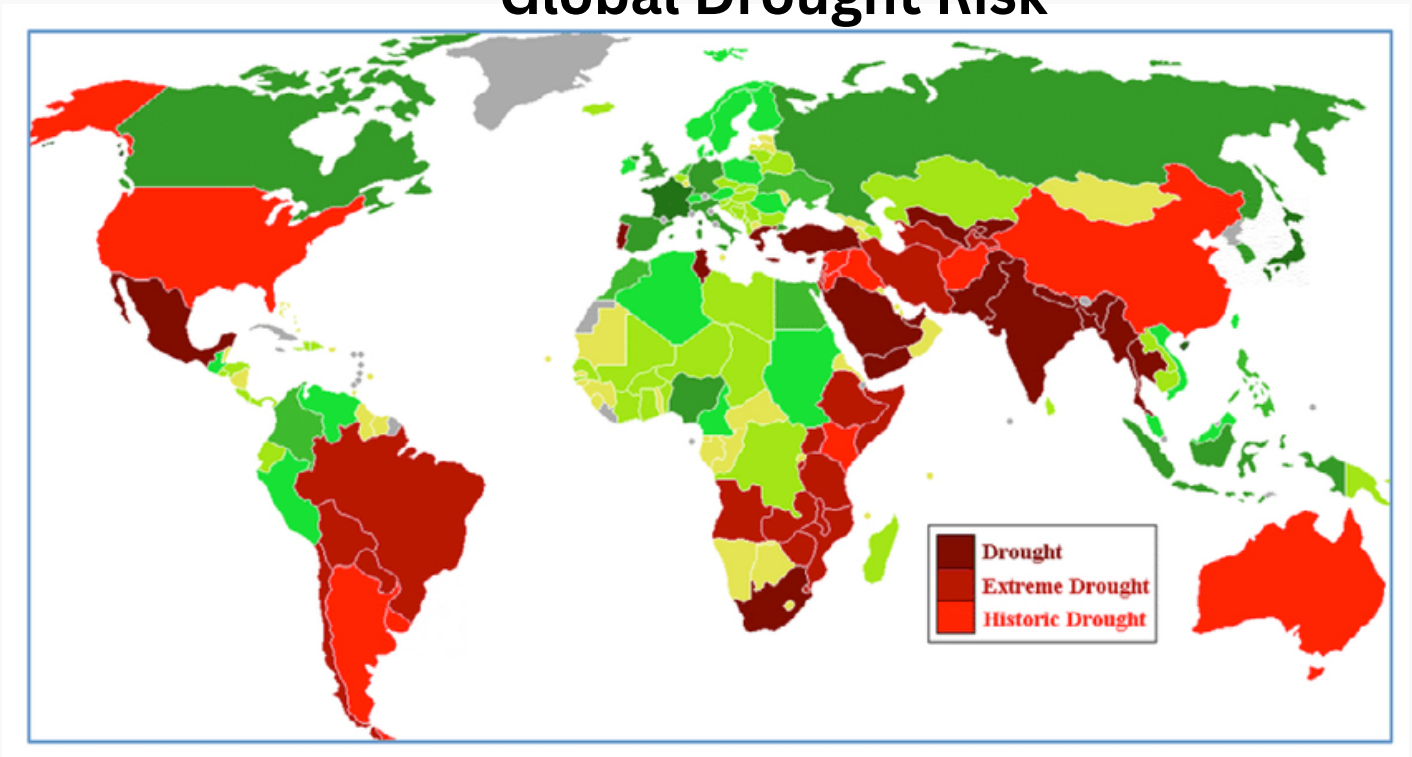
Deciphering the Airborne Sounds of Plants Under Drought Stress

Enabling **Precision Irrigation** Through Nature's Own Signals

Motivation

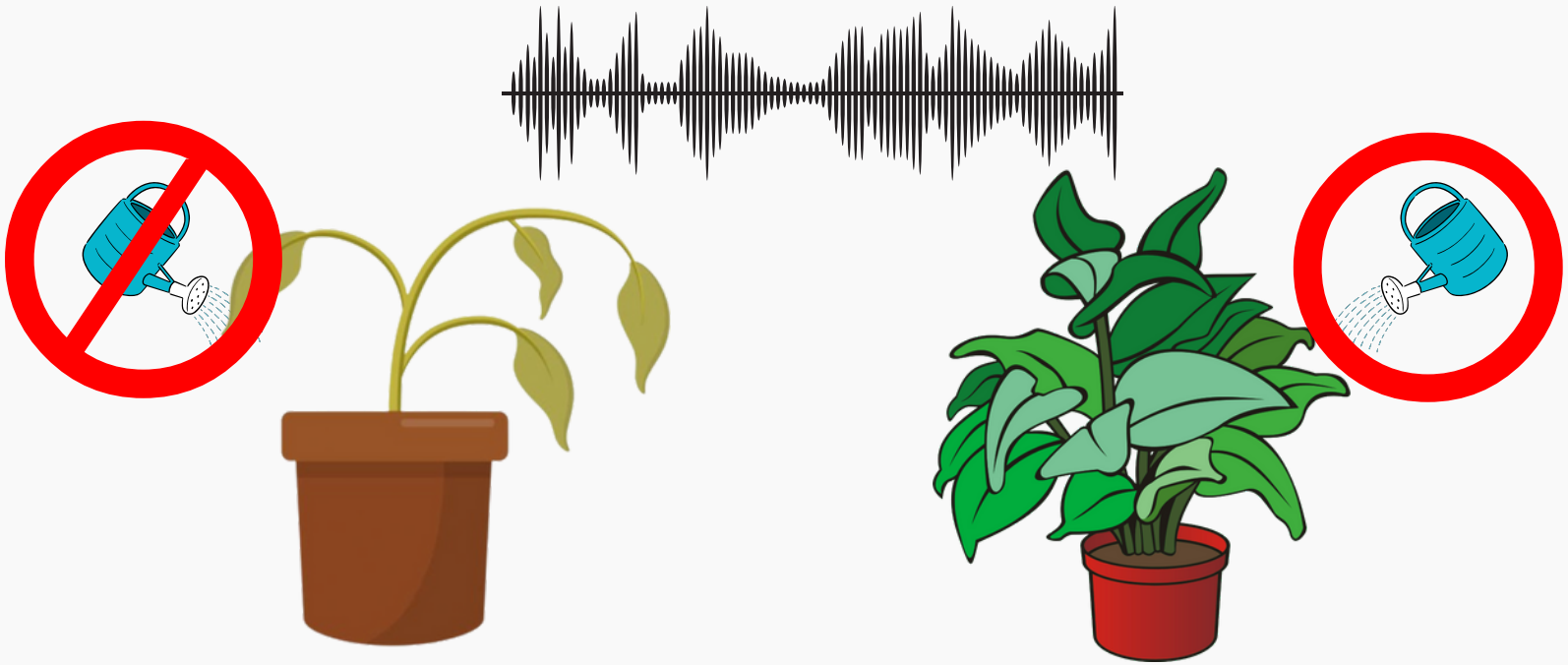
Global Drought Risk



This study uses plant signals to make farming more eco-friendly, enhancing precise irrigation and advancing water management.

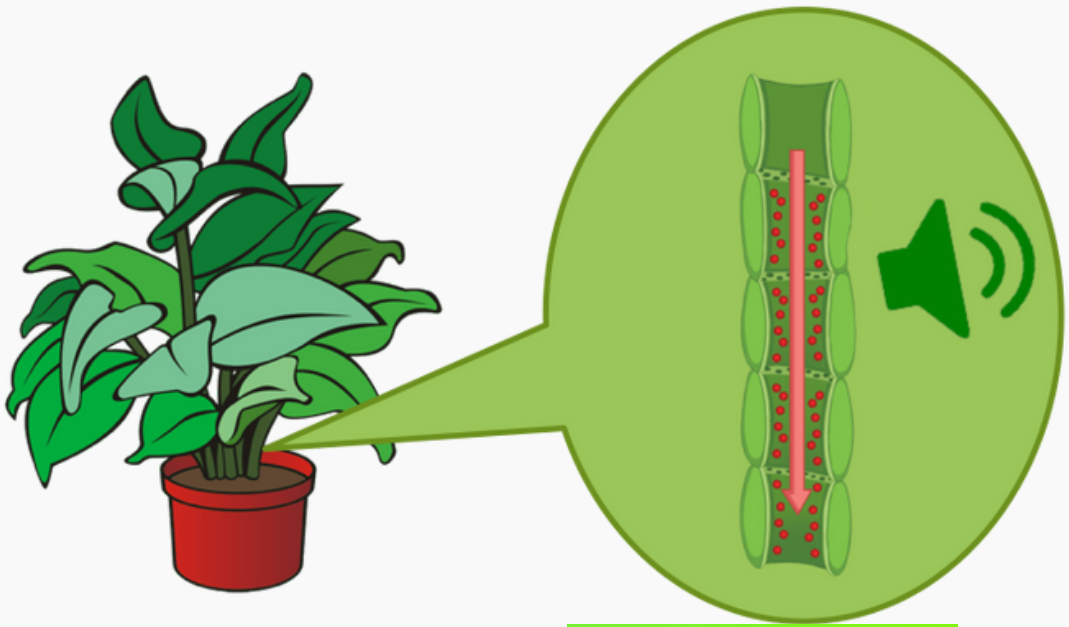
Hypothesis

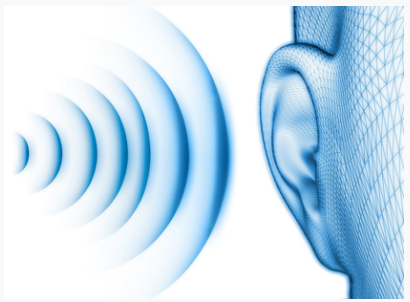
I hypothesized that plants emit distinct airborne sounds in response to drought stress compared to when adequately watered.



Why do plants produce airborne sounds?

- When plants are exposed to drought, air bubbles form in the xylem where they expand and collapse.
- These air bubbles collapsing leads to vibrations and causes the plant to emit airborne sounds. This process is called cavitation.





Materials

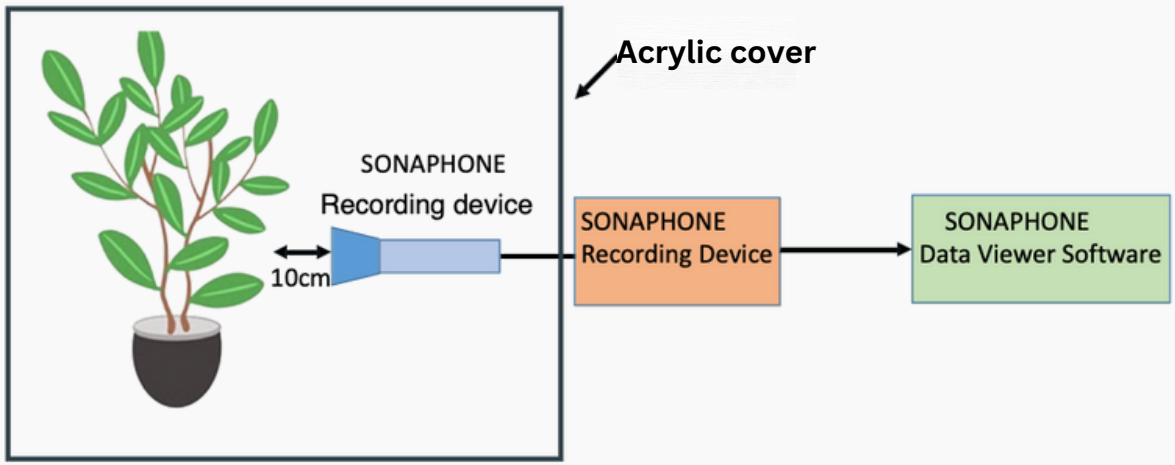
- **SONAPHONE Digital Ultrasonic Testing Device**
- **SONAPHONE DataSuite Software**
- **Acrylic cover**
- **Ixora Plant**

Experiment Design

Placed recording device 10 cm away from the plant

Recording device angle adjusted using camera stand

Acrylic cover to block out interfering noises



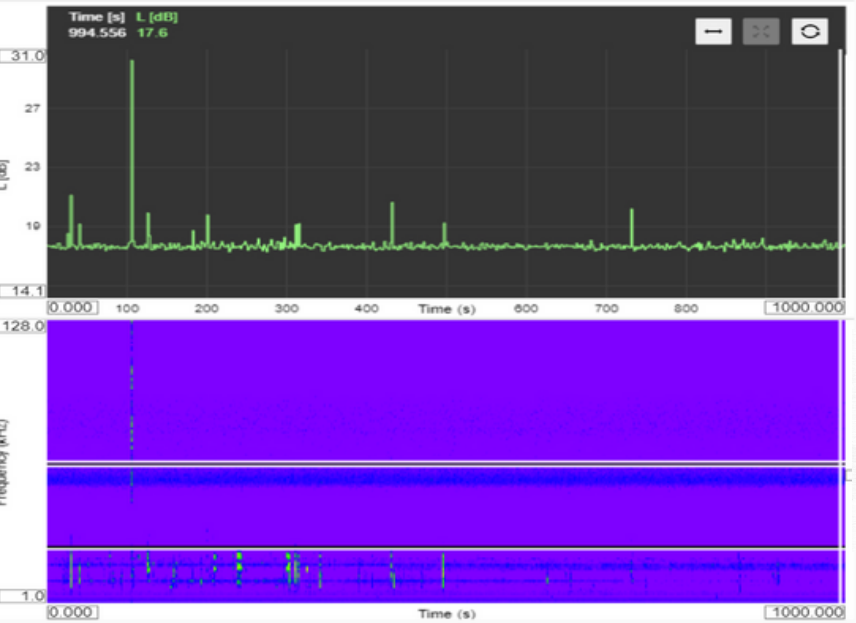
Procedures

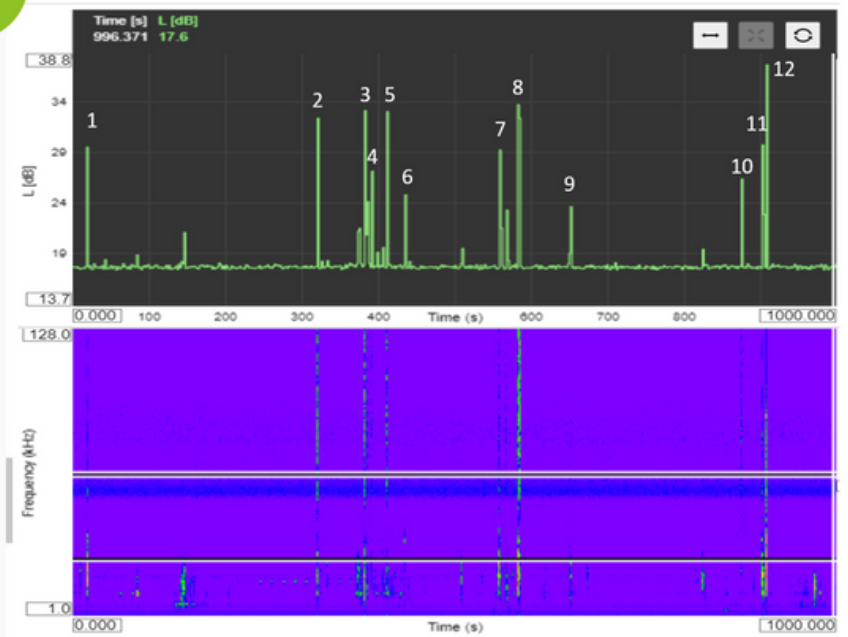
Recorded the plants' airborne sounds 1 hour after watering

Recorded the plants' airborne sounds 9 hours after watering

Recorded the airborne sound of plants for 10 minutes

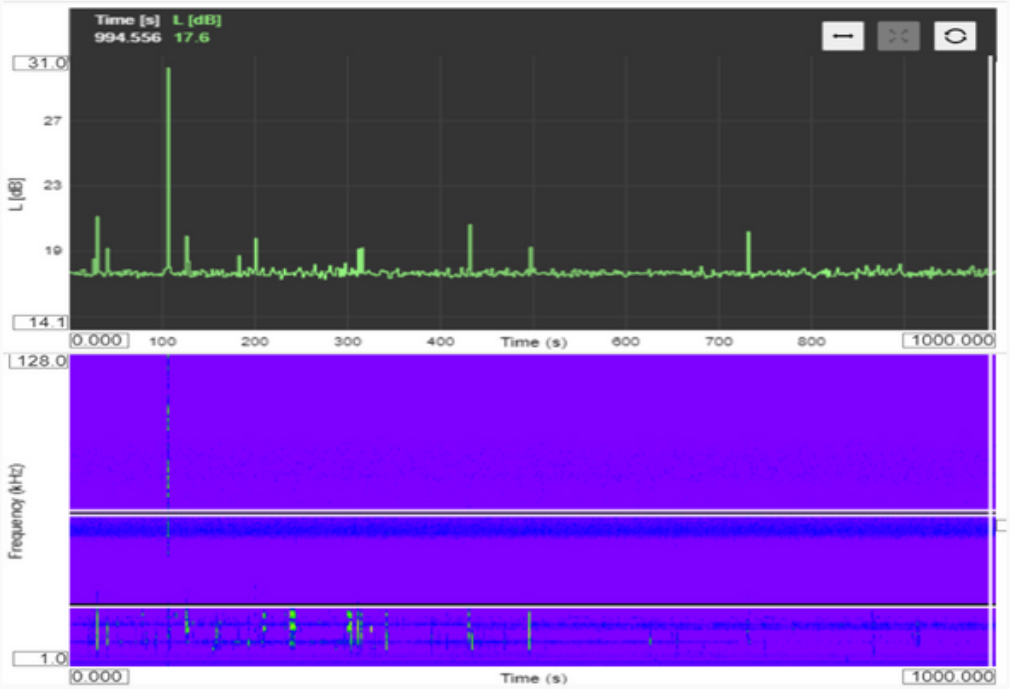
Watered vs. Droughted





Graphs of Plants Airborne Sounds

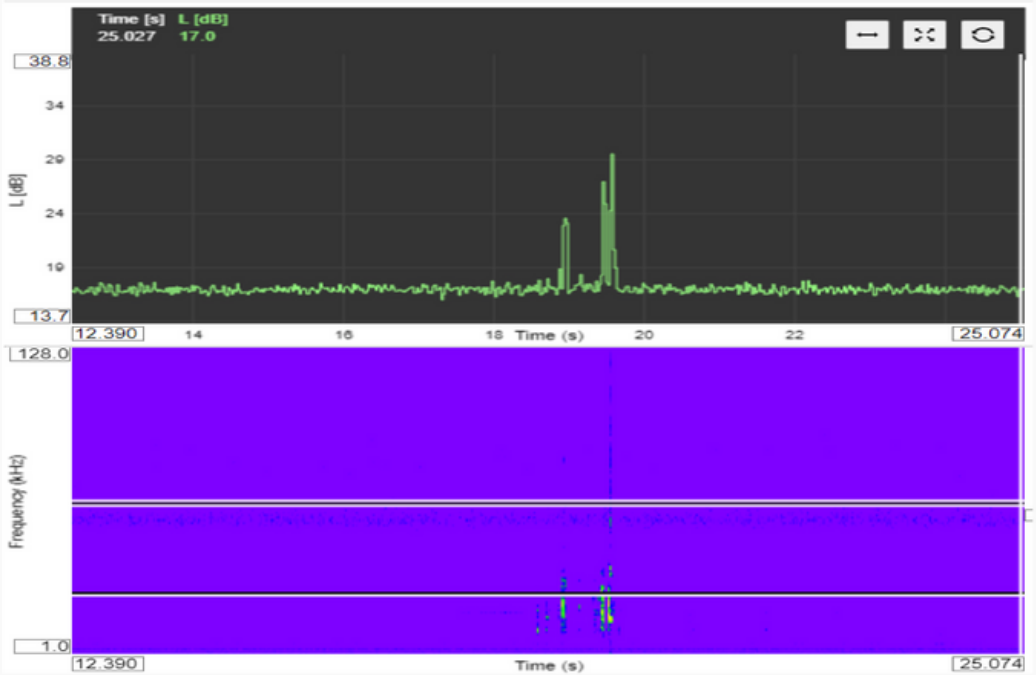
Watered Plant

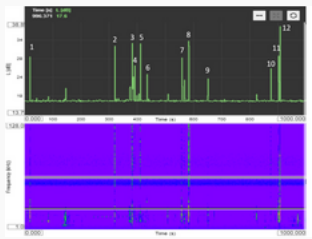


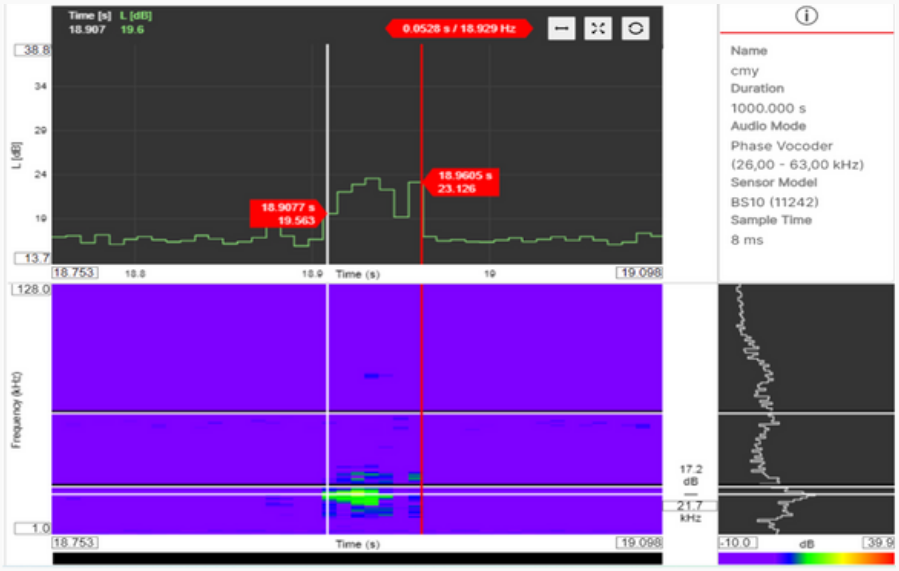
Appearance time	total wave dBmax	# of small spikes	Total wave Width ms	wave dBmax frequencyKHZ		wave dBmax freq. KHZ	
				dB	KHZ	dB	KHZ
105.67s	31	1	7	17.1	73.7	17.1	104.8

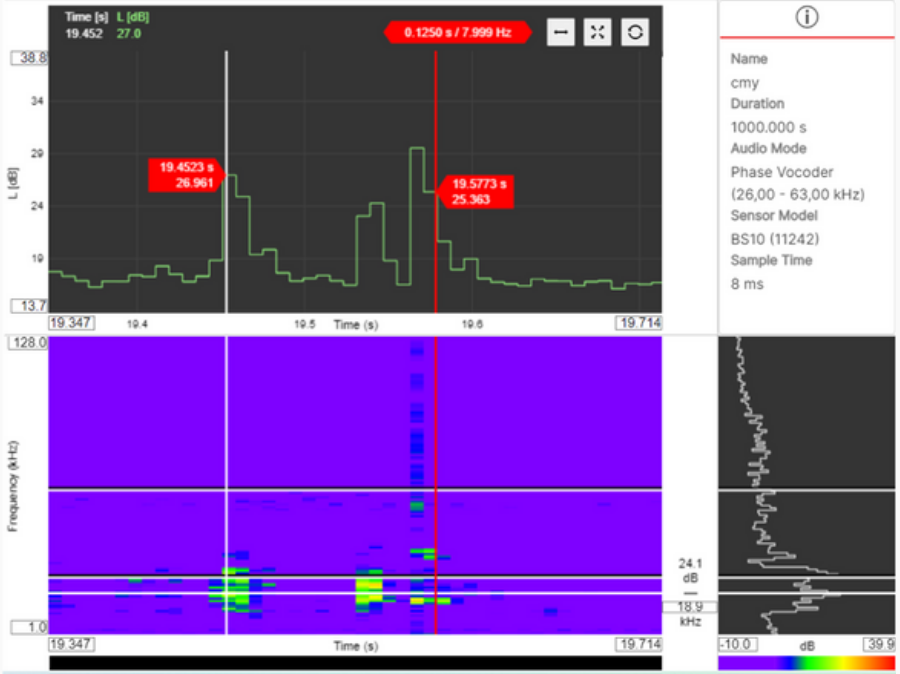
Motivation | Hypothesis | Experiment Design | **Analysis** | Summary

Droughted Plant









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Result

	Length of Appearance	Total Wave Width	dBmax	dBmax(KHZ)
1a	18.9	54.5	23.6	29.7
1b	19.4	17	26.9	18.4
1c	19.53	14.1	24.3	22.1
1d	19.6	13.7	29.6	15.6
2a	320.4	7.6	32.4	28.3
2b	320.5	7.6	21.6	21.7
2c	320.53	7.5	26.7	28.3
3a	381.8	8.2	26.1	11.3
3b	382.1	8.2	33.2	18.8
3c	385.8	7.5	24.1	14.1
4	390.4	16.5	27.1	88.5
5	410.9	8.5	33.1	58.8
6	435.2	7.8	24.8	34.4
7	558.6	15.1	29.3	19.8
8a	581.8	70	29.5	19.3
8b	581.9	33.1	33.8	15.1
8c	582.9	17.7	32.4	79.1
9	651.2	7.9	23.6	18.8
10	873.1	8.6	26.4	21.7
11a	900.4	8.5	22.7	19.8
11b	900.45	7.8	22.7	15.6
11c	900.5	14.9	23.2	15.1
11d	900.57	14.9	29.7	19.8
12a	906.1	8	22.2	11.3
12b	906.68	32.1	37.7	21.7
12c	907.18	7.7	25.6	11.3
12d	907.39	16.6	23.5	19.8
Average		16.36ms	27.25dB	25.86KHZ

There is a **clear difference** between the airborne sounds of the **droughted plant** and the **watered plant.**

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				dB	KHZ	dB	KHZ
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Discoveries

Plants emit unique airborne sounds that are indicative of their condition

A direct correlation has been discovered between the airborne sounds and the plant's condition.

Future Works

completed
Phase 1 — Characteristics of Airborne Sounds Emitted by Plants With and without Water Deficiency.

completed
Phase 2 — Comparing Airborne Sounds in Hydrated and Droughted Plants.

Phase 3 — Research the effect of plant airborne sounds on surrounding plants