

Are your clothes threatening the future?

How plants are affected by PFOA from the textile industry in Bangladesh

Johan Dellbring and Victoria Niska, Umeå Elitidrottsgymnasium

UMEÅ
ELITIDROTTS
GYMNASIUM



Abstract

PFAS and their impact on plants and animals is a hot debate. The purpose of the project was to investigate how vegetation is affected by PFOA.

During analysis, it was observed that cress had a delayed germination and grew significantly worse at high levels of PFOA in dependent cultivations.



Source: Environment and Social Development Organization (2019). "PFAS: Bangladesh Situation Report"

Introduction

Have you noticed a pattern where your clothes are often produced? Southeast Asia, the world's largest textile producer, contributes dangerous emissions that pollute water. PFASs are persistent chemicals that have harmful effects on our ecosystem.

Purpose and research question

The purpose of the project was to investigate PFOA's impact on vegetation.

- How is the growth of cress affected in the presence of PFOA?

Methods

Cress grew on agarose gels with different concentrations of PFOA using two different methods. The process was documented using a Raspberry Pi with the associated camera module.



Figure 1: Shows setup for Experiment 3

Results

Higher levels of PFOA in dependent cultivations gave:

- Delayed germination
- Impaired growth



Figure 2: Shows cress that has grown for two weeks in the different concentrations. Increasing concentration from the left. Experiment 1



Figure 3: Shows cress that has grown for two weeks. Increasing concentration from the left. Experiment 2

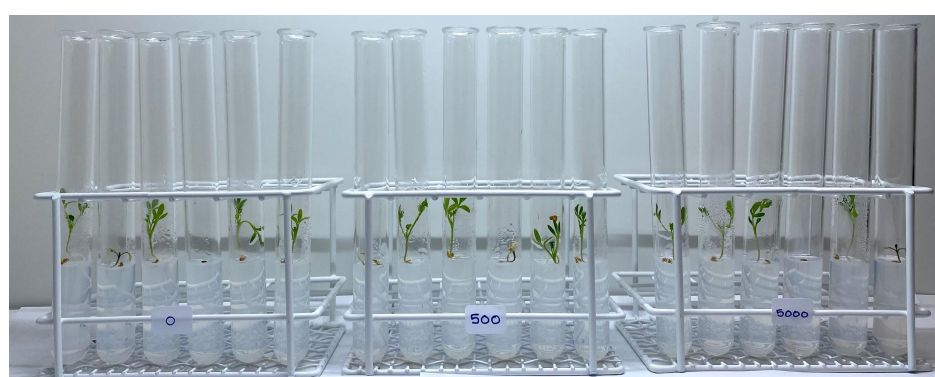


Figure 4: Shows cress that has grown for two weeks. Increasing concentration from the left. Experiment 3

PLEASE SCAN US

to see timelapse videos:



Experiment 1



Experiment 2



Experiment 3

T-test for mean difference in height shows significant results when $p < 0.05$:

T-test	
μ_1	:expected value for mean height in population 1
μ_2	:expected value for mean height in population 2
μ_3	:expected value for mean height in population 3

$$\begin{cases} H_0: \mu_1 = \mu_2 \\ H_1: \mu_2 < \mu_1 \end{cases} \quad \begin{cases} H_0: \mu_1 = \mu_3 \\ H_1: \mu_3 < \mu_1 \end{cases}$$

Figure 5: Shows hypothesis in T-test for mean difference in height.

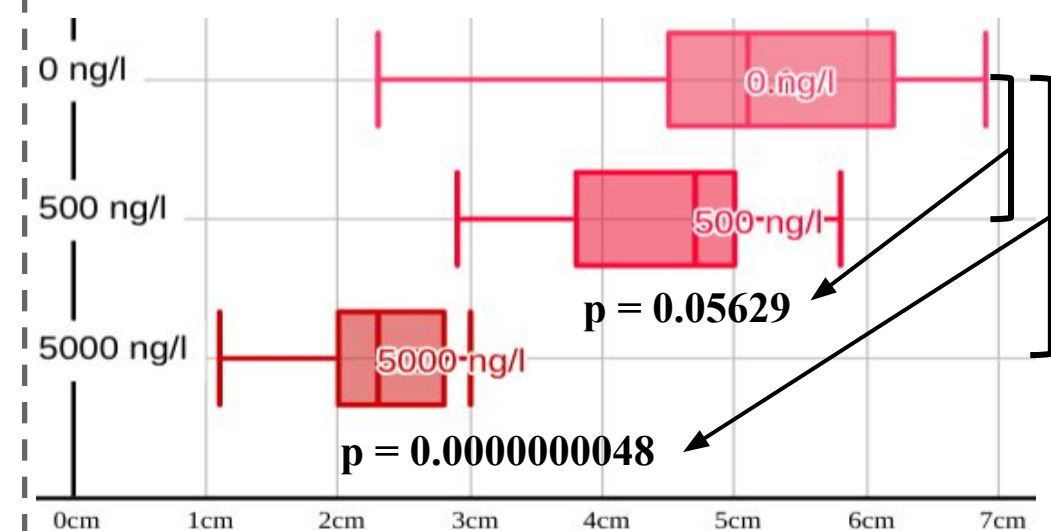


Figure 6: Shows min, max, mean and median length for each population and p-values. Experiment 1.

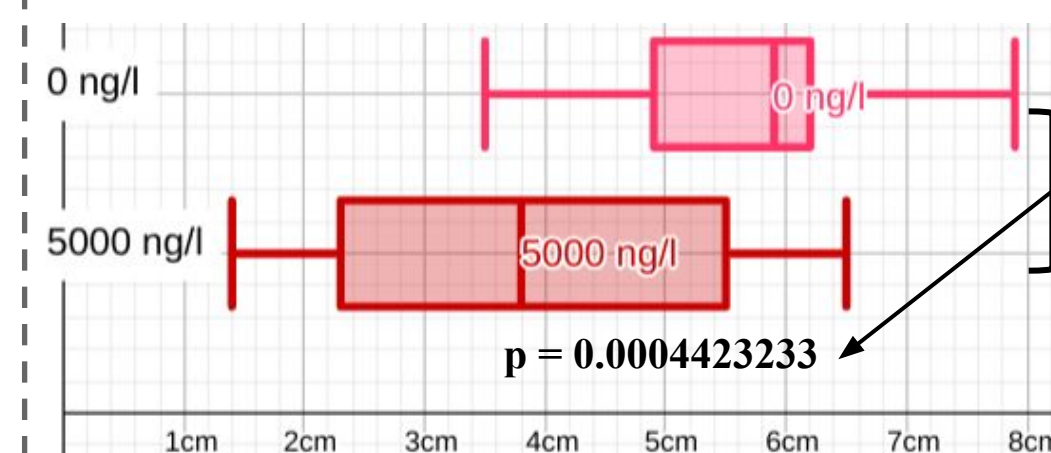


Figure 7: Shows min, max, mean and median length for each population and p-value. Experiment 2

Conclusion

A negative impact on plants at high concentrations of PFOA during a shorter period of time can be visually observed and proven with T-tests in dependent cultivations. In independent cultures, no difference in growth could be detected.

References

1. Environment and Social Development Organization (2019). *PFAS: Bangladesh Situation Report*.
2. Sweco Environment AB. (2019). *PFAS Umeå Airport*.
3. Naturskyddsforeningen (2022). *Minst 2 miljoner svenskar har för mycket PFAS i dricksvattnet*.
4. Miljösamverkan Sverige (2022). *PFAS vid deponier*.
5. Livsmedelsverket (2023). *PFAS i dricksvatten och livsmedel - kontroll*.
6. Naturskyddsforeningen (2022). *Frågor och svar om PFAS*.
7. Raspberry Pi. (2024). *Raspberry Pi 3 Model B*.
8. Livsmedelsverket (2024). *PFAS - Per- och polyfluorerade alkylsubstanser*.
9. Kind, J. (2012). *Fytoremediering - Ett hållbart sätt att tillgängliggöra förorenad mark?*
10. Greger, M. Landberg, T. (2024). *Removal of PFAS from water by aquatic plants*.



UMEÅ
ELITIDROTTS
GYMNASIUM