

The Effects of Menthol Concentrations on Germination Rates of *Arabidopsis thaliana*

Taylor Brown, Sunny Le, and Owaiss Lpizra
 Advisor Dr. Kathleen Engelmann
 Department of Biology
 University of Bridgeport, Bridgeport, CT

Background

Menthol is a toxin found in plants. *Arabidopsis thaliana* was tested with several different concentrations of menthol to observe whether or not germination and fungal growth would be inhibited due to the menthol.

Hypothesis 1

Arabidopsis thaliana grown with higher menthol concentrations added will have germination and fungal growth inhibition.

Hypothesis 2

Arabidopsis thaliana grown with heavily diluted menthol concentrations will not have germination inhibited and fungal growth will be present.

Growth Conditions

Light: 16:8
 Day temperature: 20° C
 Night Temperature: 18° C
 Agar & Murashige Skoog
 Strain: Mt-0
 Plant Therapy 100% Pure
 Liquid Peppermint Oil

Method

Table 1: Experiment 1

Treatment 1	0% concentration
Treatment 2	0.1% concentration
Treatment 3	0.2% concentration
Treatment 4	0.3% concentration

Table 2: Experiment 2

Treatment 1	0.01% concentration
Treatment 2	0.001% concentration
Treatment 3	0.0001% concentration



Figure 1: Control group plate showing *A. thaliana* growth.

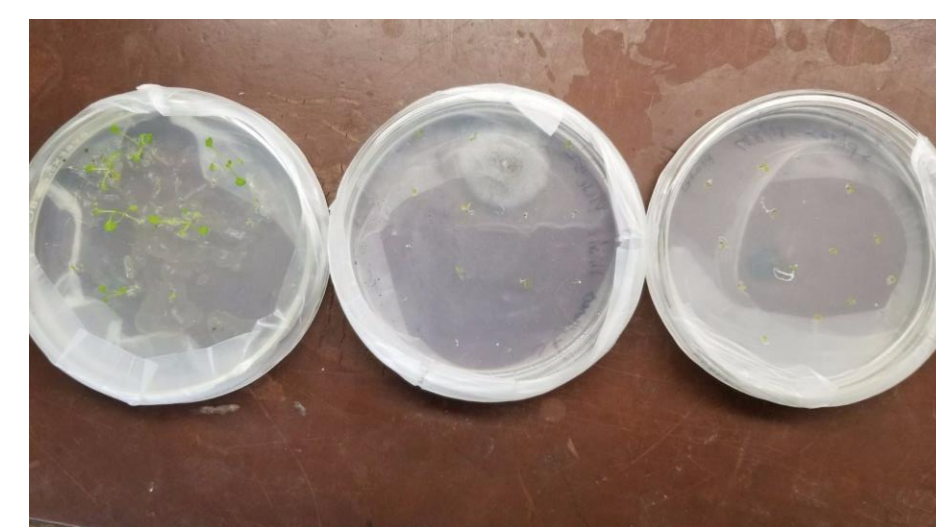


Figure 2: Experiment 2 treatments 3, 2, 1 displaying varying growth in each plate.

Results

Figure 5: # of plants Germinated After 4 Days (out of 48)

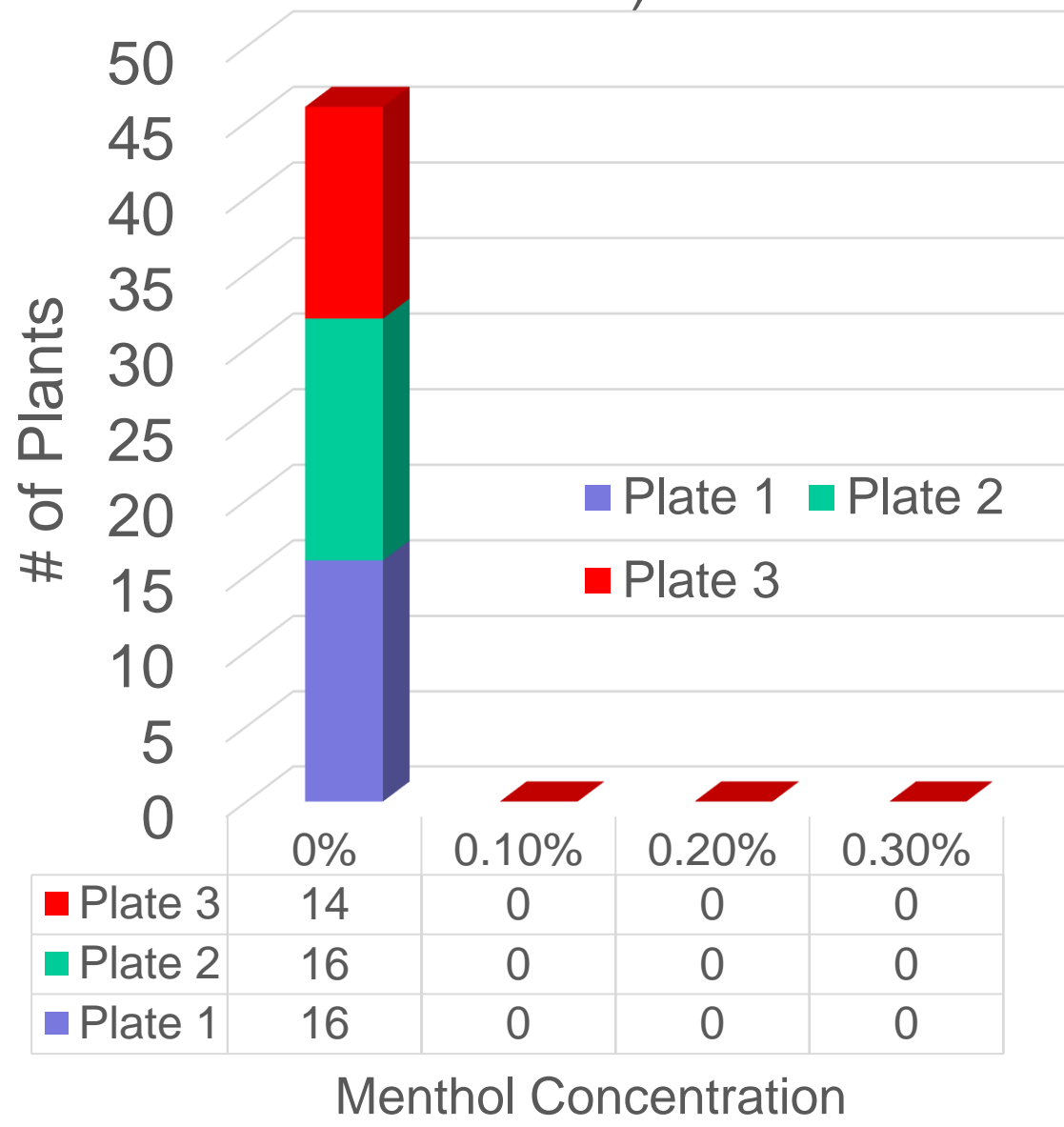


Figure 6: # of plants (out of 48) Germinated After 8 Days

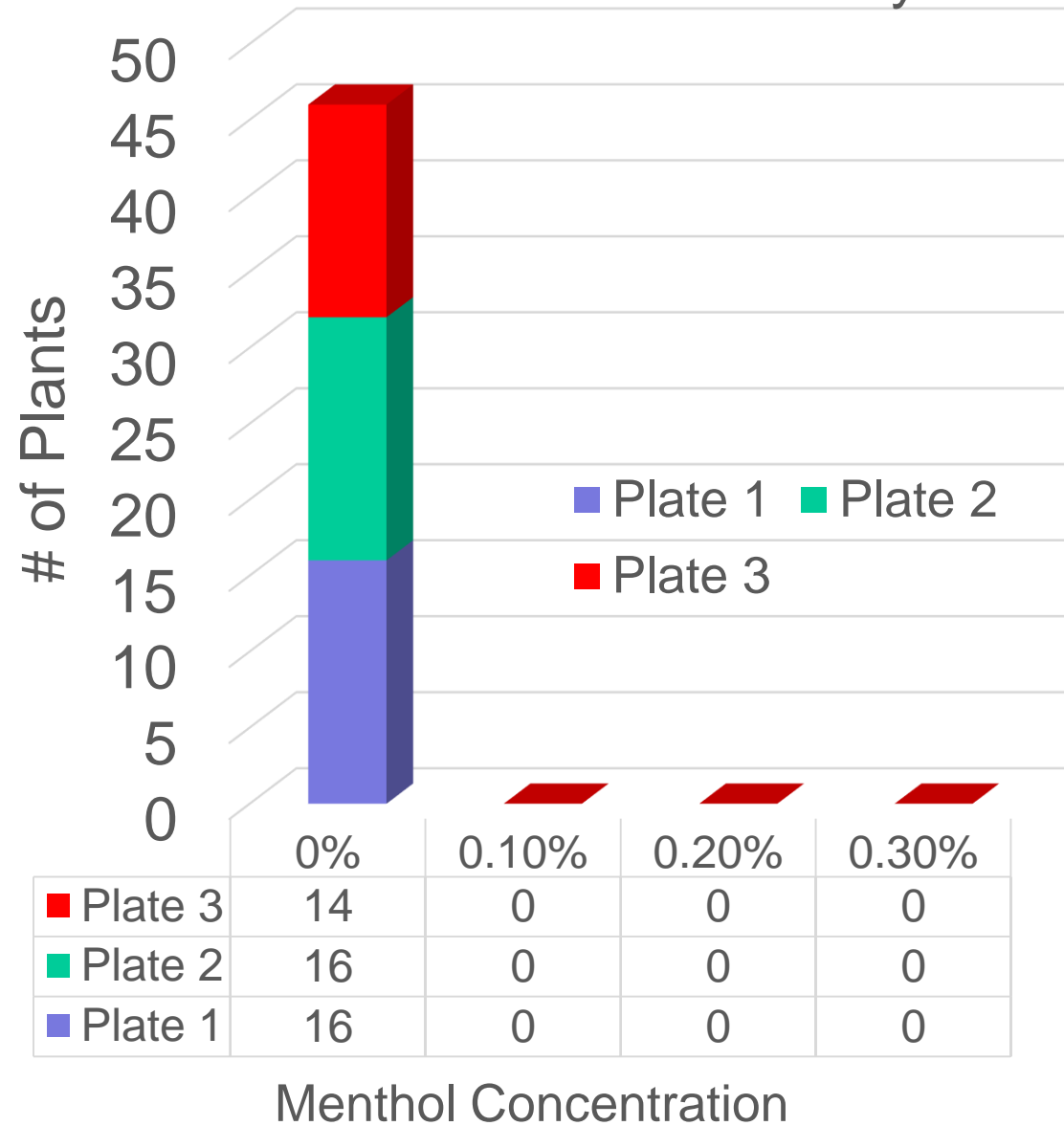


Figure 7: # of plants Germinated After 14 Days (out of 48)

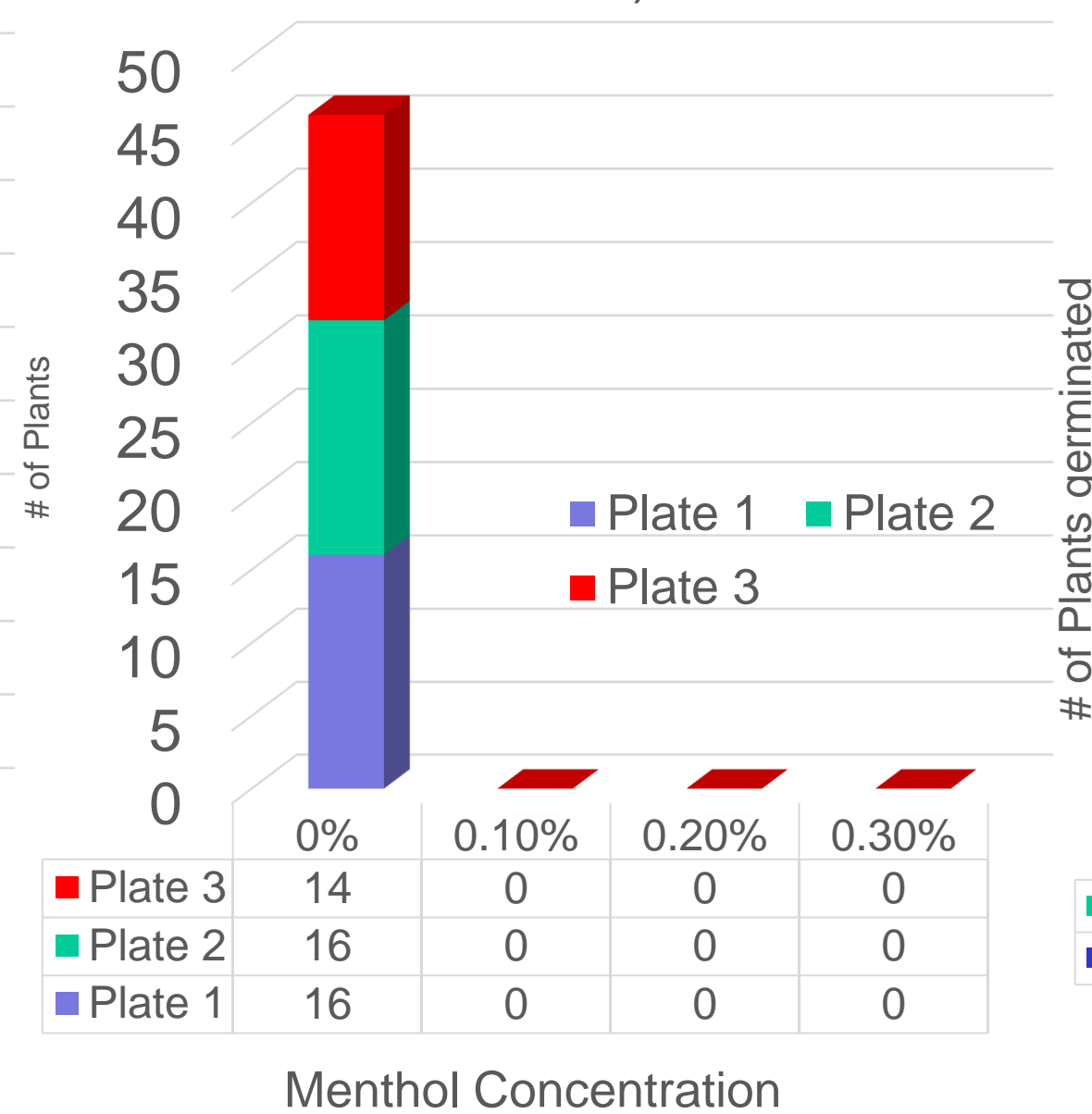


Figure 8: Germination Rates per Concentration

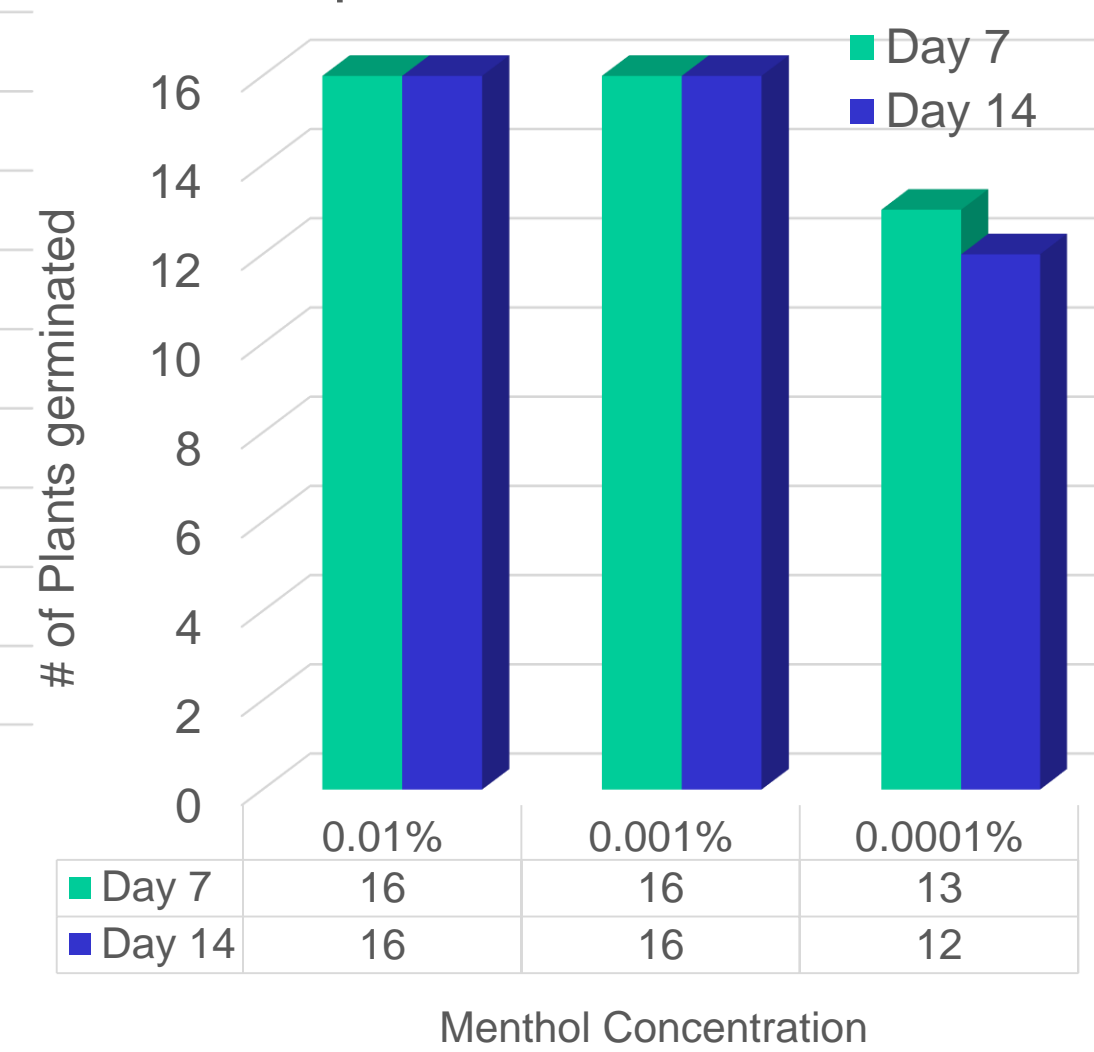


Table 3: Experiment 1 (Observed on days 4, 8, 14)

	0.00%			0.10%			0.20%			0.30%		
	Plate 1	Plate 2	Plate 3	Plate 1	Plate 2	Plate 3	Plate 1	Plate 2	Plate 3	Plate 1	Plate 2	Plate 3
Day 4	N	N	N	N	N	N	N	N	N	N	N	N
Day 8	Y	N	Y	N	N	N	N	N	N	N	N	N
Day 14	Y	Y	Y	N	N	N	N	N	N	N	N	N

Table 4: Experiment 2 (Observed on days 7, 14)

	0.01%	0.001%	0.0001%
Day 7	N	N	Y
Day 14	N	Y	Y

Analysis:

Germination was inhibited in 0.1, 0.2, and 0.3% but not in the 0.0, 0.01, 0.001, and 0.0001%. Fungal growth was inhibited in 0.1, 0.2, 0.3, and 0.01% while the lower concentrations experienced fungal growth.

Conclusion:

The minimum concentration of menthol needed to inhibit the germination of *A. thaliana* is greater than 0.01% but less than or equal to 0.1%. The minimum concentration of menthol needed to inhibit fungal growth on *A. thaliana* is greater than 0.001% but less than or equal to 0.01%.

Development and Future Application:

To expand this research, pure menthol would be observed rather than peppermint. This would allow agriculturists to utilize menthol as an alternative to the harmful fungicides on the market.

Citations

Abbaszadeha, S, et al. "Antifungal Efficacy of Thymol, Carvacrol, Eugenol and Menthol as Alternative Agents to Control the Growth of Food-Relevant Fungi." *Journal De Mycologie Medicale*, vol. 24, no. 2, June 2014, pp. 51-56. June 2014.

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