IPRO 334-The Inflatable Greenhouse

Goal: The purpose of the Inflatable Greenhouse IPRO was to design an air supported structure that was cheaper than the current greenhouse solution. The structural support of current greenhouses creates shadows that prevent an even sunlight exposure for the plants. The other issues we investigated were the cost, size, thermal control, and pest control of current greenhouse designs. The majority of the cost for a traditional greenhouse goes towards the structural support therefore an air supported structure should be significantly cheaper. The basic greenhouse design is oriented towards human occupants and is subsequently quite large. If the greenhouse was instead designed to house the plants already in the ground, just for the months that they needed shelter to grow, the cut back in size would also greatly affect the cost. We also looked into the thermal qualities of greenhouses. The very nature of a greenhouse absorbs and traps the light and heat of the sun. Without a cooling system a greenhouse can overheat and harm the plants within it. The other problem we found with current greenhouses was the pest control solution. Most greenhouses use strong chemicals that require special training for use and safety. Even the "organic" solutions use natural chemicals in concentrations considered toxic. Our goal was to design a greenhouse that would address each of these issues with a cheap and practical solution.

Organization and Accomplishments: In order to investigate all of the elements of this problem, we divided as follows to determine the design solution for our greenhouse.

Structure: The structure team determined the actual design of the greenhouse and the materials used to create it. We used a polyethylene film as it is the most widely used greenhouse covering and is fairly economical. Once two sheets were ironed together and inflated, we had an air mattress type wall that created the basic greenhouse structure. Our greenhouse is not designed for people to work inside. The actual structure would only be about 3 feet tall. These tunnels would house the plants at ground level for a few months to jump start their growing season when the weather outside is too harsh for them to survive. Because there isn't a metal or wood structure, the whole system could easily be removed when the weather permitted.

Thermal Analysis: The thermal analysis team investigated the wavelengths of light required for photosynthesis and the possibilities of blocking those not required to cut back on the absorbed heat by the greenhouse. We are still investigating solutions of painting or spraying a coating onto the greenhouse or using a plastic film that will block those extra wavelengths and thereby ease the cooling needs.

Pest Control: The pest control group investigated the oxygen and carbon dioxide requirements for both plants and animals. We determined and proved that if the oxygen in the greenhouse was lessened or eliminated for a period of time, insects would not be able to survive, but there would be no harm to the plants. Because the greenhouse is designed only for plants, and does not have to provide an environment for people, there is not a safety issue with removing the oxygen. This effectively creates a completely organic pest control without the use of any hazardous chemicals.

Enpro: The final group provided cost analysis for the entire project. There is about an 80% decrease in cost for our greenhouse solution compared to the current designs. We save money by not having a rigid structure. There are energy savings with the smaller tunnels and thermal blocking. We also do not have to buy expensive chemicals or train personnel to use them with our pest control solution.

Team:

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