Forest Fire Frenzy

By Amare Lakhani

Question & Hypothesis

Question: What kind of fire extinguisher chemicals could help grow back plants faster after a forest fire?

Hypothesis: I think that water would be the best option for putting out the fire and not harming the plants because water does not have any harmful chemicals. The reason I did not pick the fire retardants/extinguisher because I learned from research that it has diammonium sulfate which reduces the pH of the soil which is not good for the plants.

Why is it important to research about this topic?

Variables

Controlled:

- Amount of fire extinguisher
- Temperature (Room temperature)
- pH meter
- Amount of soil

Manipulated: Chemicals used on plants (3 kinds)

- water, Class ABC dry chemical extinguisher, 1/2 concentration of extinguisher

Responding: Growth of plants

Procedure

1. Get the soil and pots. Label each pot with the type of chemicals/treatment used
2. Use a measuring cup and put 4 cups of soil to each pot
3. Two different trials (grass seeds + spruce and then lodgepole pine)

Procedure (grass & spruce tree)

For grass seeds and spruce tree seeds:

1. For extinguisher treatment: Measure equal amount (15ml/1 tablespoon) of fire extinguisher powder and add to the grass seed pots (Labelled E)
2. Water treatment: Add same amount of water to each pot (15-80mL)
3. Water the grass seed approximately every 3-4 days
4. Start recording the height of the sprouted plant and pH about every week
5. Make observations about the health/color of the plant and any other changes

Procedure - Lodgepole Pine

Lodgepole pine seeds

1. Soak the lodgepole pine seeds for 10 mins
2. Put the seeds on a wet paper towel in a ziplock bag and store them in the fridge for 21 days.
3. Fill pot with soil, plant seeds, then add 30 ml of water to the soil.
4. For extinguisher treatment: Same procedure as last time
5. For ½ extinguisher treatment: Add ½ tbsp of extinguisher then mix with 4 teaspoon water (labeled ½ E)
6. Water treatment: Add same amount of water to each pot (30-80mL)

Research

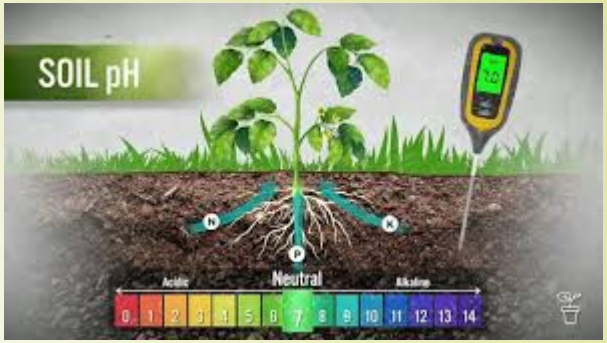
Chemicals used to put out fire

- **Water**: evaporates quickly but not as effective as others
  Class A fires (natural fires, paper, plastics, cloth) can be put out by water

- **Foam**: Better than water but not so efficient. The fluorine (PFAs) in foam affects plants

- **Fire extinguisher** : Best option of all of these but can break down due to the heat
  Fire extinguisher used in BC use a red dye called Red Iron Oxide to see where the extinguisher lands. The red iron oxide improves soil quality

Research



How does diammonium sulfate affect Albertan soil?

- Most Plants prefer 6.2-6.8 pH
- General pH level of the soils in Alberta: 6 or less.

- diammonium sulfate: When mixed with soil forms an acid that helps put out the fire. The diammonium sulfate and soil produces alkaline ammonia and neutral calcium sulfate. The ammonia then reacts with hydronium ions to make nitric acid. So the soil that has around pH of 6 now reduces to 5.5 pH.

Research

Effects of forest fire on the ecosystem (soil, plants, animals)

- Takes 200 years for a boreal forest to completely grow back after a fire

- After a fire, wood boring insect population increases. They eat the wood on the dead trees. Then, fungi population decreases because there are no trees. Because of this, insects are reduced because their shelter is gone.

- The fire causes loss of soil structure and soil porosity (pass through soil). This is bad for plants and organisms because water and minerals can't get through.

Research

How do different species react and adapt to the forest fire?

- Aspen and birch are the first plants to grow
- The tall trees die because of fire. So birch and aspen have sunlight to grow

Lodgepole pine seeds

- They are called pioneer trees
- Need sand, lots of sun, loamy soil

Types of extinguishers:

- We used a class ABC dry chemical extinguisher for all the treatments
- Class ABC can put out paper, cloths, oil, paint, and electrical equipment fires
- Other types of extinguishers include: Class D, Class K, Carbon dioxide extinguisher.

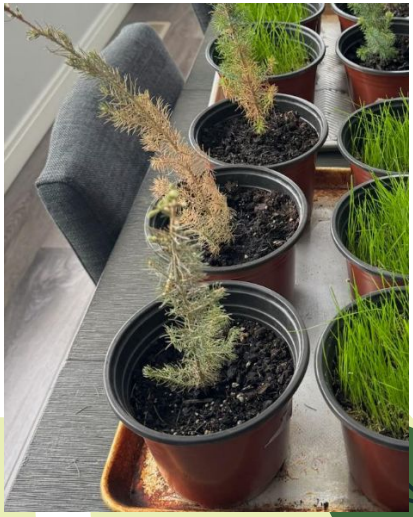
Observation

Watering schedule

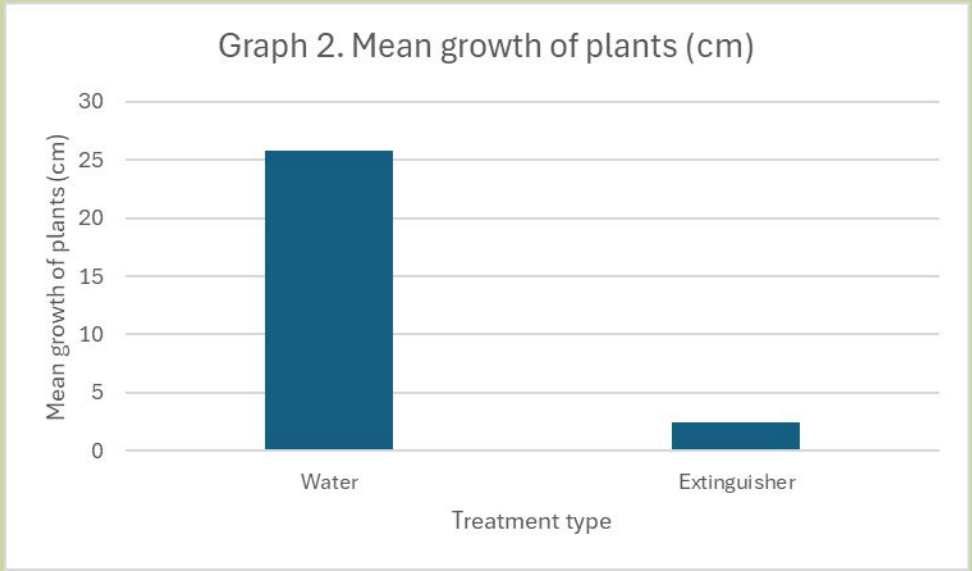
- Started on June 22, 2024 watered with 150 mL (too much)
- Watering changed: July 1 - 80mL for both
- Ended experiment by Feb 2025

Update: July 8, 2024

- All extinguisher plants died and water 2 and 3 died. Water 1 stayed alive. We knew others were dead because of the brownish yellow color instead of green.



Analysis - Grass seeds + spruce



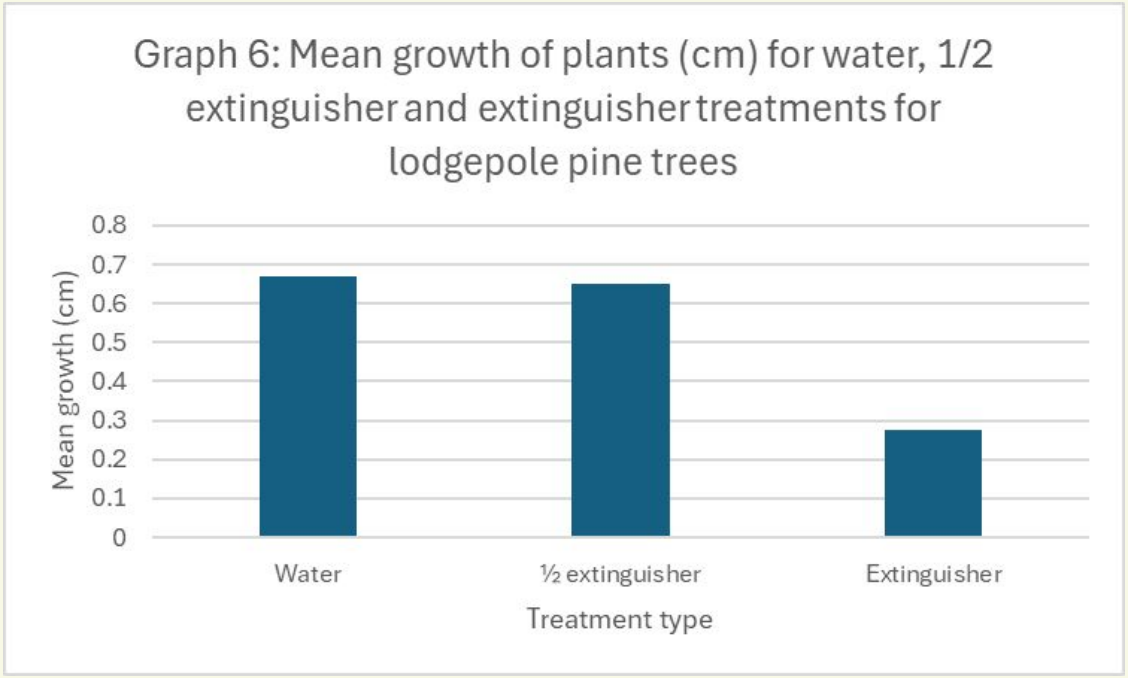
Observations: The best growth was for water treatment. The least growth was extinguisher treatment.

Analysis for Graph 2:

- The best treatment was water. The results are not surprising since it didn't have any harmful chemicals

- Extinguisher had the least growth. This makes sense because extinguisher is bad for plants since it reduces the plants pH by 0.5. They prefer a pH of 6.5 to 6.8

Analysis
Lodgepole pine

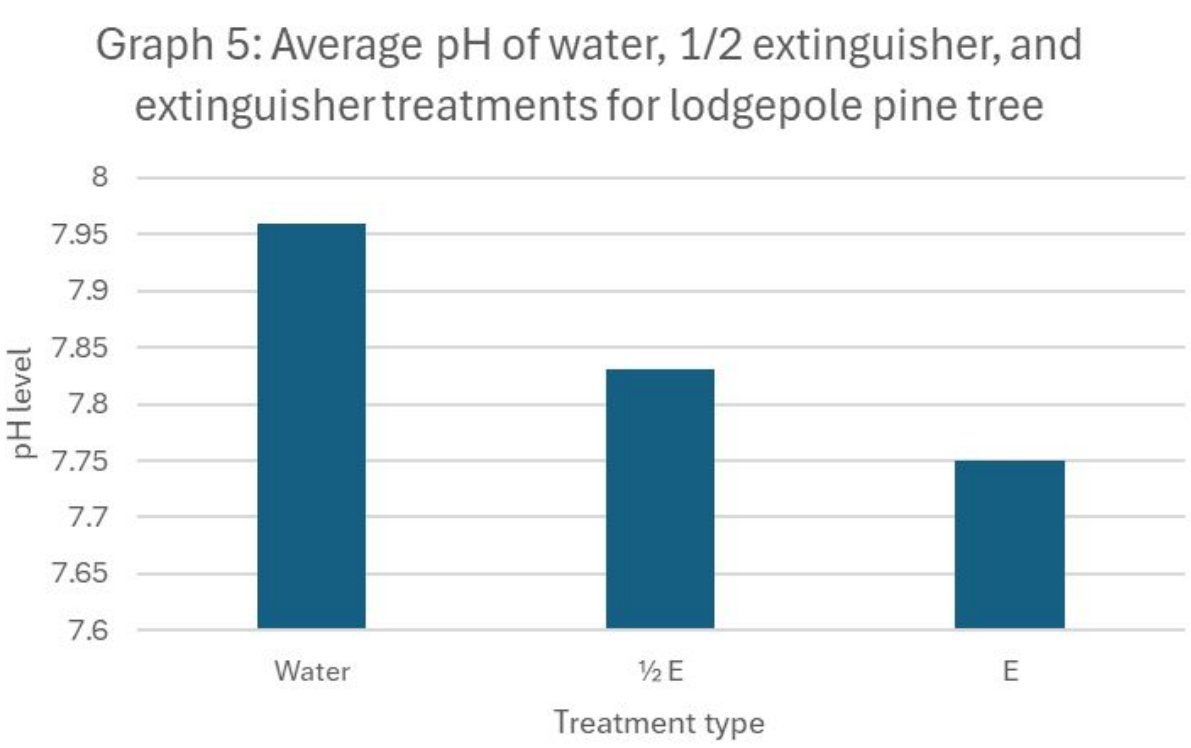


Observations: The highest mean growth - 0.67 cm (water treatment)
Lowest mean growth - 0.275 cm (extinguisher)

Analysis: The results are expected. Water does not have monoammonium sulfate like extinguisher.

Too much of **monoammonium sulfate** will make it experience **ammonium toxicity** which can cause leaves to burn, plant leaves to turn yellow, root damage and death.
It means **chloroplast** is not doing its job
Growth of the plants will stay the same or reduce

Analysis - pH



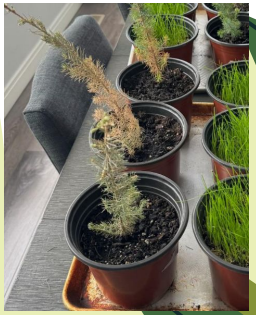
Observations: Highest pH - water treatment. Lowest pH- extinguisher treatment.

Analysis: The preferred pH of lodgepole pine trees is 5-7.5. All the treatments gave a pH higher than this value. This tells me that the plants did not grow in their preferred pH environment.

The results for the water treatment are unexpected. Maybe this happened because the tap water we used has chemicals that increase pH and harm the plants.

Sources of Error

1. Measuring plants
2. Plants were dead soon into the experiment
3. Watering for lodgepole pine: The watering started at 15 mL and then went to 80mL.



Conclusion

- **Hypothesis**: Water would be the best option for putting out the fire because water does not have any harmful chemicals.

- **Spruce tree and grass seeds**: The best treatment was water. The results are not surprising since it didn't have any extinguisher.

- **Lodgepole pine**: The water treatment did the best. The $\frac{1}{2}$ extinguisher did second best. And the extinguisher treatment plants had lowest growth. This is because extinguisher has monoammonium sulfate which can kill the plants by burning leaves.

Applications

I found out that water grew better than extinguisher.

- Helps in real life because now firefighters can use chemicals on forest fires that will put the flame out and not harm the plants.
- Firefighters can lower the amount of extinguishers to reduce harm to plants (see Slide 15)

Applications

Different ways to lower concentration of extinguisher:

- You can reduce the amount of extinguisher by shortening the area of the nozzle on it
- If nitrogen is added to the extinguisher, it can reduce the amount of concentration in it

Different techniques used to put out fire:

- gases like argon to get rid of the oxygen
- Use extinguishers with gas, ice and water to reduce the temperature of the fire.

Experimental changes

1. When we were measuring the height of the plants some were drooped down. We lifted them up so that the plant was as tall as possible. Add a column in the weekly record of plant growth for this

2. The plants were dead soon into the experiment. We should have given them more time to grow

3. We may have over watered the plants. We were watering 15 mL then turned to 80mL.

4. We used a class ABC dry chemical extinguisher, we could have tested different ones. Other types of extinguishers include: Class D, Class K, Carbon dioxide extinguisher.

Acknowledgement

I want to thank my mom (Reneeta Lakhani) for helping me plant the plants.
I want to thank my teachers for helping me learn more about fires and analyze graphs.
I want to thank Blessy Mathew for helping me understand areas of my project.

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Government of BC - Wildfire

Firefighting Canada

How does foam put out fire?

BC Fire Extinguishing Process

Fire Extinguisher Powder

Preventing Environmental Impacts
Forest Fire Ecology

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