Application of Muropeptides for Sustainable Management of Invasive Plant Species

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Research Question

Is there a method capable of effectively eliminating invasive plants while simultaneously preserving the health of surrounding species?

Hypothesis

Muropeptides and their immune-stimulating effects can be used to selectively kill invasive plant species in a sustainable and eco-friendly manner

Background

- The average annual temperature has increased 1.9° F since 1970 (National Climate Assessment, 2014)
- Ecosystemic stress
- Addressing this growing issue now is crucial to safeguarding the health of our planet's natural ecosystems.

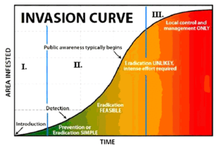


Figure 1: Invasion Curve of Invasive Species *([Invasive Plant Invasion Curve] , 2021)*

- Removal methods for invasive species (Mechanical, Chemical, Biological)
- No established method capable of effectively eliminating invasive plants while simultaneously preserving the health of surrounding species.
- Pyroptosis (inflammatory programmed cell death)
- Muropeptides and Peptidoglycan are proven to induce pyroptosis

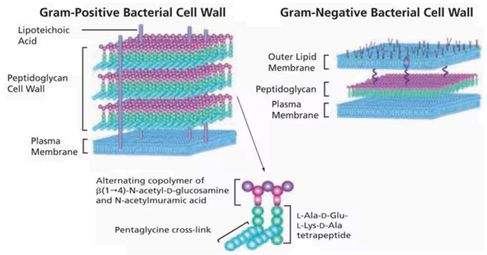


Figure 2: Peptidoglycan Structure and Biosynthesis (Sigma Aldrich, 2025)

Purpose

- Reduce the environmental impacts of invasive plant species on ecosystems worldwide
- Engineer an eco-friendly removal mechanism that prioritizes the health of native species before the removal of exotic ones

Main Takeaway

Pioneering a sustainable, bio-based alternative to chemical herbicides, this research harnesses plant immunity to combat invasive species, paving the way for the restoration of biodiversity and protection of critical ecosystems as invaive plant species have been proven to express PRRs recognizing bacterial peptidoglycan

Results

RT-qPCR Analysis

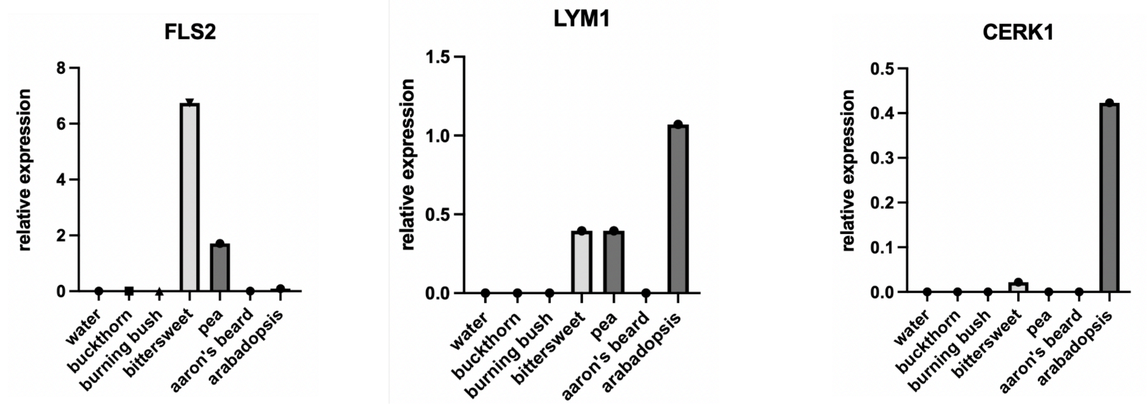


Figure 3: Expression of Genes FLS2, CERK1, and LYM1 in Plant Sample through qPCR. Each gene's expression is demonstrated in each plant in the sample as well as the negative control, H2O.

β-Glutaminase Functional Assay in Recombinant Arabidopsis Thaliana

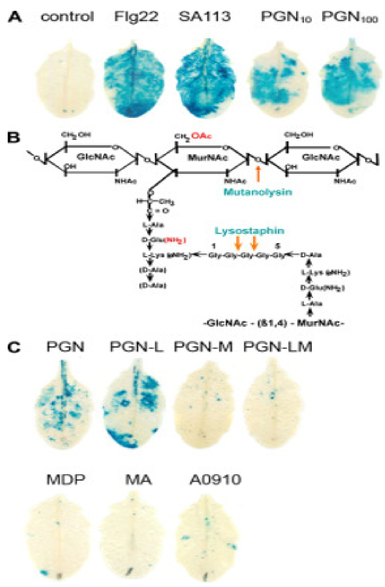


Figure 4: S. aureus peptidoglycan is perceived in A. thaliana plants. (Gust et al., 2007)

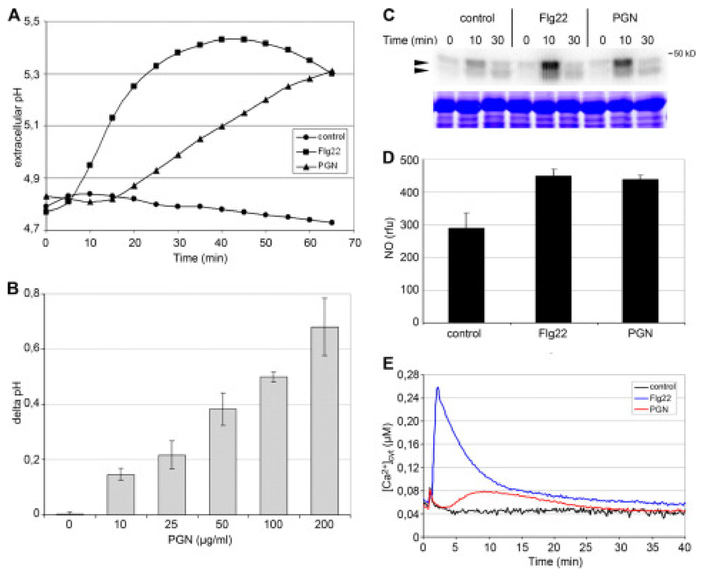
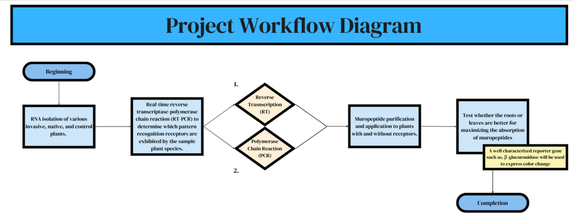


Figure 5: Innate immune early defense mechanisms due to direct influence of peptidoglycan perception. A, extracellular pH was monitored over a time course in 6-day-old A. thaliana cell cultures. B, change in extracellular pH in cell cultures. C, MAP kinase activity. D, NO production is given as relative fluorescence units E, [Ca2+]cyt was measured in a luminometer. (Gust et al., 2007)

Methods



- Assess pattern recognition of various plants, invasive and native
  - Collect data on the purity and amount of RNA in the sample
  - Perform RT-qPCR
- Muropeptide Application
  - Peptidoglycan will be measured in recombinant Arabidopsis Thaliana
- Test to determine whether the roots or leaves are more effective in the absorption of muropeptides

Conclusions

- Primary objective
  - Determine how PRRs recognizing bacterial peptidoglycan are conserved in sample
- Muropeptides as possible invasive plant removal technique
- Importance of functionality assays
  - Cut-off/dosage
  - Mode of delivery
  - Type of muropeptide

References

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