

### **How Might We Statement**

How might we eliminate invasive kudzu vines in residential areas across the United States?

### **The Problem**

In 1876, the invasive Kudzu vine was introduced with the intention to reduce soil erosion. Although it has been effective against soil erosion, the introduction of this species to the United States produced unforeseen consequences [1]. Kudzu's fast growth rate, complex root system, and ability to thrive in the climate of the southeastern United States have allowed it to spread and take over [2]. Today, Kudzu infests approximately 30,000 sq km of the country per year [3]. The vine has a significant effect on farmers, often growing over the crops on their property. It grows over various structures (telephone wires, streetlights, etc.) and causes extensive damage. It is necessary to find a workable solution to eliminate kudzu because it has proven to be a financial burden: it costs about \$500 million to control the vine and around \$1.2 million to control the damage in the southeast [3]. Not only that, it is catastrophic to the infrastructure, causes a loss of biodiversity, and hinders crop production [4].

Past attempts to eliminate kudzu have included spraying the vine with herbicides and using goats to graze the area. However, both methods have shortcomings. Kudzu is very resistant to treatment because of the semi woody roots that account for 40% of its biomass. Problems with using herbicides include the fact that they might kill any other flora in the vicinity of the herbicide application and contaminate nearby water sources [4,5]. Using a herd to graze and eat the kudzu is costly (\$725/goat/day). Goat grazing also requires space and constant care for the herd, which can only be done by experienced caretakers [6].

If Kudzu invasion in the southeastern United States is not addressed, it will continue to out-compete the native species and reduce biodiversity in that area, causing problems for the other plant species, landowners, and farmers [4].

### **Context of the Problem**

Kudzu in America has a history that spans over 70 years. For years, it has not been seen as an issue, but as a blessing. It has captured the imagination of gardeners, politicians, ecologists, and farmers; being hailed as a "the miracle vine" [7] that could solve many problems. However, as it spread farther than people expected, kudzu was recognized as a problem itself. Originating in Asia, kudzu had many natural competitors to keep it under control. When it came to the United States, no one realized that this plant could ever pose a problem. It was introduced to the United States as a solution to the erosion problem. Its extreme growth rate allows it to grow well in soils that few other plants could [8]. It was advocated by the United States Government to be planted, even going so far as to pay farmers \$8 per acre of kudzu that they grew [7]. Having no natural competitors in its new home, the plant exploded across the south. Its lack of competition, explosive growth rate, and government support allowed kudzu spread out of control and earn its nickname "the plant that ate the south" [7]. Today, kudzu is seen as a threat, being able to topple power lines, cover homes, and block sunlight to plants in any area that it is introduced to. Even though it is seen as a problem, it still persists in hundreds of thousands of acres because of its resilience and its ability to grow back after being attacked.

## **The Solution**

The goal is to develop a simple new method of eradicating kudzu in residential areas with minimal environmental effects. Kudzu is an invasive species that damages ecosystems by covering vegetation and blocking out the sun [9]. The common method currently is broadband spraying of herbicides, which impacts both the kudzu and the plants surrounding it [10]. By implementing a direct injection method kudzu can hopefully be neutralized in a way that will be less detrimental to the environment.

Direct injection is an alternative to broadband spraying. It will use less chemical (about 5 mL) and will give the herbicide ample time to deteriorate before leaving the plant and entering the soil. In the future, the team hopes to make this solution cheap and easy to implement. However, preliminary research is required to determine whether it will be an effective approach to killing kudzu.

## **Objectives**

### **Objective 1: Find an injection method for the chemical (Roundup Concentrate Pro)**

The current experiment involves testing the effects of Roundup Concentrate Pro by injecting it into the kudzu vine at various locations. One major problem the team is facing is the vine is not absorbing any solution. The initial assumptions of the workings of the injection method were proved wrong, so now the objective is to find a method that doesn't let the chemical simply drip out. When the team finds a method, it can start running experiments in the lab.

**Completion Criteria:** The team would know its objective is successfully completed when an injection method is found that results in the vine absorbing solution.

**Status of Objective:** This was not one of the initial objectives. It was assumed that the original injection method would work, so the team never included this as an objective. Now, this is the first step to the experiment.

**Previous accomplishments:** The team has found multiple injection methods that do not work. Initial assumptions were based off of injection techniques in hollow stemmed vines, which did not work on kudzu. Hollow stems would allow for the injection of a chemical and the chemical to penetrate the vine, something that a non-hollow stem does not allow. The team thus needs to find an injection method for non-hollow vines like kudzu.

**Future work:** The team has begun finding a new injection method, but has not found much success yet. This means that it would have to be an injection method that does not allow the chemical to drip out.

**Plan:** The plan is to complete this objective involving testing out different injection methods to find one that will allow the chemical to stay in the vine. The team plans to complete this objective before the Fall 2014 semester begins, so every team member will have to individually experiment with the different injection methods over the summer. Three injection methods will be tested: the drip method, the cavitation method and the cross-section method.

### **Objective 2: Testing our procedure in lab**

Upon the determination of a successful injection method, the group will proceed to test that method in the lab, with carefully regulated physical conditions. Research will occur in a lab space in the Clough Undergraduate Learning Commons (CULC 435), and a graduate student to help us with the procedure. The goal is to see if the injection method killed the kudzu. The team will repeat experiments until a successful solution is found.

**Completion Criteria:** The team will know that the objective is complete when the kudzu dies from chemical injection.

**Status of Objective:** The initial goal was to start the experimental runs during Spring 2014. When the team realized that the injection method wasn't working, it had to alter its projections and postpone the experiment.

**Previous accomplishments:** The team has acquired lab space, supplies and the chemical for lab testing. It has also formulated a detailed experimental procedure.

**Future work:** In order to start work on this objective, the team has to find an effective method of injection.

**Plan:** The team plans to complete this objective in Fall 2014. The team is assuming that it will be successful in finding an injection method over the summer, which will allow them to start our experimental testing in the beginning of Fall 2014.

### **Objective 3: Apply Results at the Watershed**

After getting results in the lab that satisfactorily meet the goal of killing the kudzu vine with minimal environmental effects, the same method will be applied at the watershed on a larger scale. This is an important part of the experimentation process because the team does not have the proper equipment to regulate the physical conditions similar to Kudzu's natural environment. In order to run the experiment, the team has collaborated with Trees Atlanta, an organization that aims to protect and preserve the green space in the Metro Atlanta region. This collaboration has enabled Clever Kudzu Crew to acquire a place at the Watershed to test naturally growing kudzu upon successful completion of the lab tests. The watershed has areas of kudzu infestation, and the team has chosen one such plot to test the chemical. When successful results have been obtained in the lab, the same procedure will be used to test its effectiveness in eradicating kudzu in its natural habitat. The results will provide another layer of legitimacy to our solution.

**Completion Criteria:** This objective will be accomplished when the experimental procedure works as well on the naturally occurring kudzu as it does with the lab-grown kudzu.

**Status of Objective:** The team has not started working on this objective yet, as it is dependent on our lab experimentation. As soon as the team finishes lab testing (which is projected to conclude in the first half of Fall 2014), the team will begin working on this objective.

**Previous accomplishments:** Finding an injection method is the first step towards seeing if the proposed experimental procedure will work.

**Future work:** Before the team can approach this objective, it needs to find an injection method that works and test it in the lab.

**Plan:** The team does not have a plan to complete this objective yet, as it is far into the future. Objectives 1 and 2 need to be successfully completed before the team can go on to completing this last objective.

### **How has the project changed over time?**

When determining a solution that will help eradicate kudzu, the group thought it would be necessary to first find and track the roots growing underground using ground penetrating radar. During the beginning of the Spring semester, the team decided that finding the right equipment and location to test this was going to be too difficult to do while running chemical experiments. Therefore, the tracking objective was removed. Throughout the Spring semester, the logistics of obtaining lab space repeatedly delayed the project. When the team finally obtained the space and approval to conduct the experiment, the team found that kudzu in its present state does not retain solution injected into it. Considering that Kudzu was still coming out of dormancy during the months of March and April, the team has decided to break up Objective 1 to solving the injection problem during the summer and performing the actual experiment in the early fall. Unforeseen problems in logistics and experimental methods led the team to modify its solution.

### **Future Steps**

The team is following its plan of finding the most effective injection method. The team hopes to find this during the summer so that it can resume with the experimental portion of the project upon returning to school. If the team finds out that the method is more effective than the usual spraying method of killing kudzu, then the injection method will be tested at the watershed. One of the biggest obstacles in performing the second objective will be the weather. Kudzu grows only in the warmer months of June to August, so the team will be unable to test at the watershed if the lab experimentation is not finished on time.

As of right now, the team has not determined any future partners or collaborators. If the proposed method is effective, the team plans on determining the chemical impact on the soil by doing tests using resources at University of Georgia. The team has some connections with their Agricultural department for determining the chemical content on the soil after the kudzu has died. Other than the soil testing, the team has no other future plans with the project.

### **Sources**

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