

Hong Kong Student Science Project Competition 2023

Template of Extended Abstract (Investigation)
(Word Limit: 1,600 words, Pages: 3 pages only)

Team Number: SBBC169

Project Title: The effect of different medical painkillers on the growth rate of bean sprouts

Project Type: Investigation

*To our best knowledge, there are / ~~are no~~ * similar works in the field; (if there are,) related research links are as below:*

<https://www.sciencedaily.com/releases/2020/12/201201124059.htm>

The enhancement our project made / the difference with related research are:

Previous research highlights the qualitative effect of adding aspirin to aid plant growth, but did not compare the quantitative efficacy of different concentrations of aspirin in water on plants. This research focuses both on comparing the effect of different pharmaceutical drugs and the effect of concentration on the growth of bean sprouts, showing that the addition of medicine into the plant is quantitative and not simply qualitative.

I. Background

In this project, we make four main decisions.

1. The choice of testing aspirin, ibuprofen and paracetamol as medical fertilizers.

Aspirin (acetylsalicylic acid) is prepared by chemical synthesis from salicylic acid, through acetylation with acetic anhydride. Salicylic acid is a stress signal in plants. It also participates in regulating plant growth and development. Previous studies have shown that, aside from providing the plant with salicylic acid which promotes the plant's immune response, aspirin also benefits plant growth in many ways, including pH regulation of soil, to provide the optimal environment for plants to grow. As aspirin can help acidify and decrease the alkalinity of the soil, it can maintain a suitable pH for bean sprouts to grow. Ibuprofen is a pharmaceutical drug derived from salicylic which has similar medical effects on humans. Paracetamol has a similar chemical structure and applications in the medical field as aspirin. Thus, it is worth investigating whether it has similar effects as aspirin and if it would be a better alternative on plant growth.

2. The choice of testing the effect of medicine on bean sprouts.

Bean sprouts, a type of grain legume in the family Fabaceae, are widely grown agricultural crops that are used for human consumption. Aden green manure. We use bean sprouts mainly because bean sprouts grow faster than most of the plants. The experimental results of the experiments can be observed more easily: the waiting period will be shorter and a more significant increase in size, mass and height.

3. The choice of replacing traditional fertilizers.

Since traditional fertilizers increase the toxicity of the plants and cause pollution, we decide to replace traditional fertilizers.

4. Implementation of above mentioned considerations.

We aim to combine the advantages of using pharmaceutical drugs and the health benefits of bean sprouts to implement a sustainable and eco-friendly way of food plantations.

II. Objectives

The aim of this investigation is to find out and compare the effects of aspirin, ibuprofen and paracetamol in different concentrations on the growth rate of bean sprouts, and derive the most beneficial medical fertilizer amongst them, as to judge whether the usage of that medical fertilizer is therefore a more effective method for plant growth, and which concentration is optimal.

III. Hypothesis

As the addition of aspirin provides bean sprouts with salicylic acid, which boosts the bean sprouts' immune response and growth, we hypothesize that the group A1 (i.e. 1 mg of aspirin in 5 mL of water), which has the highest concentration of aspirin, will have the largest growth rate. This hypothesis is tested by measuring the growth rate of groups of bean sprouts watered with different concentrations of different drugs over a span of 13 days, as to find the 2 factors affecting bean sprout growth: type of drug used and the concentration of the drug applied.

IV. Methodology

Materials:

- 12 identical plastic cups
- 120 bean sprouts
- A bag of cotton balls (around 40)
- 12 reagent bottles
- 4 identical syringes
- Solutions of different concentrations of medication (130 mL each)

Procedures:

12 distinct experimental groups were set up, the twelve including plants watered with solutions of different concentrations of aspirin, paracetamol and ibuprofen respectively.

12 experimental groups were set up by packing 2 cotton buds respectively into 12 clear plastic containers, and the containers were labelled A1-A4; B1-B4; C1-C4. 10 bean sprouts were added respectively to each container. The medicines were dissolved and diluted in distilled water according to the following steps: the medicine tablet was crushed into fine powder with a pestle and mortar. 100 mL of distilled water was added to a beaker. All the powder was transferred to the beaker and the mixture was stirred until the powder completely dissolved in the distilled water. Serial dilution was conducted according to calculation, and the above steps were repeated until there were 4 solutions of different dilution: 1 mg in 5 mL distilled water; 1 mg in 10 mL distilled water; 1 mg in 20 mL distilled water; 1 mg in 40 mL distilled water. The steps were repeated with the other two kinds of medicines.

The plants were watered with 10 mL of its corresponding solution every day for 13 days.

Reasoning:

The bean sprouts are grown in cotton buds (moistened with the same amount of medical solution) to limit the sprouts' exposure to other minerals and chemicals, to ensure that the difference in growth rate between different groups is not because of other nutrients. The independent variable in the experiment is the types of medicine dissolved in water, and the concentration of the solution. To ensure a fair comparison can be made, we kept the amount of sunlight, oxygen and the level of humidity to be the same. Moreover, the respective brand of medicine and the mass added in each portion were kept the same.

V. Results

Day	Height (cm)											
	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4
1	1	1	1	1	1	1	1	1	1	1	1	1
5	1.4	1.7	1.8	1.8	1.7	1.7	1.6	1.8	1.6	1.5	1.6	1.7
9	4.5	7	7.5	7.4	6.8	6.6	6	7.2	6	5.6	6	7
13	7.9	9.9	13.4	11.3	11.9	12.4	11.2	10	3.9	7.8	9.9	10.1

Table 1: The effect of different medical painkillers on the growth rate of bean sprouts

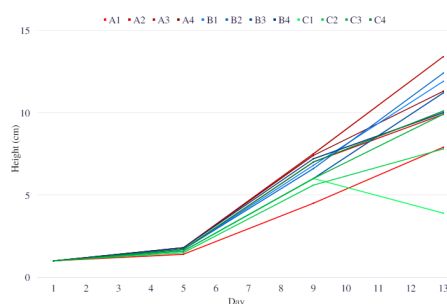


Figure 1: The effect of different medical drugs on the measured height of bean sprouts.

The height of all 10 bean sprouts in each experimental group was measured every 4 days and length of the longest bean sprout in each group (i.e. the maximum value) was recorded into Table 1. As 10 is an insufficient sample size to eliminate extreme values which occurred when a bean did not grow at all), the maximum value of

the group was taken instead of the average value.

The broken line graph was drawn with the data compiled in Table 1. From the graph, it is shown that not only does the group A3 (watered with 1 mg in 20 mL water) have the largest final height, the growth rate of A3 is also consistently higher than the other groups, showing that the A3 solution was the most effective in boosting bean sprout growth.

The results show that there is a tangible difference in the effect of not only different drugs, but different concentrations of drugs, showing that the effect of painkillers on bean sprouts is dose dependent and a quantitative finding. The presence of aspirin alone is not enough to determine a beneficial effect of the medicine on the bean sprouts, as neither the highest or lowest concentration garnered the best result. This implies that a precise concentration of aspirin added is needed when implementing aspirin solution as a replacement for traditional fertilizers.

Limitations of the experiment include a small sample size and limited dosages. As the experiment was conducted in a small scale, each experimental group could only allow for 10 beans and there would be extreme values of the bean sprout heights, for example when a bean did not sprout at all. Furthermore, a small sample size implies that there is a higher probability that the beans' growth relied on chance. However, since the results of the experiment are consistent with previous works and since all the experimental groups were kept in the same controlled environment, the results are reliable. In the controlled environment, the experimental groups were not exposed to any pests or harms; however, the salicylic acid still takes effect to aid plant regeneration and growth, therefore the effectiveness of the medicine solutions can be reflected in their growth.

Further research could be conducted with a large sample size with the numbers closer to crop levels, and with more solutions with varying concentrations of aspirin. In addition, as bean sprouts are primarily grown for food consumption, it is worthwhile to conduct clinical trials to test if bean sprouts watered with aspirin solution have different effects on humans than traditionally grown bean sprouts, and whether the addition of aspirin into the bean sprouts causes unintended side effects on humans.

The enhancement of growth rate of bean sprouts potentially has impacts on sustainable food production, providing a way of producing higher yield while eliminating the harmful side effects of nitrogen fertilizers on the soil and environment. Additionally, the quantitative results of this research proves that aspirin fertilizers are dose dependent, helping future farmers with the precise concoction of their own fertilizers.

VI. If your team will compete for the Sustainable Development Award, please indicate the specific sustainable development goal the project is related to, and provide justification for competing for this award. (Word limit: 300 words)

N/A

VII. If your team will compete for the Social Innovation Award, please list the target group or social issue the project focuses on, and provide justification for competing for this award. (Word limit: 300 words)

N/A

VIII. Conclusion

The addition of aspirin in the concentration of 1 mg in 20 mL for plant watering is optimal for bean sprout growth.

This conclusion shows that adding aspirin into plants is dose dependent and therefore the concentration of aspirin added should be precise when using aspirin solution as a sustainable fertilizer. This project shows that adding a specific concentration of aspirin is indeed beneficial to plant growth.

Our project is developed based on previous project and the enhancement is below:

N/A