

# Effect of increasing ph concentration on the germination and growth of mustard se...



Acid rain is caused by the presence of  $\text{SO}_2$ ,  $\text{NO}_x$  which mixes with the atmospheric gases and in the soil which is emitted by human activities such as mining. Acid rain has a pH which is lower than 5.6 which harms the soil and affects the growth rate. Natural rain has a pH of about 5.6 or above.

The soil seeps the acidic water and affects the roots. Poor root growth will affect the strength of the plant and the amount of protein content in the plant reduces.

Mustard seeds germinate fast and mature very quickly. For quicker growth of mustard seeds, a neutral pH is required which increases the germination rate.

### Hypothesis

Acid rain will reduce the germination and growth rate of mustard seeds and prevent the germination of seeds. The Lower the pH, the greater the reduction in growth rate. 1

Variables:- Table-1 - Dependent and independent

### Independent

pH of  $\text{H}_2\text{SO}_4$  acid solution. It is used as stimulated acid rain.

### Dependent

Length of root (cm)

Number of leaves

Color of leaves

Length of stem(cm)

Table -2 Controlled variables , their effect on the experiment and how to control them.

Controlled variables

Effect on the experiment

Method of controlling variables

Temperature

The enzyme inside the seeds will react differently when kept in different temperatures.

Keep the test tubes in the same room with same room temperature.

Spacing between the seeds

To ensure equal growth of the seeds, so that the seeds do not compete for space.

Measure the space between the seeds with the help of a ruler ( $\pm 0.1$ cm)

Oxygen availability

If the seeds are exposed to different levels of oxygen, the germination rate of the seeds will be different and will produce inaccurate results

Keep the Petri dishes in the same area near the window.

#### Volume of pH solution

If the amount of solution poured in each Petri dish is different, the results obtained will be different and inaccurate because of different water absorption by the seeds.

Use a measuring cylinder to pour same volume of the solution in the Petri dish everyday.

#### Size of the seeds

If the seeds used are of different sizes, the rate of germination will be different resulting in inaccurate data.

Use a graph paper to measure the size of the seeds.

#### Apparatus

- \* 30 Petri dishes with lid (this includes 5 replicas for each set )
- \* Marker for labeling
- \* Mustard seeds of the same type bought from the nursery
- \* 10 mustard seeds were kept in each petridish
- \* Forceps
- \* Ruler for measuring growth of seeds in mm and cm.

\* Scissors

\* Cotton to soak the seeds and keep in the Petri dish

### Procedure

\* 5 Petri dishes were taken with lids and labeled pH 3, 4, 5, 6, 7. (3 replicas for each pH was kept)

\* pH solutions of different levels are made using sulphuric acid.

\* pH1: 4cm<sup>3</sup> of 1M sulphuric acid and 40cm<sup>3</sup> of distilled water.

\* pH2: 4cm<sup>3</sup> of pH1 solution and 40cm<sup>3</sup> of distilled water.

\* pH3: 4cm<sup>3</sup> of pH2 solution and 40cm<sup>3</sup> of distilled water.

\* pH4: 4cm<sup>3</sup> of pH3 solution and 40cm<sup>3</sup> of distilled water.

\* pH5: 4cm<sup>3</sup> of pH4 solution and 40cm<sup>3</sup> of distilled water.

\* pH6: 4cm<sup>3</sup> of pH5 solution and 40cm<sup>3</sup> of distilled water.

\* pH7: 40cm<sup>3</sup> of distilled water.

\* Cotton was added to the bottom of each Petri dish. 10 mustard seeds were placed into each petri dish over the cotton . Soak each Petri dish with the correct pH solution and label them correctly.

\* The Petri dishes were left in a corner of the room where sufficient fresh air is available.

- \* The seeds were soaked with the labeled solution everyday and observe the growth rate in the seeds.
- \* All the dishes were exposed to the same temperature (room temperature) and the same O<sub>2</sub> availability.
- \* Fresh air was introduced to the dishes whenever they were observed and kept beside an open window to avail circulation of fresh air.
- \* The experiment was repeated 5 times with proper pH solution for accurate results.

## Discussion

With the investigation on the effect of acid rain on germination and growth of mustard seeds, our hypothesis of the experiment can be confirmed i. e. mustard seeds grow more when they are kept in neutral pH. This is due to the fact that optimum pH 7 for germination and growth of mustard seed is in neutral pH. The enzymes are all active and hence best growth results are obtained in this pH. pH 3 as well showed a positive result for root growth though the growth rate is slow in comparison with the other pH. If we compare the average root length on pH 4 with pH 3, we can see there is a big difference. While pH 4 has an average root length of 0.595 (+ OR - 1CM), pH 3 has an average of 4.95 (+ or - 1cm). Surprisingly pH 4 gave the worst result for the growth of root when compared to other pH. The fungal infection noticed in pH 3 in day 5 and 7 in pH 4 in day 7 is may be due to lack of moisture due to high concentration of acid rain that inhibited absorption of water.

The enzymes are all active in pH 7 and hence the best result for shoot development is achieved in pH 7. The average growth is 2.025 (+ or - 1cm). A positive result is shown as expected. pH 4 has shows the worst result for the average growth of the shoot. pH 3 on the other hand has shown a better result when compared to pH 4 and has an average growth rate of 1.76 (+ or- 1cm). The shoot growth rate has been affected because of the fungal infection.

The average number of leaves is the most in pH 7, and has shown a positive growth result overall. The average numbers of leaves are 19 for each seed. The average numbers of leaves are less in pH 3 and 4 due to fungal infection.

## Conclusion

Finally from table 6, we can see that the highest average stem length is in pH 7 (2.025) and the second best result is obtained in pH 6 (1.94) with an average difference of 0.085 cm. pH 4 showed the lowest average for stem length. Fungal infection was observed in pH 3 and 4 due to lack of moisture. After this analysis we can conclude that pH 7 showed best result in germination and growth and development of mustard seeds due to proportional development of root and shoot.

From this experiment on the effect of acid rain on germination of seed, the hypothesis I stated is justified to a certain extent as the mustard seeds grow faster with a neutral pH 7. After conducting the experiment and looking at the observation, we can conclude that acid rain effects the growth of seeds and that a neutral pH helps in the germination of seeds faster and better.

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## Evaluation

The result obtained by conducting the above experiment is accurate due to the following reasons:-

\* The spacing between the seeds in the Petri dish was the same. This was done to ensure that all the seeds get enough space to grow and was growing in the same environmental conditions.

\* All the seeds were exposed to the same temperature, and the Oâ level. Therefore all the seeds had the same conditions to germinate and develop their features.

\* A ruler measuring in mm was used to measure the growth of all the seeds. Therefore the growth of all the seeds measured was accurate.

## Limitations

\* Although a ruler was used to measure the growth of the seeds in mm, a few seeds got disturbed from their position which led to inaccuracy of the data.

\* The seeds should be kept in a bigger container. This will ensure the spacing between the seeds is sufficient enough and the seeds do not get disturbed while measuring their growth.

\* Volume of the cotton kept in petridishes were not equal in volume. This might create uneven competition for water absorption by the seeds for germination.



### Suggested improvement

- \* Weight of the seeds should be measured before starting the experiment so that the seeds can absorb the same amount of water.
- \* Inaccuracies can be seen in the measurement of pH as pH paper was used to measure pH of each solution. pH meter should be used for correct measurement of pH in each solution.
- \* Volume of the cotton should be weighed and equal volume of the cotton should be placed on each petridish for fair result.

### Bibliography

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- \* Rutherford, Jill. Environmental Systems and Societies. New York: Oxford UP, 2009. Print