Oak Park and River Forest High School

BioBuilderClub

Saving Our Local Trees

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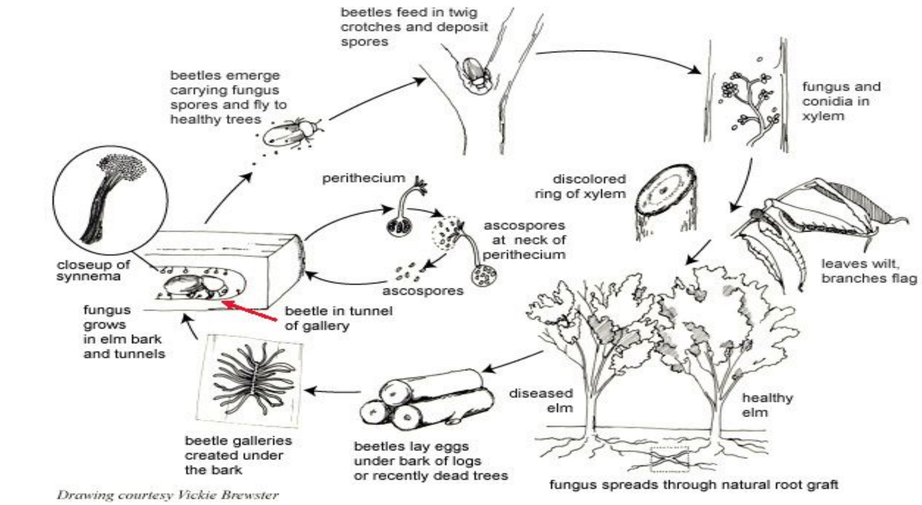
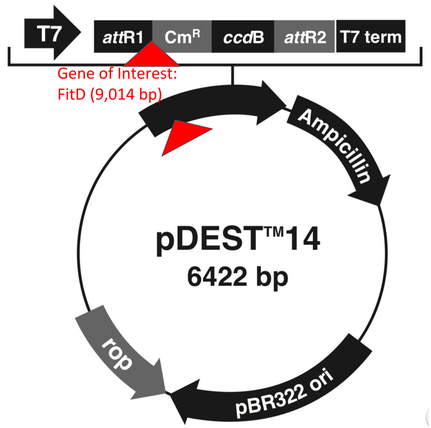
Background & Ecological Impact

Since it was brought to North America in the 1920's, Dutch Elm Disease (DED) has killed thousands of Elm trees all over the country. Once the Dutch Elm trees are infected, the leaves on upper branches curl and turn gray-yellow and finally brown and ultimately must be cut down. The disease has killed thousands of elms in Illinois, and it is especially prevalent in the Oak Park and River Forest area.

DED is caused by two species of fungi: *Ophiostoma ulmi* (formerly known as Ceratocystis ulmi) and *Ophiostoma novo-ulmi*, the latter of which is more aggressive. All native elm trees, especially the American elm, *Ulmus americana*, are susceptible to the fungus. Trees that grow at a faster rate tend to be more susceptible than trees that grow at a slower rate. Unfortunately, the fastest growing elms possess large vessels that limit the tree's ability to block the spread of the pathogen. The fungus is transmitted by Elm Bark Beetles (*Scolytus multistriatus*), who contract the fungus by burrowing and laying eggs into already infected trees. When the beetles emerge in the Spring, they spread DED to healthy trees by feeding off of upper branches. The beetles feed on living elms for a short period before starting their breeding cycle over again in dying or weakened elm wood. The DED fungus is made an even larger issue because it can grow in both healthy and dead wood, therefore contaminating not only the offspring of all Elm Bark Beetles but other insects as well (U of I report on plant disease).





The pDEST 14 plasmid (available from ThermoFisher) is ideal for longer inserts, as our gene of interest is 9kb.

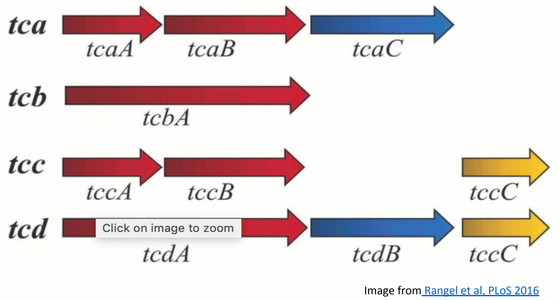


Image from Rangel et al. PLoS 2016

Tc's (Toxin Complexes) from *Pseudomonas fluorenscens* strain PF-5 (which normally lives on the roots of crop plants).

These toxin complexes have shown to be toxic to a variety of root fungi, Tobacco hornworms, lepidopterans (butterflies / moths) and *Drosophila melanogaster*.

Design Considerations:

Advantages / Opportunities

The tcb gene is advantageous because it is a bacterium already closely associated with plants and has both antifungal and insecticide properties. Therefore, the proteins it creates will certainly accommodate our goal of repelling elm bark beetles because it can act as a defense mechanism for the tree bark.

Dangers / Limitations

However, there are some dangers associated with using this gene. Utilizing a gene that codes for a protein that acts as an insecticide has the potential of eliminating not only elm bark beetles, but also a broad range of insects. Targeting the elm bark beetles presents a possible threat to our local ecosystem.

Impact

In theory, our product would be a better alternative to pesticides. We believe that a bacteria based solution would be less harmful and more enduring than pesticide and other insect prevention products.Although there is certainly the possibility of an unseen and harmful butterfly effect by introducing a new organism into the environment, we hope that we would be able to save our population of elm trees.

Questions and Future Work:

Future experimentation would explore the production of a viable solution in the form of a standardized product, such as spray or paste. We would also hope to create a product that is an improvement over available pesticide products, which can be harmful to both the tree and to humans as many contain carcinogenic products. If we got the opportunity, we aren't certain what the best medium to test the reliability and success rate of a finalized solution would be. We think the best option would be testing tree cookies of recently affected and cut down trees by contacting landscaping local companies.