Wyatt's Science Fair Log Book

Topic Choice/Timeline/Misc

Sept 20, 2023

I have an idea for science fair. I kinda came up with it last winter when my mom and I were walking our dog around the block but since I didn't choose the science fair option last year so I didn’t do anything with it. When walking my dog I noticed that a lot of our neighbours put deicers down on the snow and ice. Sometimes my dog would be able to walk over it without a problem but other times he would lift a paw or start to limp like he was hurt. I wondered what is in these things and if it was hurting my dog what was it doing to earth. I can't test these deicers on animal paws but maybe I can see what these are doing to plants.

Sept 26, 2023

I have been doing some google searches to see what has been done and I found a science project that looked at table salt on radish seed germination
https://owlcation.com/stem/Science-Project-How-Does-Salt-Affect-Seed-Germination

It looks like a really good project design but I want to see how the different salts used in deicers affect seed germination. I’m going to use sodium chloride, calcium chloride, magnesium chloride and potassium chloride as they are used in deicers.

I think radish seeds might be a good seed to test on as they germinate fast and are pretty hardy. I want to look at seeds and not plants since there are too many variables that I can't control with growing plants in soil and with seeds you can see the results fast.

September 28

Came up with a rough timeline

September/October 2023 start thinking of science fair ideas and research question
October/November 2023 start background research, think of a hypothesis, materials needed and procedures
November 2023 science fair proposal and draft background paper due
December 2023 do at least 2 trials during winter break
January 2024 write up results and analysis and get trifold ready for school science fair

November 1, 2023
Handed in my science fair proposal

Jan 16, 2024
Started to work on google slides to make slides for the trifold

Jan 17, 2024
Worked on google slides

Jan 18, 2024
Worked on the slides

Jan 19,
Worked on slides

Jan 20
Finished slides and printed them off and made a title in word to print off.

Jan 22, 2024

Got trifolds and brought it home to work on. Started laying out the printed slides and started to put them on. Finished the trifold.

Jan 25
Presented science fair to students from Maple Ridge.

Jan 26
Presented science fair to 3 different judges at RTA science fair.

Jan 30
Totally shocked and terrified when my teacher said I was put forward for CYSF.

Feb 7
Logged in CYSF website and started filling things in and doing the ethics form

Feb 14
My mom picked up the CYSF trifold and it is so huge. I am now a lot more nervous and anxious about this.

Background Research

October 11, 2023

Started looking more into what deicers are and how they work. Found some websites. Most seem to be chemical companies and environmental orgs.

Minnesota Pollution Control Agency
Occidental Chemical Corporation
Salt Smart Collaborative
Canada Salt Group Ltd
Government of Canada

Search terms:
what are deicers,
how does salt melt ice
deicers+canada

October 13, 2023

Worked on background writing

October 17, 2023

Googled what effect deicers have on the environment for my background. Lots of negative things that salt does. There does seem to be conflicting information about the salts' effects; some sites say they are okay for plants and animals, some say they are toxic or others harm concrete or are safe for concrete.

Search terms:
What does road salt do to the environment
How does salt affect plants
How does salt affect seed germination
How do deicers affect the environment

Bridgestone tires
Minnesota Pollution Control Agency
K-State Research and Extension
University of Massachusett
West Virginia University (Bennet)

October 18, 2023

Worked on background research writing.

October 19, 2023

Worked on background research writing

November 6, 2023
Worked on background research writing

November 13
Finish background

Nov. 15, 2023
Handed in my draft background

December 9, 2023
I got feedback on my background research and it needs more detail on deicers and how it affects the environment so I did more work on it. I found a really good video on how deicers work and some good information on salt use and its impact. Will work on it over winter break.

sites
Iowa Department of Transportation
Garden and Lawn

Feb 27, 2024

Got some feedback on my science fair for CYSF and need to add details about radish seeds and some more on info and pictures of salts and started to work on that.

sources
Brightly Inc.
Ice Slicer Blog
Ninja Deicer
West coast seeds

Question/Hypothesis/Variables

Oct 4, 2023

Completed the science fair intent form for school and got my mom to sign off on it. I am going to look at how radish seed germination is affected by different salts. I think I am going to follow a similar procedure that owlcation used but with different salts and different measurements they increased by ½ and I am going to do by ¼.

Came up with research questions: Do different sidewalk deicer salts affect seed germination? Is there a difference between salts on seed germination?

Thought of the titles pass the salt or salt solutions. I like salt solutions better.

October 5, 2023

To make my research question more testable I thought about “how do different deicer salts at different concentrations affect the number of radish seeds that germinate”. Is there a difference between the salts on seed germination?

October 25, 2023

Started working on my hypothesis. I think that as the salt in the solutions increases then the seed germination will decrease because the seeds can’t absorb enough water to start the germination process. I also think that if a salt that has more seeds germinate in higher concentrations of salt solutions then it is less harmful to seeds.

The independent variables are the salts used and the different concentrations

Dependant variable is number of seeds germinating

Controls are tap water and distilled water.

October 26, 2023
Worked on background writing

October 30

I have finished my hypothesis, I hypothesize that if deicer salts are added to a water solution in increasing amounts and applied to radish seeds, then the seed's capacity to germinate will decrease because the rise in salinity will reduce the seeds ability to absorb enough water to start the germination process. I also predict that if different deicer salts are used on radish seeds then the salts that have more seeds germinate in the higher concentrations of salt then they are less harmful to seeds because it is allowing the seeds to get the water necessary to start germination.

Materials/Procedures

October 6, 2023
Came up with a list of possible materials needed

- Tap Water
- Distilled water
- Spray bottles
- Paper napkins
- Radish seeds
- Sodium chloride (table salt)
- Magnesium chloride
- Calcium chloride
- Potassium chloride
- Measuring spoons/cups
- Ziplock bags
- Table
- Funnel
- Sharpie
- Paper/pen

October 9, 2023

Got my mom to order radish seeds, calcium chloride, potassium chloride and magnesium chloride on Amazon. I will use table salt that I have at home for the sodium chloride.

- 3 bags of Early Scarlet Radish Seeds from JNB SEED 1000 seeds in a bag
- 1 100g bag of Calcium Chloride from Elo's Premium
- 1 pound bag of potassium chloride from Alpha Chemicals

- 1 350g jar of Magnesium chloride flakes from Natural Solution

October 11
Amazon delivery came.

October 23, 2023

Outlined a procedure based on owlification's experiment but it might change as the experiment happens.

1. Take ten spray bottles and label them A through J. Fill them as follows:

a. Solution A: 8 oz. tap water only
b. Solution B: 8 oz. distilled water only
c. Solution C: 8 oz. distilled water with ¼ teaspoon of sodium chloride. Stir to dissolve salt.
d. Solution D: 8 oz. distilled water with ½ teaspoon of sodium chloride. Stir to dissolve salt.
e. Solution E: 8 oz. distilled water with ¾ teaspoon of sodium chloride. Stir to dissolve salt.
f. Solution F: 8 oz. distilled water with 1 teaspoon of sodium chloride. Stir to dissolve salt.
g. Solution G: 8 oz. distilled water with 1¼ teaspoon of sodium chloride. Stir to dissolve salt.
h. Solution H: 8 oz. distilled water with 1½ teaspoon of sodium chloride. Stir to dissolve salt.
i. Solution I: 8 oz. distilled water with 1¾ teaspoon of sodium chloride. Stir to dissolve salt.
j. Solution J: 8 oz. distilled water with 2 teaspoons of sodium chloride. Stir to dissolve salt.

2. Place the 10 Ziplock Bags down on a table and label each bag with the salt type used and the letter of the solution to be used in each one (A through J).

3. Unzip the bags and put a paper napkin in each one.

4. Pour one tablespoon of solution on the napkin in the bag with the same label, making sure it soaks the whole napkin.

5. Put 40 seeds on the napkin of each bag. Make sure the seeds are scattered evenly over the napkin.

6. Zip up the Bags. Place all 10 bags at room temperature out of direct sunlight.

7. Observe the bags daily for two weeks and record the number of seeds that have germinated in each and any other changes in the seeds.

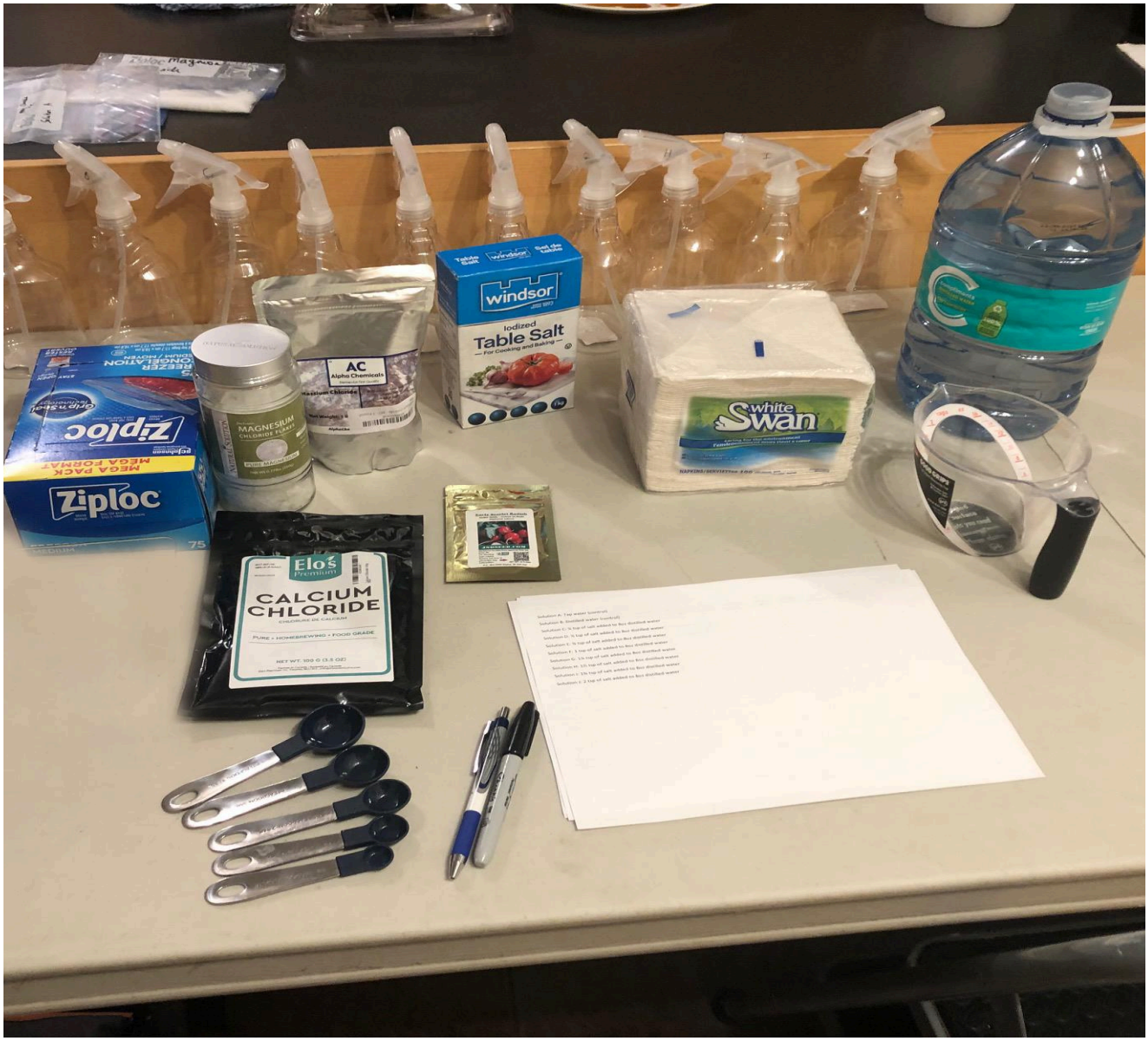
8. If the napkins in the bags seem to be drying out, spray the right solution into the bag to moisten seeds.

9. Repeat this process for Calcium Chloride, Potassium Chloride and Magnesium Chloride.

Nov 21
Made up some data sheets to record seed germination and printed off 2 copies.

December 14 2023
Got the rest of the materials:

- 2 4L Compliments Distilled water bottles
- 40 spray bottles from the dollar store. I used spray bottles to store the solutions was because having 40 plastic cups lying around I was worried that they might spill or the water would evaporate making the solution too salty or germs would get in it so I decided to put the solutions into spray bottles.
- 1 bag of Swan paper napkins 100 sheets
- 1 bag compliments 16 oz plastic cups - i decided to use cups to make the solutions in and then pour those into the spray bottles because they are wider so easier to pour the salt into and to stir.
- Mega pack of 75 medium sized ziplock bags.
- ¼ teaspoon, ½ teaspoon, ¾ teaspoon, 1 teaspoon and 2 teaspoon
- 2 cup measuring cup
- Sharpie


windsor
Iodized
Table Salt
For Cooking and Baking
AC
Alpha Chemicals
MAGNESIUM
CHLORIDE FLAKES
Ziploc
MEGA PACK
MEGA FORMAT
white Swan
Elos
Premium
CALCIUM
CHLORIDE
PURE • HOMEBREWING • FOOD GRADE

December 15, 2023
Prepped for trial 1

- Labeled 10 plastic cups A through J and wrote the salt name Sodium Chloride on the bottom.
- I labeled 10 spray bottles from a to j with the salt initial on it on the handle (SC)
- Labeled 10 ziploc bags with trial 1 the salt initial (SC) and the solution letter (A-J) and put a napkin in each of the bags with the napkin spine facing toward the zipper part so that the seeds don't fall in between the napkin sheets

Made up the different salt solutions in the corresponding cups.

a. Solution A: 8 oz. tap water only
b. Solution B: 8 oz. distilled water only
c. Solution C: 8 oz. distilled water with ¼ teaspoon of sodium chloride. Stir to dissolve salt.
d. Solution D: 8 oz. distilled water with ½ teaspoon of sodium chloride. Stir to dissolve salt.
e. Solution E: 8 oz. distilled water with ¾ teaspoon of sodium chloride. Stir to dissolve salt.
f. Solution F: 8 oz. distilled water with 1 teaspoon of sodium chloride. Stir to dissolve salt.
g. Solution G: 8 oz. distilled water with 1¼ teaspoon of sodium chloride. Stir to dissolve salt.
h. Solution H: 8 oz. distilled water with 1½ teaspoon of sodium chloride. Stir to dissolve salt.
i. Solution I: 8 oz. distilled water with 1¾ teaspoon of sodium chloride. Stir to dissolve salt.
j. Solution J: 8 oz. distilled water with 2 teaspoons of sodium chloride. Stir to dissolve salt.

It was interesting to see the salt solutions. The sodium chloride became more and more hazy as the salt increased. Calcium Chloride and magnesium chloride were crystal clear and you could not tell anything was added. Potassium chloride turned the water almost white it was so cloudy even in the lower solutions.

I took a tablespoon of each solution and poured it on the napkin in the corresponding bag making sure to wash and dry the tablespoon before adding the next solution and then sealed the bags. I was going to make the solutions in the spray bottles and then spray until the napkins were damp but then I wasn't too sure how much solution was getting in the bag so I changed it to a tablespoon instead.

I counted out 40 seeds for each bag which was really hard as the seeds are small and liked to bounce or stick to you, it was very frustrating. I first put the seeds in a bowl and took some seeds out and put them on a plate and sorted them into 4 groups of ten. Leftover seeds were put back in the bowl for the next count. I then had my mom double check to make sure there were 40 seeds. I then took the plate and opened one of the ziploc bags with the solution in it and poured the seeds on top of the bag making sure the seeds were all on the side that did not have any writing on it so it would be easier to count. I had to spread out the seeds as best I could with my hand then seal the bag. I then recounted to make sure there were 40 seeds in the bag. I repeated this process until all the bags had seeds. It was time consuming. Glad I didn't use more seeds.

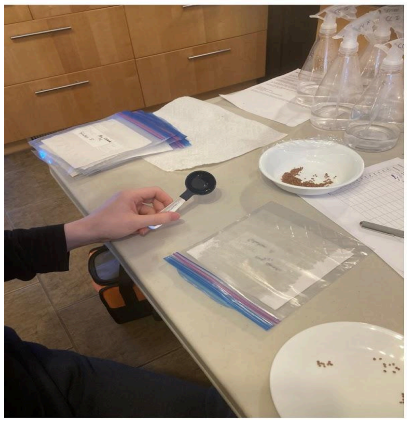
Took the ziploc bags to my basement and laid them out in a row from A to J.

I poured the solutions from the cups into the corresponding spray bottles using a funnel that I washed and dried after each use.

I washed out and dried the cups so they could be reused for the next trial.

I repeated this process for calcium chloride, potassium chloride and magnesium chloride. It was a long day but got easier as I figured out a rhythm.

If the bags seem to be getting dry spray the inside of the bag with the matching solution. If the bags seem to have too much water drain off the excess as it can stop seeds from germinating. The bags should be damp but not super wet.



Making a bag reasy for seeds

How I counted out seeds

Bag ready to go

Trial 1 laid out

Trial 2 laid out

Data/Observations

December 16
No seeds have started germinating but they look like they have gotten bigger in size.

December 17
Some of seeds in the controls have little tiny nubs or radicle starting to come out

December 18
A lot more seeds have started to germinate. Some of the roots are white and fuzzy looking some have yellow leaves coming through. The count is on the data sheet.

December 19

- Roots are getting longer in the controls some are out of the seed coat completely
- really surprised at magnesium chloride that there are seeds germinating in Solution I.
- A few bags seem to have more water in it than the others so I drained out the extra

December 20
Some of the leaves are starting to turn greenish in the controls and in C and some Ds

December 21

- The seedlings are starting to push up on the ziplock bag leaves are greener and roots are getting longer and tangling together
- Starting to get hard to tell which are seeds and seed coats in the controls and in some solutions of C and D

December 22

- Seedlings are getting longer and the roots are getting thicker for the controls and in C and sometimes D
- Little black spots are starting in some of the bags that have salt in them.
- Potassium is a surprise I thought since it is used in fertilizers it might help with germination but it doesn't seem to be.

December 23
Seedlings are growing fast and it is starting to get harder to count seeds. Glad i did not go with a higher seed number. Not sure how owlcation deal with 100 seeds!

December 24

- Germination of seeds is slowing down but growth is surprising in the seedlings in the controls and solution c and in d magnesium and calcium. The germinated seeds in the salt solutions seem to be a lot slower in developing and there are a lot of seeds not doing anything.

December 25
Merry Christmas!
Seed count recorded on data sheet
A few more mold spots in the salt solutions
Having to open some of the bags to see if a seed is a seed or a seed sack. Its hard to tell in the tangles of roots.

December 26
As the bags do not seem to be drying out I decided to empty out the spray bottles and clean them so I can start trial 2 tomorrow.
Counted trial one seeds (see the data sheets)

December 27
I started setting up trial 2 and I followed the same steps as trial 1

Trial 1 counted and recorded on data sheet
Molds spot are getting bigger and a few seeds seem to be molding as well

December 28
Day 13 for trial 1 recorded count on data sheet
Day 1 for trial 2 no seeds germinating but they look a little bigger.

December 29
Last count for trial 1! Took the napkins out and was able to count all the seedlings, definitely some that I thought were seeds were actually seed cases. Took pictures. The roots in the controls are really connected to the napkin and quite large. The controls look good and thick and green as do the sprouted seeds in solutions in C and D beyond these it looks like the seedling development is slowed or even stopped since they look more like the controls did in the first week. Many seeds did not do anything. Sodium and Potassium really hurt seed germination.

Day 2 trial 2:
Quite a few seeds have the little root poking out in A B and C and even E & F in calcium and magnesium

December 30
More seeds are sprouting

December 31
Seeds that sprouted leaves are turning from yellow to more green.
Seeds are germinating in calcium and magnesium all the way to G

Jan 1
Happy New year!
Sprout roots are growing longer in the controls

Jan 2
Leaves are getting greener and roots longer

Jan 3
Some small spots of mold have started on the napkin in some of the bags with higher salt

Jan 4
Seedlings are starting to push up the bags in the controls and C and D

Jan 5
Magnesium chloride has seeds germinating all the way to J.

Jan 6
Germination is slowed down growth is good in the controls and C and D

Jan 7
Getting hard to tell seeds from seed cases

Jan 8
Seedlings growing bigger roots and getting tangled

Jan 9
Recorded count

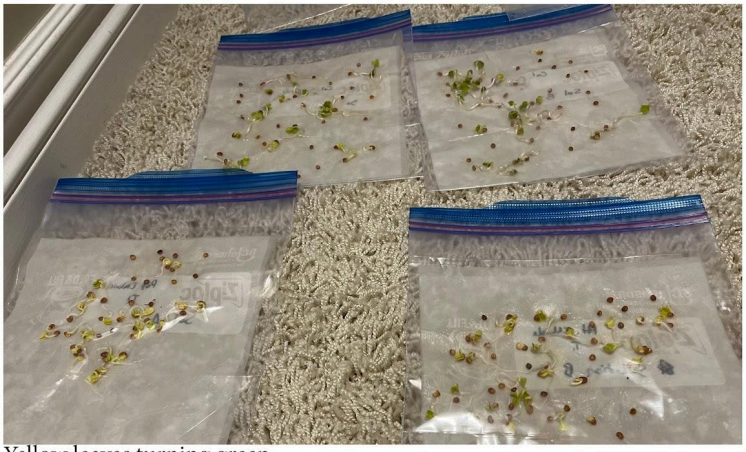
Jan 10
Last day! Took the napkins out and took pictures results are similar to trial 1.

Solutions left to right: Sodium Chloride, Calcium Chloirde, Potassium Chloride and Magnessium Chloride

Seedlings pushing up on bag

Seeds starting to germinate

Yellow leaves



Yellow leaves turning green

Magnesium has germination in G & H

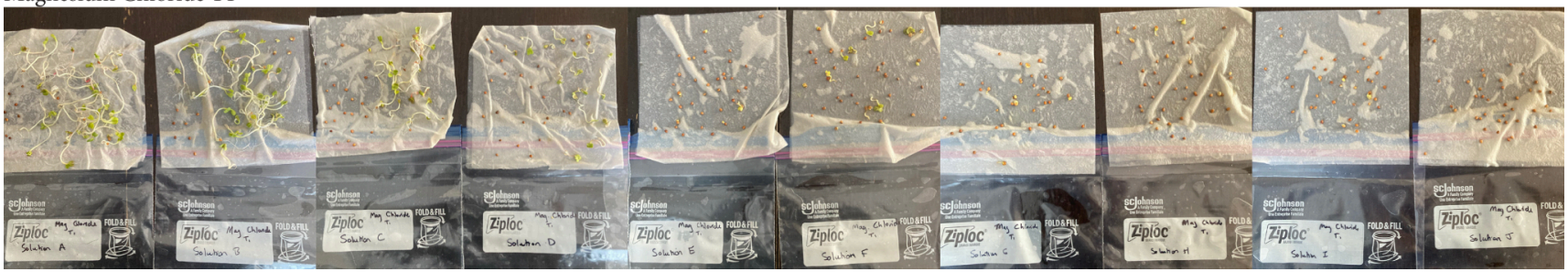
Roots day 14

Sodium Chloride T1

Calcium Chloride T1

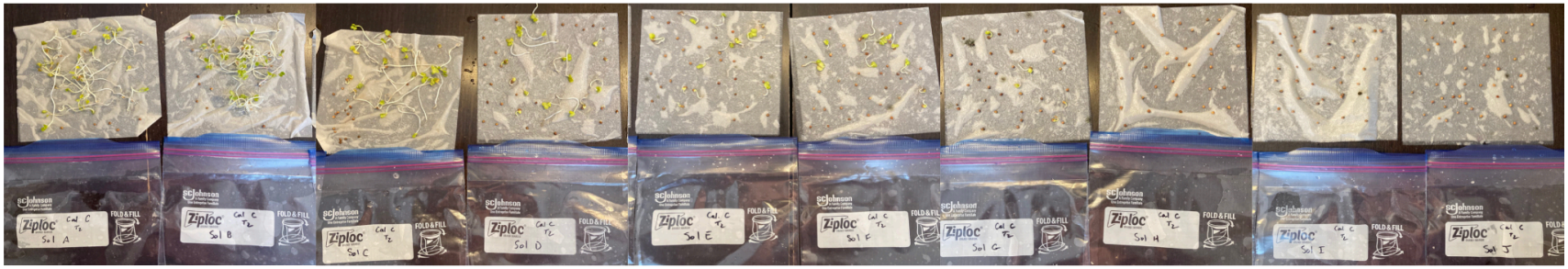
Potassium Chloride T1

Magnesium Chloride T1



Sodium Chloride T2

Calcium Chloride T2



Potassium Chloride T2

Magnesium Chloride T2

Trial 1

Sodium Chloride

Solutions:	A: number sprouted	B: number sprouted	C: number sprouted	D: number sprouted	E: number sprouted	F: number sprouted	G: number sprouted	H: number sprouted	I: number sprouted	J: number sprouted
Day 1	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 2	5/40	9/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 3	30/40	29/40	11/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 4	31/40	31/40	15/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 5	34/40	33/40	27/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 6	35/40	35/40	27/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 7	35/40	37/40	27/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 8	36/40	37/40	29/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 9	37/40	37/40	29/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 10	38/40	37/40	29/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 11	38/40	39/40	30/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 12	38/40	40/40	30/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 13	38/40	40/40	31/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 14	40/40	41/40	31/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40

Trial 1

Calcium Chloride

Solutions:	A: number sprouted	B: number sprouted	C: number sprouted	D: number sprouted	E: number sprouted	F: number sprouted	G: number sprouted	H: number sprouted	I: number sprouted	J: number sprouted
Day 1	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 2	12/40	11/40	6/40	1/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 3	20/40	23/40	20/40	9/40	5/40	4/40	0/40	0/40	0/40	0/40
Day 4	23/40	24/40	20/40	14/40	7/40	7/40	0/40	0/40	0/40	0/40
Day 5	25/40	25/40	22/40	14/40	8/40	7/40	0/40	0/40	0/40	0/40
Day 6	25/40	25/40	22/40	14/40	8/40	8/40	0/40	0/40	0/40	0/40
Day 7	25/40	25/40	22/40	14/40	9/40	8/40	0/40	0/40	0/40	0/40
Day 8	25/40	25/40	23/40	14/40	9/40	9/40	0/40	0/40	0/40	0/40
Day 9	26/40	25/40	23/40	14/40	9/40	9/40	0/40	0/40	0/40	0/40
Day 10	26/40	25/40	23/40	14/40	9/40	9/40	0/40	0/40	0/40	0/40
Day 11	26/40	25/40	23/40	14/40	9/40	9/40	0/40	0/40	0/40	0/40
Day 12	26/40	25/40	23/40	14/40	9/40	9/40	0/40	0/40	0/40	0/40
Day 13	26/40	26/40	23/40	15/40	9/40	9/40	1/40	0/40	0/40	0/40
Day 14	27/40	26/40	23/40	18/40	9/40	9/40	1/40	0/40	0/40	0/40

Trial 1

Potassium Chloride

Solutions:	A: number sprouted	B: number sprouted	C: number sprouted	D: number sprouted	E: number sprouted	F: number sprouted	G: number sprouted	H: number sprouted	I: number sprouted	J: number sprouted
Day 1	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 2	16/40	18/40	6/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 3	26/40	26/40	8/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 4	26/40	28/40	8/40	1/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 5	27/40	28/40	8/40	1/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 6	27/40	31/40	8/40	1/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 7	27/40	31/40	8/40	2/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 8	27/40	31/40	8/40	2/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 9	28/40	31/40	8/40	2/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 10	29/40	31/40	8/40	2/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 11	29/40	31/40	8/40	2/40	1/40	0/40	0/40	0/40	0/40	0/40
Day 12	29/40	31/40	8/40	3/40	1/40	1/40	0/40	0/40	0/40	0/40
Day 13	30/40	31/40	8/40	3/40	1/40	1/40	0/40	0/40	0/40	0/40
Day 14	30/40	32/40	8/40	3/40	1/40	1/40	0/40	0/40	0/40	0/40

Trial 1

Magnesium Chloride

Solutions:	A: number sprouted	B: number sprouted	C: number sprouted	D: number sprouted	E: number sprouted	F: number sprouted	G: number sprouted	H: number sprouted	I: number sprouted	J: number sprouted
Day 1	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 2	9/40	11/40	10/40	11/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 3	15/40	23/40	17/40	17/40	3/40	9/40	4/40	0/40	1/40	0/40
Day 4	17/40	25/40	17/40	17/40	3/40	10/40	4/40	7/40	3/40	0/40
Day 5	17/40	25/40	19/40	17/40	3/40	11/40	4/40	8/40	4/40	0/40
Day 6	19/40	31/40	19/40	17/40	3/40	11/40	4/40	8/40	5/40	0/40
Day 7	21/40	31/40	18/40	17/40	3/40	13/40	4/40	8/40	5/40	0/40
Day 8	25/40	31/40	18/40	17/40	3/40	13/40	4/40	8/40	5/40	0/40
Day 9	28/40	31/40	18/40	17/40	3/40	14/40	4/40	8/40	5/40	0/40
Day 10	29/40	33/40	19/40	18/40	3/40	14/40	5/40	9/40	5/40	0/40
Day 11	30/40	33/40	19/40	18/40	3/40	14/40	5/40	9/40	5/40	0/40
Day 12	30/40	33/40	19/40	18/40	6/40	14/40	5/40	9/40	5/40	0/40
Day 13	30/40	33/40	19/40	18/40	6/40	16/40	6/40	9/40	5/40	0/40
Day 14	32/40	33/40	19/40	18/40	6/40	15/40	6/40	9/40	5/40	0/40

Trial 2

Sodium Chloride

Solutions:	A: number sprouted	B: number sprouted	C: number sprouted	D: number sprouted	E: number sprouted	F: number sprouted	G: number sprouted	H: number sprouted	I: number sprouted	J: number sprouted
Day 1	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 2	11/40	19/40	1/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 3	31/40	28/40	15/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 4	37/40	28/40	26/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 5	37/40	32/40	32/40	2/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 6	38/40	34/40	34/40	4/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 7	38/40	35/40	32/40	4/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 8	39/40	35/40	34/40	4/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 9	39/40	35/40	34/40	4/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 10	40/40	36/40	35/40	4/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 11	40/40	36/40	35/40	4/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 12	40/40	36/40	36/40	4/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 13	40/40	37/40	36/40	4/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 14	40/40	37/40	36/40	4/40	0/40	0/40	0/40	0/40	0/40	0/40

Trial 2

Calcium Chloride

Solutions:	A: number sprouted	B: number sprouted	C: number sprouted	D: number sprouted	E: number sprouted	F: number sprouted	G: number sprouted	H: number sprouted	I: number sprouted	J: number sprouted
Day 1	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 2	9/40	16/40	8/40	1/40	1/40	0/40	0/40	0/40	0/40	0/40
Day 3	19/40	26/40	15/40	7/40	9/40	4/40	0/40	0/40	0/40	0/40
Day 4	21/40	28/40	19/40	13/40	12/40	8/40	3/40	0/40	0/40	0/40
Day 5	22/40	29/40	19/40	14/40	13/40	9/40	4/40	0/40	0/40	0/40
Day 6	23/40	30/40	20/40	15/40	13/40	10/40	5/40	0/40	0/40	0/40
Day 7	25/40	34/40	22/40	17/40	13/40	10/40	5/40	0/40	0/40	0/40
Day 8	28/40	35/40	23/40	17/40	13/40	10/40	5/40	0/40	0/40	0/40
Day 9	28/40	35/40	23/40	19/40	13/40	10/40	5/40	0/40	0/40	0/40
Day 10	28/40	35/40	23/40	19/40	13/40	10/40	5/40	0/40	0/40	0/40
Day 11	28/40	35/40	23/40	19/40	13/40	10/40	5/40	0/40	0/40	0/40
Day 12	35/40	35/40	23/40	20/40	14/40	10/40	5/40	0/40	0/40	0/40
Day 13	32/40	35/40	23/40	20/40	14/40	10/40	5/40	0/40	0/40	0/40
Day 14	35/40	36/40	23/40	21/40	14/40	10/40	5/40	0/40	0/40	0/40

Trial 2

Potassium Chloride

Solutions:	A: number sprouted	B: number sprouted	C: number sprouted	D: number sprouted	E: number sprouted	F: number sprouted	G: number sprouted	H: number sprouted	I: number sprouted	J: number sprouted
Day 1	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 2	13/40	16/40	8/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 3	17/40	29/40	14/40	3/40	0/40	1/40	0/40	0/40	0/40	0/40
Day 4	18/40	31/40	14/40	5/40	0/40	1/40	0/40	0/40	0/40	0/40
Day 5	18/40	32/40	15/40	6/40	0/40	1/40	0/40	0/40	0/40	0/40
Day 6	18/40	33/40	15/40	6/40	1/40	1/40	0/40	0/40	0/40	0/40
Day 7	18/40	34/40	15/40	6/40	1/40	1/40	0/40	0/40	0/40	0/40
Day 8	18/40	34/40	15/40	6/40	1/40	1/40	0/40	0/40	0/40	0/40
Day 9	26/40	34/40	15/40	6/40	1/40	1/40	0/40	0/40	0/40	0/40
Day 10	26/40	34/40	16/40	6/40	1/40	1/40	0/40	0/40	0/40	0/40
Day 11	26/40	34/40	16/40	6/40	1/40	1/40	0/40	0/40	0/40	0/40
Day 12	29/40	34/40	16/40	6/40	1/40	1/40	0/40	0/40	0/40	0/40
Day 13	29/40	34/40	16/40	6/40	1/40	1/40	0/40	0/40	0/40	0/40
Day 14	31/40	34/40	16/40	6/40	2/40	2/40	0/40	0/40	0/40	0/40

Trial 2

Magnesium Chloride

Solutions:	A: number sprouted	B: number sprouted	C: number sprouted	D: number sprouted	E: number sprouted	F: number sprouted	G: number sprouted	H: number sprouted	I: number sprouted	J: number sprouted
Day 1	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40	0/40
Day 2	16/40	9/40	13/40	19/40	7/40	2/40	0/40	0/40	0/40	0/40
Day 3	20/40	23/40	20/40	21/40	15/40	13/40	2/40	0/40	0/40	0/40
Day 4	28/40	23/40	21/40	21/40	15/40	17/40	2/40	0/40	0/40	0/40
Day 5	28/40	23/40	21/40	24/40	16/40	18/40	3/40	0/40	0/40	0/40
Day 6	28/40	28/40	24/40	26/40	16/40	20/40	3/40	0/40	0/40	0/40
Day 7	30/40	30/40	25/40	26/40	16/40	20/40	3/40	0/40	0/40	0/40
Day 8	30/40	30/40	25/40	26/40	16/40	20/40	3/40	0/40	0/40	0/40
Day 9	31/40	30/40	25/40	26/40	16/40	20/40	5/40	2/40	0/40	4/40
Day 10	31/40	30/40	26/40	28/40	17/40	20/40	5/40	3/40	0/40	4/40
Day 11	31/40	30/40	27/40	28/40	17/40	20/40	5/40	3/40	7/40	4/40
Day 12	31/40	30/40	27/40	28/40	18/40	22/40	5/40	3/40	7/40	4/40
Day 13	31/40	32/40	27/40	29/40	20/40	24/40	5/40	4/40	7/40	4/40
Day 14	32/40	32/40	30/40	29/40	20/40	24/40	5/40	4/40	7/40	4/40

Results/Analysis

Jan 11
I started to put all the data into google sheets and tried to think of how to best show the data. I think bar graphs for each of the salts for the 2 trials combined will make the most sense. I did try a line graph to represent the number of seeds that germinated each day for each solution but the information overlapped and it really didn't help show what was going on. Lots of data to put in and making the chart and labeling the charts takes a lot of time!

If I try to grow things again I need to give myself more time

Jan 12, 2024
For my analysis section I think a chart that has the means from the total number of seeds that germinated from the 2 trials for each salt altogether will help show if there is a trend in the experiment.

Jan 13
Worked on writing up the results and analysis from the charts and the data.

My hypothesis was supported when the salt in the solutions increased seed germination decreased. Magnesium had the most seeds so it might be the least harmful of these salts.
Sodium and potassium were bad for seed germination

Calcium and magnesium had seeds germinate in higher salt solutions but growth of the seeds is a lot slower than the controls

Seeds did not develop in Sodium Chloride after ½ teaspoons

Seeds did not germinate after Calcium Chloride reached 1½ teaspoons

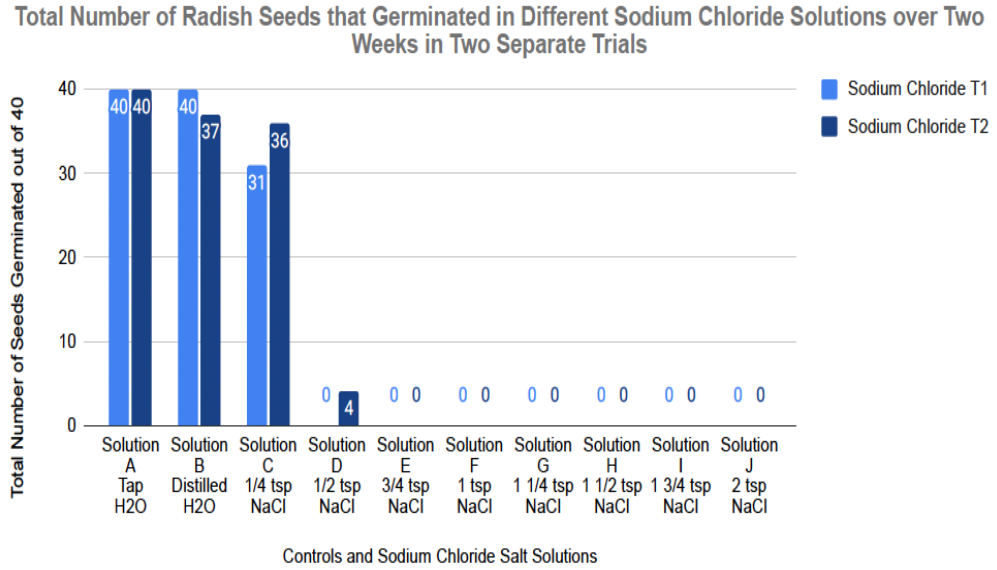
Seeds did not germinate after the Potassium Chloride solution reached 1 teaspoons

Seeds germinated in all solutions of Magnesium Chloride but growth was reduced after 1 teaspoons

Jan 14, 2024
Worked on finishing the results and analysis write up.

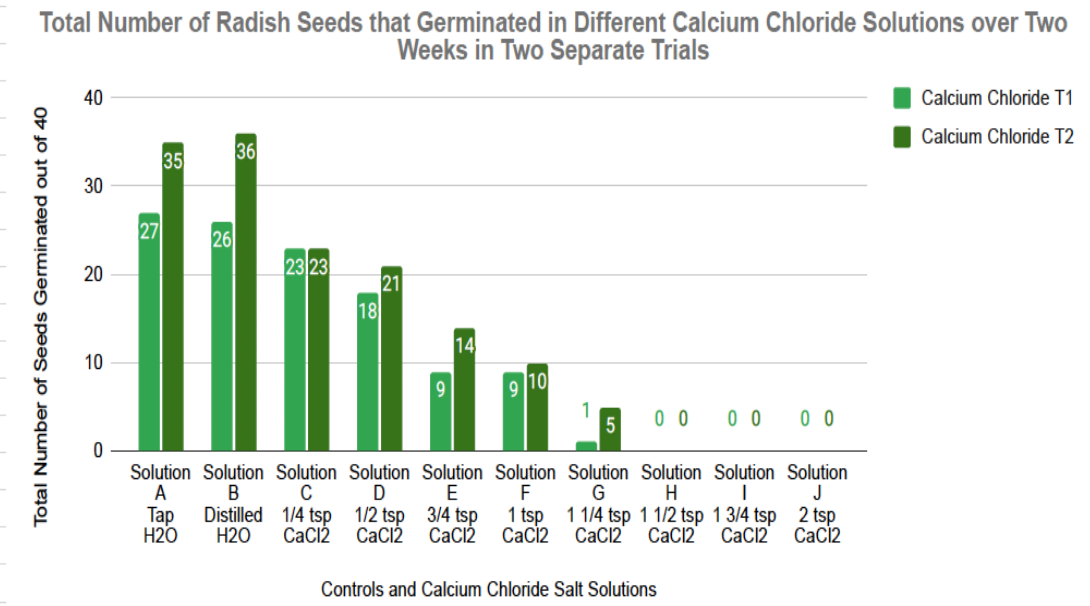
Jan 15
Handed in analysis to my teacher

	Solution A Tap H2O	Solution B Distilled H2O	Solution C 1/4 tsp NaCl	Solution D 1/2 tsp NaCl	Solution E 3/4 tsp NaCl	Solution F 1 tsp NaCl	Solution G 1 1/4 tsp NaCl	Solution H 1 1/2 tsp NaCl	Solution I 1 3/4 tsp NaCl	Solution J 2 tsp NaCl
Sodium Chloride	40	40	31	0	0	0	0	0	0	0
Sodium Chloride	40	37	36	4	0	0	0	0	0	0



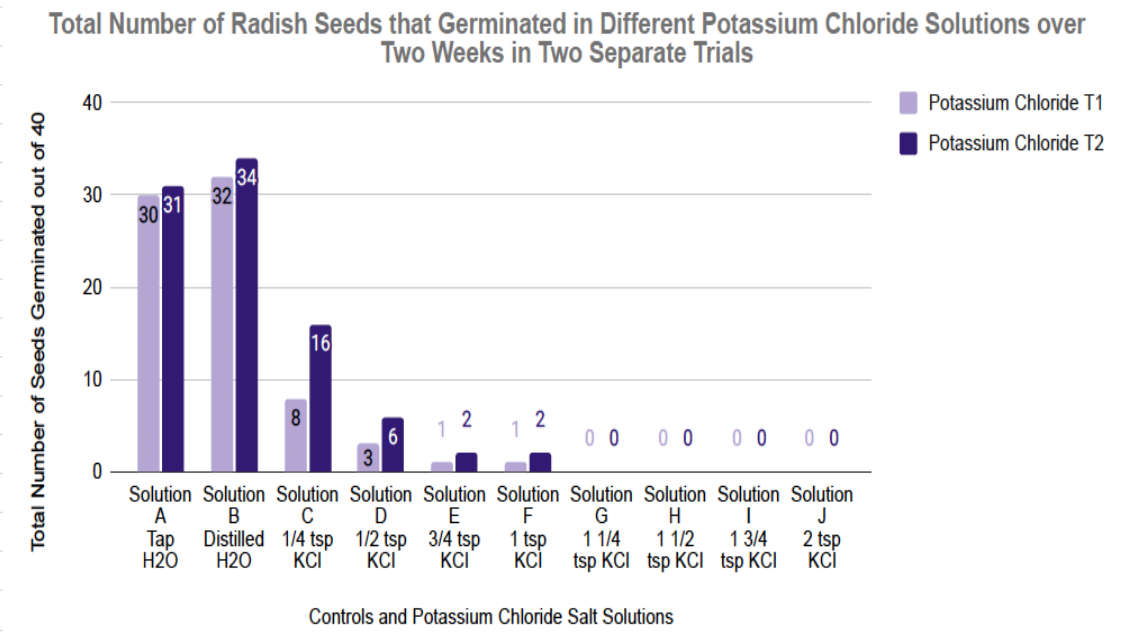
	Solution A Tap H2O	Solution B Distilled H2O	Solution C 1/4 tsp NaCl	Solution D 1/2 tsp NaCl	Solution E 3/4 tsp NaCl	Solution F 1 tsp NaCl	Solution G 1 1/4 tsp NaCl	Solution H 1 1/2 tsp NaCl	Solution I 1 3/4 tsp NaCl	Solution J 2 tsp NaCl
Sodium Chloride	40	40	31	0	0	0	0	0	0	0
Sodium Chloride	40	37	36	4	0	0	0	0	0	0
Average rounde	40	39	34	2	0	0	0	0	0	0

	Solution A Tap H2O	Solution B Distilled H2O	Solution C 1/4 tsp $CaCl_2$	Solution D 1/2 tsp $CaCl_2$	Solution E 3/4 tsp $CaCl_2$	Solution F 1 tsp $CaCl_2$	Solution G 1 1/4 tsp $CaCl_2$	Solution H 1 1/2 tsp $CaCl_2$	Solution I 1 3/4 tsp $CaCl_2$	Solution J 2 tsp $CaCl_2$
Calcium Chloride	27	26	23	18	9	9	1	0	0	0
Calcium Chloride	35	36	23	21	14	10	5	0	0	0



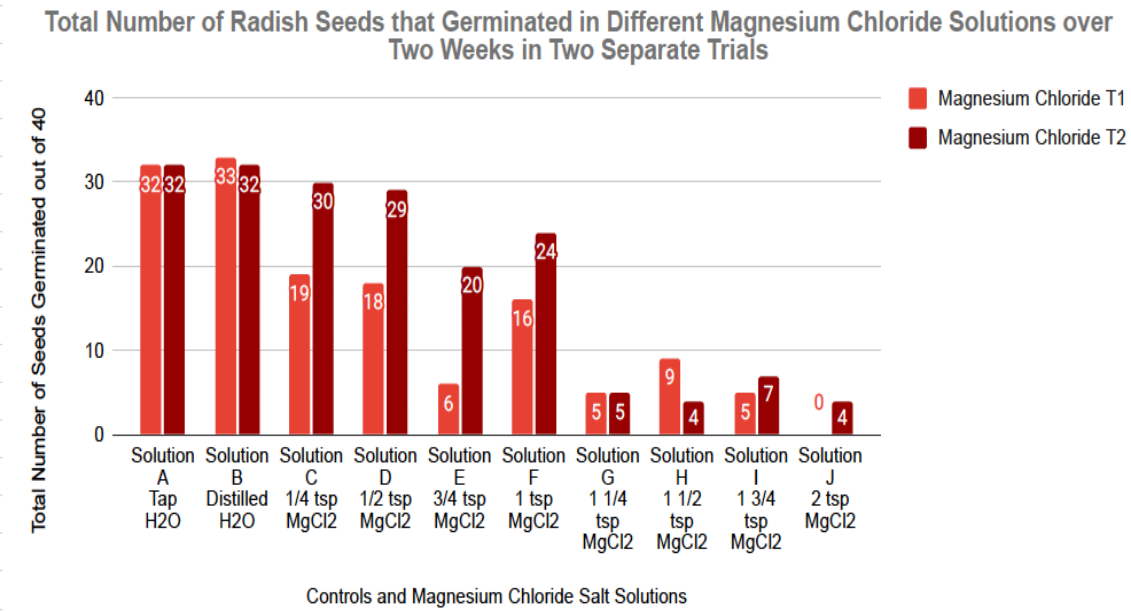
	Solution A Tap H2O	Solution B Distilled H2O	Solution C 1/4 tsp $CaCl_2$	Solution D 1/2 tsp $CaCl_2$	Solution E 3/4 tsp $CaCl_2$	Solution F 1 tsp $CaCl_2$	Solution G 1 1/4 tsp $CaCl_2$	Solution H 1 1/2 tsp $CaCl_2$	Solution I 1 3/4 tsp $CaCl_2$	Solution J 2 tsp $CaCl_2$
Calcium Chloride	27	26	23	18	9	9	1	0	0	0
Calcium Chloride	35	36	23	21	14	10	5	0	0	0
Average rounded	31	31	23	20	12	10	3	0	0	0

	Solution A Tap H2O	Solution B Distilled H2O	Solution C 1/4 tsp KCl	Solution D 1/2 tsp KCl	Solution E 3/4 tsp KCl	Solution F 1 tsp KCl	Solution G 1 1/4 tsp KCl	Solution H 1 1/2 tsp KCl	Solution I 1 3/4 tsp KCl	Solution J 2 tsp KCl
Potassium Chlor	30	32	8	3	1	1	0	0	0	0
Potassium Chlor	31	34	16	6	2	2	0	0	0	0



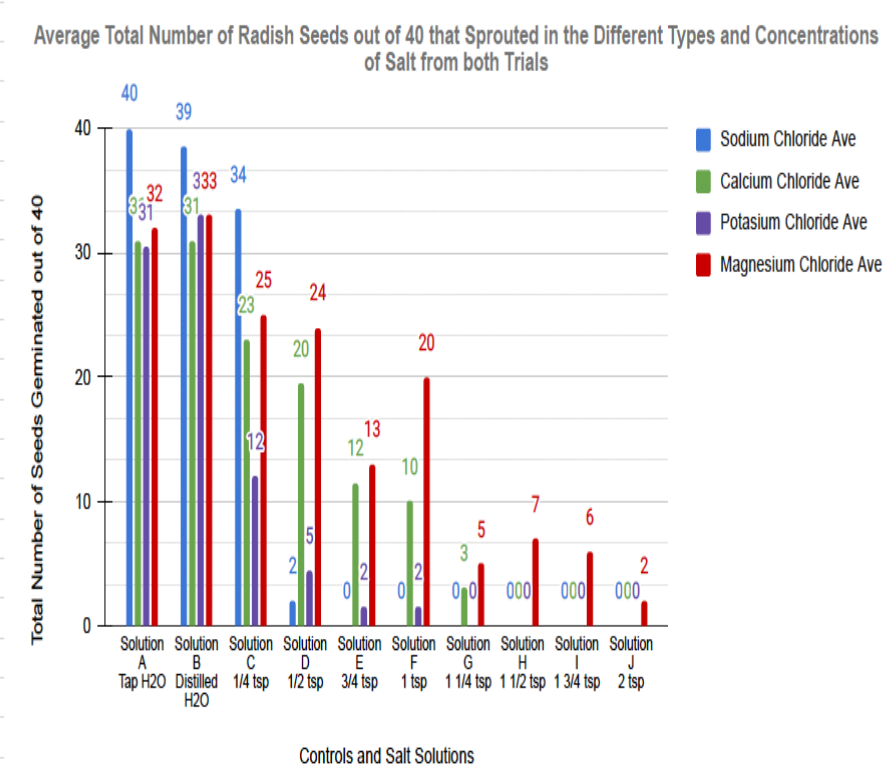
	Solution A Tap H2O	Solution B Distilled H2O	Solution C 1/4 tsp KCl	Solution D 1/2 tsp KCl	Solution E 3/4 tsp KCl	Solution F 1 tsp KCl	Solution G 1 1/4 tsp KCl	Solution H 1 1/2 tsp KCl	Solution I 1 3/4 tsp KCl	Solution J 2 tsp KCl
Potassium Chlor	30	32	8	3	1	1	0	0	0	0
Potassium Chlor	31	34	16	6	2	2	0	0	0	0
Average rounde	31	33	12	5	2	2	0	0	0	0

	Solution A Tap H2O	Solution B Distilled H2O	Solution C 1/4 tsp MgCl2	Solution D 1/2 tsp MgCl2	Solution E 3/4 tsp MgCl2	Solution F 1 tsp MgCl2	Solution G 1 1/4 tsp MgCl2	Solution H 1 1/2 tsp MgCl2	Solution I 1 3/4 tsp MgCl2	Solution J 2 tsp MgCl2
Magnesium Chlo	32	33	19	18	6	16	5	9	5	0
Magnesium Chlo	32	32	30	29	20	24	5	4	7	4



	Solution A Tap H2O	Solution B Distilled H2O	Solution C 1/4 tsp MgCl2	Solution D 1/2 tsp MgCl2	Solution E 3/4 tsp MgCl2	Solution F 1 tsp MgCl2	Solution G 1 1/4 tsp MgCl2	Solution H 1 1/2 tsp MgCl2	Solution I 1 3/4 tsp MgCl2	Solution J 2 tsp MgCl2
Magnesium Chlo	32	33	19	18	6	16	5	9	5	0
Magnesium Chlo	32	32	30	29	20	24	5	4	7	4
Average rounde	32	33	25	24	13	20	5	7	6	2

	Solution A Tap H2O	Solution B Distilled H2O	Solution C 1/4 tsp	Solution D 1/2 tsp	Solution E 3/4 tsp	Solution F 1 tsp	Solution G 1 1/4 tsp	Solution H 1 1/2 tsp	Solution I 1 3/4 tsp	Solution J 2 tsp
Sodium Chloride Ave	40	39	34	2	0	0	0	0	0	0
Calcium Chloride Ave	31	31	23	20	12	10	3	0	0	0
Potasium Chloride Ave	31	33	12	5	2	2	0	0	0	0
Magnesium Chloride Ave	32	33	25	24	13	20	5	7	6	2



Conclusions/Sources of Error

Jan 22, 2024
My hypothesis was supported when salt increased seed germination decreased and so did seedling development

Magnesiums seems to be a bit better than the others since it did have seeds germinate in all solutions. Calcium also might be better to use. Sodium and potassium i would not use near plants

From my findings I would not recommend using salt to get rid of ice on sidewalks. I think shoveling is better.

If people need to use salt and have plants near then I would choose magnesium but from my background research it can be bad for concrete.

I suggest if you need to use salt then read the instructions carefully so you dont over use the salt and use the right salt for the job. If it is really cold choose calcium chloride as it can work in cold temps.

Clean up any undissolved salt so it does not get into the environment and avoid shoveling salted ice and snow on your grass or plants.

Try other ice melts that don't use chloride salts

I think more work is needed to find other ways to melt ice other than salt because we need to protect our soil and water so we can have food to eat and water to drink especially considering how bad climate change is getting.

Possible sources of error

Salts that were used might not be what is used in commercial deicer products so that could impact results
Human errors in measuring, pouring, mixing and counting might have affected results
Seeds coats or seeds? as the seedlings grew it got harder to tell seeds from seed cases so that could have affected counts also I had to reach in and test some to the seeds to see if they were a seed or a coat so that might have affected growth but since no mold grew in the controls or solution C I don’t think it had a big impact.
Seeds were bought online and some may have been damaged when packaged or in transit so that might have affected results

I think it would be interesting to carry out this research with the store bought ice melts to see how they affect seed germination because so many say they are environmental and pet friendly but many contain these chlorine salts. It might be interesting to look at new methods like beet, cheese and pickle brines and their impact on seeds. If I was to do this project again I would give myself more time and I would do a third trial to see if the pattern is the same.

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