeds.