

In vitro Bioaugmentation of *Zea mays* L. via a *Bacillus subtilis* Seed Coating to Stimulate Allelopathic Defense Mechanisms Against Co-Germinating *Ambrosia artemisiifolia*

Gowen, Carter (School: EAGLE Homeschool Association)

As *Ambrosia artemisiifolia*, an invasive weed species, expands its global presence, it generates significant yield losses of up to 50% in *Zea mays* L., destabilizing economies and altering soil structure through nutrient depletion. This series of experiments harnesses the natural potential of *Bacillus subtilis*, a plant growth-promoting rhizobacterium, to increase allelochemical production in *Zea mays* L. and reduce *Ambrosia artemisiifolia* density in the rhizosphere through seed coatings. The initial two trials focused on analyzing the effects of a liquid *Bacillus subtilis* suspension combined with nutrient broth on *Zea mays* L. seeds, which were co-germinated with *Ambrosia artemisiifolia*. Conclusively, the third trial investigated the responses of *Ambrosia artemisiifolia* and co-germinated *Zea mays* L. seeds, which were coated with a sodium alginate-based seed coating containing *Bacillus subtilis*. ANCOVA results statistically validated ($p < 0.01$) a link between the *Bacillus subtilis* seed coatings and the inhibition of *Ambrosia artemisiifolia*. Furthermore, *Ambrosia artemisiifolia* grown alongside *Bacillus subtilis*-coated *Zea mays* L. revealed a Mean Response Index of -0.51, indicating that the average physiological trait difference was 51% less than that of the control *Ambrosia artemisiifolia*. Additionally, UV-Vis spectrophotometric analysis indicated that the sodium alginate and *Bacillus subtilis*-coated *Zea mays* L. contained approximately 165% more allelochemical concentrations than the control *Zea mays* L., suggesting the stimulation of phenylpropanoid pathways. These conclusions suggest that sodium alginate-based seed coatings containing *Bacillus subtilis* provide a sustainable solution to suppressing *Ambrosia artemisiifolia* in agricultural regions through allelopathy.

Awards Won:

Arizona State University: Arizona State University ISEF Scholarship (valued at up to \$32,000 each)