

De-Icers

What works for the environment and is effective?

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Purpose

The purpose of this experiment was to determine the affect that various de-icers (both organic and inorganic based) had on the health of grass, as well as determine the efficiency of the de-icer in melting ice to then compare and contrast the data to find the best overall de-icer in terms of effectiveness and environmental impact.

Hypothesis

I predict that the inorganic based de-icers will be the most efficient at melting ice but will have the greatest damage to the grass, and the organic de-icers will have the opposite impact.

Materials

- Conviron plant chamber
- 6 beakers > 200 mL
- 6 graduated cylinders (25mL)
- Electric balance (readability 0.001)
- 6 Erlenmeyer flasks > 500mL
- Black, red & green markers
- Translucent sheet of paper
- Pro-Hex 72 cell root development system
- Adobe photoshop cc 2018
- Perlite soil
- 6 small plastic tubs
- Molasses brine (60% fancy molasses, 30% water, 10% 20% NaCl solution)
- 20% NaCl solution
- 20% CaCl2 solution
- 20% MgCl2 solution
- 20% Urea (CH4N2O) solution
- 20% NaC2H3O2 solution
- Tap water
- Scott's grass seed "all purpose mix"
- 6 "24cm by 14cm" plastic containers
- Camera

Method

De-icer efficiency at melting ice experiment

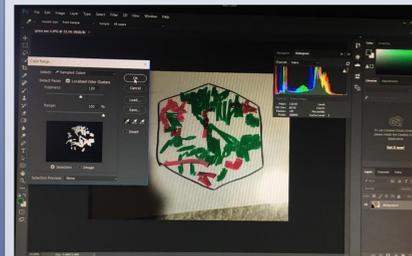
1. Fill 6 identical plastic tubs up with 200mL of water and put them into a freezer.
2. Put the beaker that will be used in the measuring for the experiment on a balance and mass it out and do the same for the graduated cylinder that will be used in the experiment.
3. Once frozen, mass one of the plastic tubs with ice in it.
4. Fill separate graduated cylinders 25mL full with a different de-icer and then mass each of the graduated cylinders to find the mass of each of the 25mL de-icers.
5. Pour each of the different 25mL of de-icer into the container with ice and start a timer countdown from 10 minutes.
6. Once the timer goes off, pour the contents of each container into a separate beaker designated to each different de-icer.
7. Mass the contents of the beaker and then subtract the mass of the beaker and the mass of the selected de-icer to find the amount of ice melted.
8. Mass out the tub of ice too, to confirm your results from step 7 and if results differ, take the difference from the mass of the tub as the proper result and re-do the experiment.



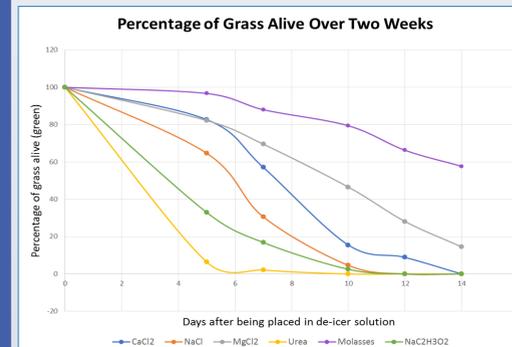
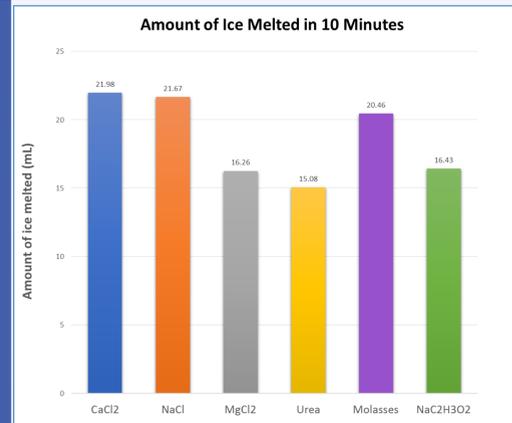
Method (cont.)

De-icer impact on grass experiment

1. Fill all pockets of root development system 3/4 full with soil and pour grass seed that has been massed out on a balance (mass within range of 0.600g to 0.700g) on the soil in each pocket.
2. Pour 1300mL of tap water into an opening in the container, filling the bottom tray.
3. Place plastic covering on tray and put into Conviron grass chamber.
4. Wait a week or until grass is adequately grown, and then take it out of the chamber.
5. Trim grass so that it is no longer than 5 cm and cut the tray so that there are seven 2 by 5 pocket trays. Place each of the trays into a different 24cm by 15cm plastic container
6. Label each tray of grass with a different de-icer, and one labelled control, and for each tray, mark off the three pockets that have the most grass; these will be the pockets of grass analyzed.
7. Fill each container with a different de-icer, and the one labelled control with water, up to 0.9cm from the bottom of the container.
8. Place the containers into a tray so that they are grouped together and put a plastic lid or covering over everything and place back in the Conviron plant chamber.
9. Every 2 to 3 days, take a photo of the three labeled pockets of grass for each of the trays of de-icers. Continue doing this for two weeks.
10. With one photo, either print it large or put it onto an iPad so it can be enlarged and then put a translucent sheet on top of the photo.
11. Using a black marker, outline the edge of the pot in the picture and then use a green marker to highlight all of the green alive grass and use a red marker to highlight all the yellow dead grass.
12. Take the translucent sheet off and put it onto a plain white sheet of paper and then take a picture of the highlighted drawing.
13. Put the photo in Photoshop, open a histogram and using a color range, calculate the number of red pixels and the number of green pixels in the picture.
14. Add the number of pixels of both red and green, and then divide that number by the number of green pixels to find the percentage of grass that was green and alive in the picture.
15. Repeat steps 17-21 for each picture taken throughout the experiment.



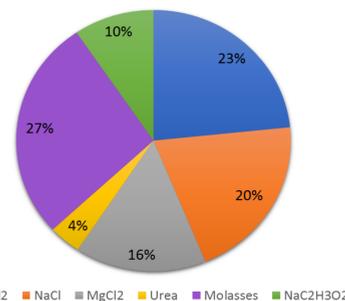
Use of Photoshop to determine % of green grass in pocket (above)



Days after grass is placed in de-icer solution	CaCl ₂	NaCl	MgCl ₂	Urea	Molasses	NaC ₂ H ₃ O ₂
0	100%	100%	100%	100%	100%	100%
5	82.71%	64.68%	81.12%	6.41%	96.69%	32.98%
7	57.1%	30.58%	69.53%	2.13%	88.01%	16.87%
10	15.51%	4.62%	46.55%	0%	79.42%	2.52%
12	8.89%	0%	28.13%	0%	66.28%	0%
14	0%	0%	14.53%	0%	57.7%	0%

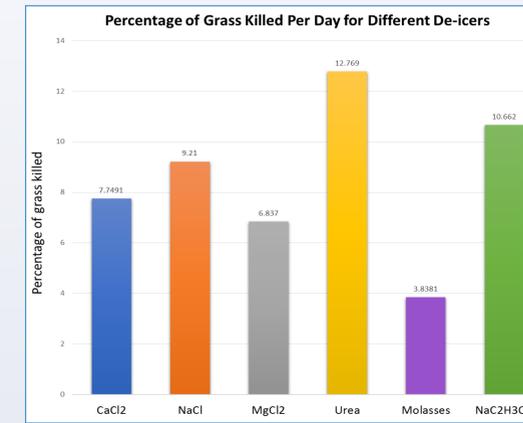
*The percentage represents the percentage of grass that is green (alive) in the pots

Best De-icer Weighing in Efficiency and Minimal Environmental Impact



Results

- CaCl2
- NaCl
- MgCl2
- Urea
- Molasses
- NaC2H3O2



Observations

- Hardly any of the grass placed in the de-icer solution grew over the two weeks.
- A white fungi developed in all of the de-icer's soil except urea. It was most present in the NaCl soil (right).
- The rate at which the de-icer was absorbed by the soil varied. Urea was absorbed the fastest and Molasses was absorbed the slowest.
- The molasses's grass (while green) was a lot darker green than the controlled normal grass and the blades were more rigid and stiff too.



Conclusion

The purpose of this experiment was to determine the affect that various de-icers (both inorganic and organic based) had on the health of grass and compare that to their efficiency at melting ice. Of all de-icers, the organic ones (with exception of molasses) had the greatest impact on grass health, killing it at a faster rate than the inorganic de-icers. In terms of efficiency at melting ice, the top two most efficient were inorganic, however, the efficiency of both was generally staggered. Moreover, it was determined that molasses was the best overall de-icer as it had the least impact on grass health by far and was the third most efficient at melting ice.

Sources of Error and Reflections

- 1) The rate from which each de-icer was absorbed into the soil was different between the de-icers
- 2) The amount of grass and soil that was put into each pocket wasn't exactly the same

The de-icer's effect on grass health experiment was done twice due to an invalid measurement of grass health (measuring height of grass), and dehydration of the grass which caused any results gathered to be questioned on whether it was the de-icer or dehydration. This was solved through putting a plastic lid over the grass when placed in the chamber as it reduced the amount of de-icer lost through evaporation. A controlled grass was also grown in order to compare it to the de-icing solution's grass. If I had another chance to re-do these experiments, I would run more trials on the de-icers efficiency test, and I would try and solve the source of error in which the de-icers are absorbed at a different rate. This could potentially be done through using a dropper to ensure that all grass gets the same amount of its respective de-icer.

Application and Implications

The results from this experiment have major applications due to the global use of de-icers and the ever growing concern for environmental safety and sustainability. Through the results it can be seen that using urea as a de-icer isn't a good option, whereas experimenting with molasses might be a good choice due to its favorable results. This opens the door for more experimental de-icers to be proposed and made due to molasses out-performing every other common de-icer. Looking at creating and testing experimental de-icers such as already created ones like pickle brine, sugar beet juice, and cheese brine is an area of research that can be conducted as an extension to this project. Other additional research that could stem off of this project could include looking at how different de-icers affect the concrete since some de-icers can actually corrode it over time. Additional research could also look at how different de-icers affect bodies of water such as rivers, ponds, and lakes in order to see if and which certain de-icers pollute the water and wreck the ecosystem. This project could also be expanded in which different concentrations of each de-icing solution are tested or even different combinations of de-icers are tested for its effect on water, concrete, vegetation, and more. A lot more research into different de-icers that prove to be cheap, effective, and environmentally safe should be looked into.

