CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Shloka V. Janapaty

Project Number
S1209

Project Title
The Effects of Pseudomonas putida Bioremediation of Agricultural Runoff on Low-Density Polyethylene Decomposition Rates

Abstract

Objectives/Goals
According to the EPA, there are 5.25 trillion pieces of plastic trash in the world's oceans with 300 million added each year. It is vital to understand how to decompose plastic responsibly. NCBI research shows that the bioremediation of certain bacteria has been effective at decomposing plastic. This project uses agricultural runoff to decompose plastic through Pseudomonas putida bacteria. The plastic used was low-density polyethylene (LDPE) commonly used in bags, six pack rings, and computer hardware.

Methods/Materials
The first part of my experiment was solely aimed at understanding whether agricultural runoff could be used to spur P. putida growth, while the second part assessed the impact on plastic decomposition.
Culture A: (control) Water and P. putida,
Culture B: Water, P. putida, and a eutrophicated water concentration of agricultural runoff (N- 0.03 mg, P- 0.08 mg)
Culture C: Water, P. putida, and higher concentration agricultural runoff (N- 1.65 mg; P- 1.1 mg)
After a 50 day period, bacterial growth and plastic decomposition rates were measured.

Results
The results indicate that eutrophicated water had three times greater growth of bacteria and the highest plastic decay at 20-30%. Culture C, with the higher concentration and nutrient content, had the next highest cell count and plastic decomposition at 17%, compared to the control, with 2%. Overall, the results show that increase in concentration does not result in higher P. putida growth and higher plastic decomposition likely due to the impact of pH of the culture on bacterial growth.

Conclusions/Discussion
Small amounts of nutrients, such as those found in eutrophicated waters spur P. Putida growth which use enzymatic degradation to breakdown the carbon backbone of LDPE plastic. P. Putida are advantageous because they have most genes to break down aromatic and aliphatic hydrocarbons (ex: LDPE Plastic). Higher concentrations of agricultural runoff render the culture more acidic and resulted in suboptimal conditions for bacterial growth. Thus, a low concentration of agricultural runoff put to good use maximizes the growth of P. Putida and can help achieve a much-needed increase in plastic decomposition rates.

Summary Statement
This project utilizes nutrients in agricultural runoff to enhance the growth of Pseudomonas putida bacteria which in turn significantly increases the decomposition rates of LDPE plastics.

Help Received
My advisor, Dr. Tracy Hughes, guided me in experimental procedure, taught me how to use a hemocytometer, and showed me how to make a nutrient broth culture.