How Scarification Affects the Germination and Growth of Peas

Planting Science Experiment

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Question

Which is the best for pea seed germination, nicked, sanded down, or unscarred?

Will it take longer for the unscarred pea seed to sprout?

If the unscarred seed sprouts later, will it stay smaller than the scarred plants, or will it grow out bigger than the others?

Research/Q&A

Q. What role do seeds play in supporting life on Earth?

A. Plants help us because they maintain the atmosphere by providing oxygen and absorbing carbon dioxide during photosynthesis.

Q. How does a sprout develop from a seed?

A. A plant contains all of the things that it need to start growing and sprouting. It contains its own food and all of the instructions necessary.

Q. What are the characteristics of seed germination and seedling growth?

A. Germination and seed growth are basically known as the same thing. The definition of germination is..... Germination Is the budding of a seed after it has been planted in soil and remained dormant for a certain period of time. For Plants and fruits that reproduce through seeds and pollen, the seeds eventually grow into young plants through the process of seed germination.

Q. What role does the environment play (biotic and abiotic) in seed germination and growth?

A. Well in order for seeds to grow and germinate they need things like sunlight, temperature atmospheric gases, water and soil. These things are all abiotic factors. In terms of biotic factors, plants and things like fungi animals and bacteria are biotic factors. So, this means that the biotic factors uses a lot of the abiotic factors to live.

Insight from Mentor

As for your seed project, I actually do know a bit about scarification. Many species, particularly those with large seeds (many trees, for example) require scarification in order to germinate. This could be due to many factors, but a common one is that plants that produce fruits are often eaten by animals with teeth or grinding digestive tracts that would kill the seed if it was small. In response, plants produce seeds that are thick and hard in order to survive this process, and the mechanical action of being eaten allows germination to take place after the seed has exited the digestive tract. This process is known to scientists as endozoochory. - Alex (our mentor) said.

What types of seeds will you be trying to germinate? Can you think of any reasons why scarification might be beneficial to those species? Think of the way the seeds are dispersed or the environmental conditions that the plants face that might require having hardier seeds. - questions he asked that got us thinking more about our experiment.

Amazing, your experiment is turning out almost exactly as expected. You can trust me when I say this is very rare. Do you have any thoughts about this type of experiment might work if you had used different species? What seed traits do you think might reproduce the results you saw, and what seed traits might lead to different results?

Hypothesis

If we sand down a pea seed, it will germinate first, before a nicked pea seed and an undamaged pea seed. It will **then** grow the best (roots longest, stem tallest)

This is our hypothesis **because** the embryo needs to burst out of the seed coat to sprout. Scarification weakens the seed coat, and sanding it down more so, so the seed will sprout at a faster rate when it is sanded down.

Variables

Identify

- Scarification- Naked and Sanded seeds
- Dependent- rate of germination and growth of the seeds
- Constants- Amount of water, type of paper towels, Area it was in.
- Control- unscarred seed

Materials

- 3 clear CD cases
- 3 clear slips of plastic with squares that make a grid
- 3 Styrofoam stands (holds up CD case)
- 3 plastic trays
- 15 pea seeds
- Exacto-knife (or any sharp object that can cut a seed)
- Sandpaper
- Water 10 - 15 ml
- 3 paper towels
- Ruler

Procedure

1. Get 3 plain cd cases and 3 clear grids. Put the grids inside the CD case so that it stays in place.
2. Take your three paper towels, and cut it or rip it so that it is 20 cm (8 inches) by 12 cm (4 5/8), and then fold the top so it makes one section of 1 inch. Do that five times so that there are 5 small sections and 1 big section.
3. Cut five pea seeds so that the hole in the seed coat are 0.5 cm wide on both sides - (the circle - hole - is 0.5 cm across one way, and 0.5 cm across the other way.
4. Sand down 5 pea seeds so that the whole coat comes off. The result should be a yellow seed (the inside of a pea seed is yellow)

Procedure

5. Open one CD case and put one of the sets of five seeds in it, at the line in between the 4th box and the 5th box. Make it so the seeds are placed at every other square so they have room to grow. Then place the paper towel on top of the seeds, so that the thickest part (the part with all of the folds) is on top of the seeds, and the bigger fold of the paper towel is hanging down below the end of the CD case. (we did this first, however we weren't sure it would work well, so we changed it so that the whole towel was folded into 1 inch sections, and the seeds were placed in a sort of section. This didn't work well, so we went back to the first idea with the folded paper towels, and it worked better.)

6. Do the same thing for the other two sets of seeds.

Procedure

7. After you set up the CD cases, make sure that when you stand them up, the seeds don't move around. If they do, redo the process so that they don't move. If they don't, split the middle of the part of the paper towel that is hanging below the CD case so that the styrofoam stand can be put on with less problems.

8. Put the styrofoam on the cd case so that it acts as a stand.

9. Place each CD case in a separate plastic tray, so that there are three different set-ups.

Procedure

10. Water each set of seeds with 10-15 mL of water (you can test a certain amount on the first day, and if the paper towel is completely dry the next, up the amount). Make sure the ends of the paper towels are soaking up the water, so that it reaches the seeds. (On the first day, we watered our seeds with 10 mL of water, but we noticed that the paper towel was barely damp, and the seeds looked really dry, so we upped the amount of water to 15 mL, and then poured 2 mL of water down the opening of each CD case so the water would directly hit the seeds. We didn't continue with the watering from above after that, however we believe that it had a part in the germination of the seeds.

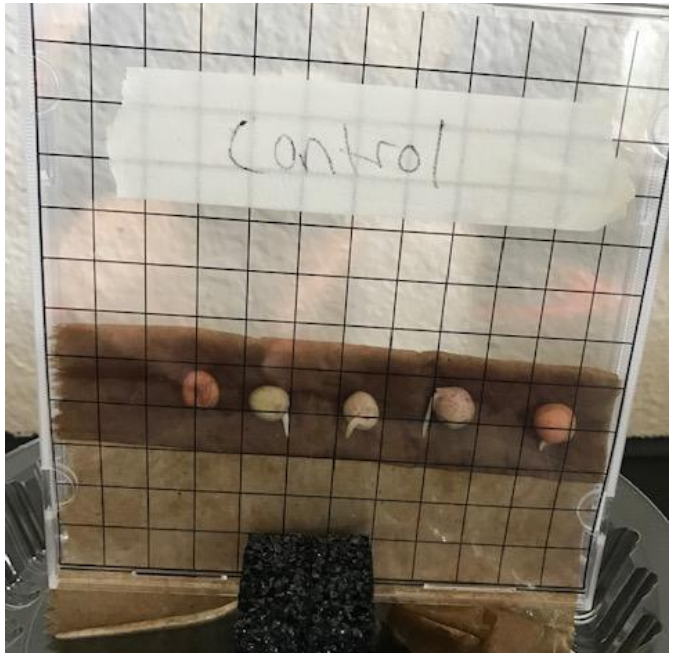
11. Water the seeds every other day, however if the experiment is being done at school, water every Friday no matter what (even if you watered the day before).

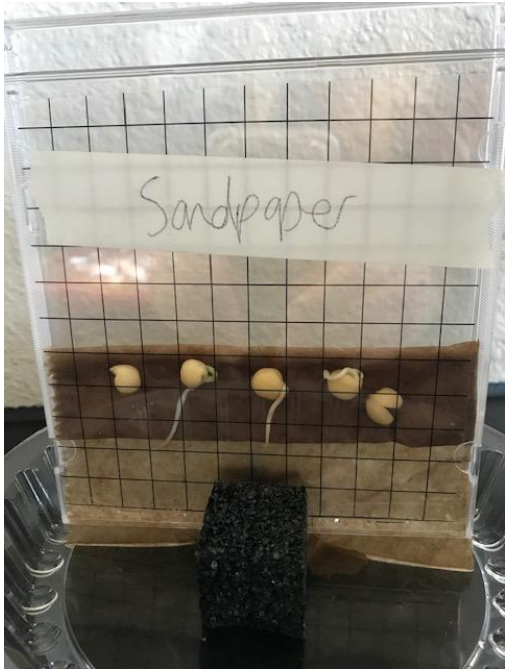
Procedure

12. Measure the length of the seeds everyday (if they have germinated). When the sprout pops from the seed, you have the choice of also measuring that, or only continuing with measuring the roots.

Data

- Data table of seed growth and germination
- 10/26/18 Mean of root growth (sanded down) 1.3
- 10/26/18 Mean of root growth (nicked) 1.3
- 10/26/18 Mean of root growth (normal) 0.4





Data

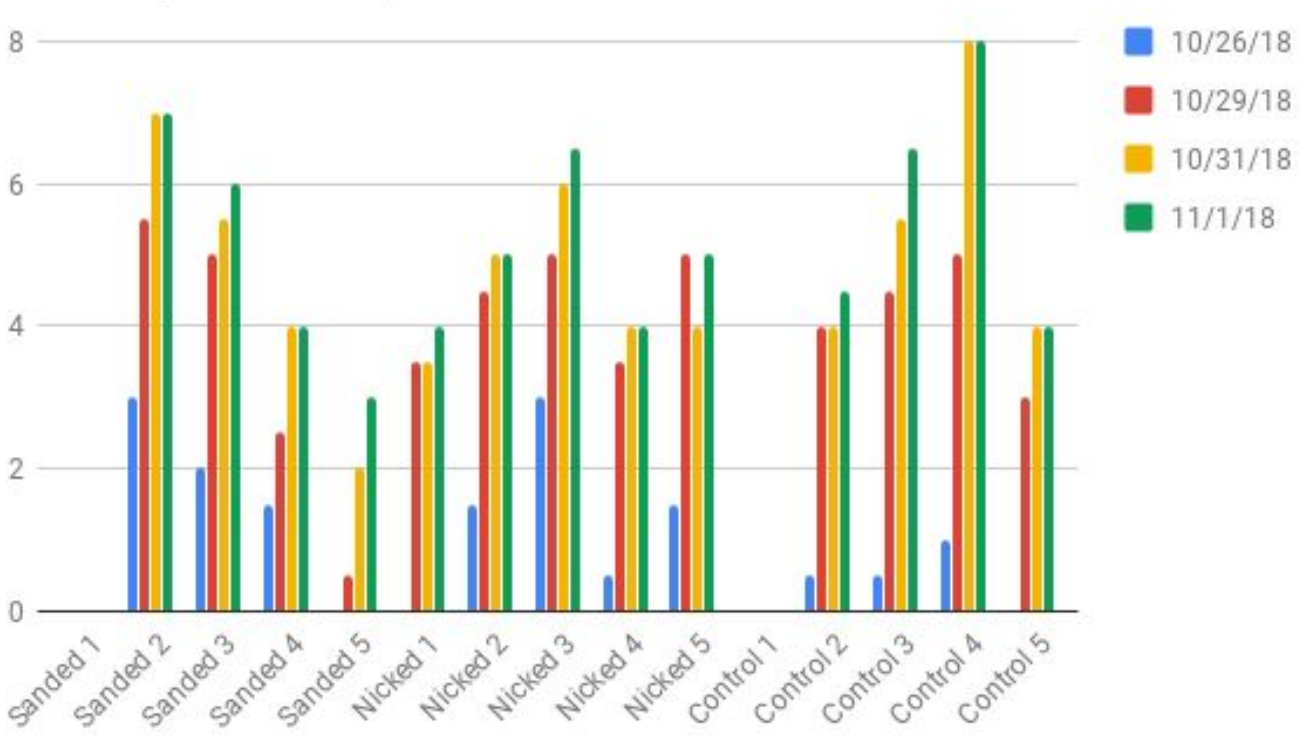
- 10/29/18 Mean of root growth (sanded down) 2.7
- 10/29/18 Mean of root growth (nicked) 4.3
- 10/29/18 Mean of root growth (normal) 3.3
- 10/31/18 Mean of root growth (sanded down) 3.7
- 10/31/18 Mean of root growth (nicked) 4.9
- 10/31/18 Mean of root growth (normal) 4.3

Data

- 11/01/18 Mean of root growth (sanded down) 4
- 11/01/18 Mean of root growth (nicked) 4.9
- 11/01/18 Mean of root growth (normal) 4.6

Graph of the Root length

On 10/25/18, Sanded down seeds 2, 3, and 4 germinated, however we focused on the fact that it germinated, not the size. On the same day, nicked seed 3 germinated as well.



Data Analysis

- The seed scarification method that was most effective for our seed germination was sanding down the seeds. The seed scarification method that was most effective for our seed growth was nicked. Over the course of 8 days our nicked seeds grew to a mean of 4.9 cm the height scale was between 4 and 6.5 cm. The overall seed that grew the best was the control. The mean was 5.75 and the smallest was 0 cm but the tallest was 8 cm. The sandpaper germinated the fasted because 3 of the seed germinated on the first day! We noticed that the sandpaper weakened the seed coat so the embryo could bust out. The Nicked seeds helped the seed in the long run because the cut provides care for the seed.

Conclusion

We know that the part of our hypothesis that says that the sanded down seeds would germinate first is supported, but the part where we said it would grow the best is not.

We know that one part is supported because the sanded down seeds germinated first. The other part was not supported when we said that it would grow the best because we measured the seeds and calculated the mean of our data, and the control seeds were the best, not the sanded down.

This means that we had partial of our hypothesis supported which was rare according to our mentor, and it was great news to hear.