Crushed garlic on seeds: germination and growth

Does the aromatic substance from garlic have an inhibiting effect on the germination and growth of the lettuce seeds? This is the question that was put as the base of our laboratory experiment.

Introduction

Many plants produce chemical compounds that are not directly involved in the normal reproduction, growth or development of organisms. These compounds are called secondary metabolites. Plants may use secondary metabolites to compete with each other by releasing these chemicals into the environment. Allelopathy is “ production of biomolecules by one plant, mostly secondary metabolites, that can induce suffering in or give benefit to, another plant. The phenomenon can also be considered as a biochemical interaction among plants”(Rizvi and Rizvi). The influence of the plants upon each other can be either beneficial – positive allelopathy or detrimental – negative allelopathy. Negative allelopathy is a form of chemical competition. Allelopathic plants prevent other plants from using the available resources such as nutrients, water, and sunlight. Positive allelopathy encourages other plants to grow. It can be done by putting off insects and other predators and by inhibiting bacteria, molds and other harmful substances.

Garlic (Allium sativum) is an allelopathic plant. Intact garlic contains odorless compound alliin and an enzyme, alliin lyase. Enzyme and substrate become mixed when damage is done to the garlic cells and as a result, volatile secondary metabolite called allicin is produced. Allicin is produced in garlic only when the plant is injured and its tissues are damaged or crushed. The typical odor of the crushed garlic is due to allicin production. Allicin inhibits the growth of microorganisms and seed germination and protects the

damaged garlic from microorganisms and competition from other plants for nutrients (Miron, Shin, Feigenblat, Weiner, Mirelman, Wilchek and Rabinkov).

The hypothesis that is stated for the experiment is:

The aromatic substance (volatile) from garlic will inhibit the germination and growth of the lettuce seeds.

Methods and Materials

In the experiment:

Independent variable: aromatic substance (volatile) of garlic

Dependent variable: number of germinated seeds, length of seed’s stems

Nuisance variables: seed’s genetics, room temperature, light

Nuisance variables were controlled by maintaining the same location for all Petri dishes and by keeping their integrity.

Experimental seeds: Lettuce (Lactuca sativa) seeds

Garlic (Allium sativum)

Seed Germination set up: 9 cm Petri dishes with two pieces of Whatman filter paper

Distilled water: 3ml per set up

Masking tape

Aluminum foil

Knife or razor

Triple beam balance

Garlic was crushed using a razor. 1. 0 g, samples were weighed on a triple beam balance and transferred to two aluminum boats. Then, two aluminum boats with crushed garlic were placed into two experimental Petri dishes that contained 2 pieces of Whatman # 1 filter paper and 20 lettuce seeds in each. 3 ml of distilled water were added and dishes were sealed with masking tape.

Two other Petri dishes were set up for control groups. Controls set up were done as described above with the exception of adding of garlic to the aluminum dishes.

All four Petri dishes were incubated and observed for two weeks under classroom conditions.

At the end of the experiment, the results of the control treatment will be compared to the results of the experimental treatments.

Two experimental and two control groups were used.

4 Petri dishes with two pieces of Whatman filter paper

4 aluminum boats

80 lettuce seeds, 20 in each Petri dish

2 g garlic, 1g in each experimental group Petri dish

12 ml distilled water, 3 ml per Petri dish

Results

There were seven measurements taken over the span of two weeks. It was observed that the two dishes with garlic had fewer germinated seeds and grew much less than the two dishes without garlic. Therefore, the result of the experiment is that garlic has a negative allelopathic effect on lettuce seeds germination and growth.

On the first day when the measurements were taken it was observed that most of the lettuce seeds in the two control groups were germinated but only one and two seeds were germinated in the experimental 1 and experimental 2 groups respectively.

On day two, all twenty seeds were germinated in both control groups 1 and 2 but only sixteen and thirteen seeds were germinated in the experimental 1 and experimental 2 groups respectively. By the end of the experiment, one more seed germinated in the experimental group 1 which brought the total number of germinated seeds in the experimental group 1 to seventeen seeds. In control group 1, control group 2 and experimental group 2 , the number of germinated seeds hadn’t changed from the day three, except two stems decayed in the control group 1 on the last day of the experiment.

As for the length of the stems, it was observed that stems started to grow noticeably on the day three of the experiment. The average length of the stems in both control group 1 and 2 was evidently longer than the average length of the stems in the experimental groups 1 and 2. The stems in both control groups continued to grow until the end of the experiment. The stems

in both experimental groups grew very little and then all decayed by the day six of the experiment. On the contrary, by the end of the experiment, only two stems decayed in the Control group 1.

The results above demonstrate that garlic has a negative effect on germination and growth of lettuce seeds.

Discussion

At the beginning of the experiment, it was stated that garlic would have a negative allelopathic effect on the germination and growth of other seeds. After conducting the experiment and gathering data it can be concluded that this experiment supports the hypothesis. The seeds in both control groups with no garlic had more germinated seeds and much longer stems than the seeds in experimental groups with garlic in them.

The shortest stem in the containers with garlic (experimental groups) was 4mm and the longest one was only 9 mm, comparing to the shortest 23 mm and the longest 53 mm in containers without garlic (control groups).

The seeds in the containers with garlic (experimental groups) did not grow longer than 9 mm and all decayed by the day six of the experiment, compared to the seeds in the containers without garlic (control groups), which grew up to a maximum of 53 mm and appeared alive and healthy except two seeds that decayed on the last day of the experiment.

I was able to replicate the experiment by using 20 seeds in each Petri dish (the sample size of 20 seeds) along with two controls and two experimental groups. Such a sample size was sufficient to draw a conclusion from one

experiment. However, the time I had to do the experiment in the laboratory was limited and therefore, I was not able to repeat the experiment multiple times in order for it to be entirely reliable. This was one of the weaknesses in my investigation. Another weakness was that many people had access to the lab, where the experiment was conducted, and as a result, the samples could have been moved from their original places. It could have affected the result of the experiment as well. If more time was given, this experiment should have been repeated multiple times and in a more secure environment if possible.

In conclusion, the results of this research are in line with the results of the same experiments conducted earlier. This experiment followed my original hypothesis that aromatic substance (volatile) from garlic will inhibit the germination and growth of lettuce seeds.

Such important characteristic of garlic can be utilized in the agriculture. As our society started to recognize the importance of organic produce and harmfulness of commercial pesticides, garlic can be used as an organic pesticide. Of course, more research and experiments are needed in this area.