I want to ask you guys to imagine something. What if? What if we lived in a world where humans depended on a single vegetable in order to survive, where a balanced diet didn't exist and we needed no need for the consumption of water? Imagine a world that single handedly depended on lettuce to feed and keep alive over the seven billion humans on the planet. It might be possible, given the value of lettuce production in Australia was valued at 43,000 US dollars, according to Subbaro in 1998.

Now, what if I told you that up to 75% of that lettuce can be lost annually due to lettuce drop, a disease that kills the vegetable? With these statistics, it comes as no surprise that the problem of lettuce drop is one that is urgent towards the industries that depend on the consumption of lettuce.

Today I aim to share and discuss my research and findings that have been completed to take the steps towards the prevention of lettuce drop. My presentation will briefly outline the cause of lettuce drop and possible preventers of the disease, while also discussing interesting research which I have gathered. I hope to inspire you with information about a topic that lacks representation.

Personally, I had no idea this was a thing until I sought it out for my extend investigation journey, and I think it's important that we are aware of the threats surrounding the food we commonly consume. And hopefully my research and presentation today will fulfill both of these goals.

But first onto my question. Is store bought Eco Fungicide a more effective protective fungus than arbuscular mycorrhizae when protecting Lactuca Sativa from Sclerotinia Sclerotiorum? This is quite daunting to view, so here's a simplified version. Is common beneficial fungus number one a more effective protective fungus than common beneficial fungus number two when protecting lettuce from Lettuce Drop causing fungus? It's as simple as that.

First, what is Lettuce Drop? As I established, Lettuce Drop is a disease that kills the lettuce vegetable and is caused by the pathogenic fungus Sclerotinia Minor and Sclerotinia Sclerotiorum. Both will be referred to as S.Minor and S.Sclerotiorum for convenience purposes. Both fungi are a part of the Sclerotinia genus, which is a genius of fungi in the Sclerotiniaceae family. Vigorous research conducted into the disease by [inaudible 00:02:44] in 2006 and Adams and Tate in 1975 have proven that the two mentioned species are responsible for Lettuce Drop. However, interestingly enough, the two species have varying impacts and infection methods on lettuce.

S.Sclerotiorum is known to affect more sporadically and harm lettuce closer to harvest age, while S.Minor can be more prevalent in fields, which is later explained by a study done by Howe and his team in 2005 deducing that the fungi's growth varied depending on the temperature of the soil which affected the rate of germination.

It's important to note that a number of studies have discovered that the Sclerotinia species has a proficiency in spreading through germination, and by the spread of Sclerotinia infected seeds. Both fungi can be seen as important perpetrators to the disease, however, my study focused on S.Sclerotiorum since I noticed that most articles utilize that specific pathogenic fungus. During my research, I also noticed that there was a lack of effort to state why S.Sclerotiorum is favored in research, which suggests that further research can be completed into the differing fungi, which may inform us more in the problem. But overall, we have an understanding of what causes Lettuce Drop and the severity of the issue.

This led me to look at possible remedies. So as you can tell, the possibility of eradicating the pathogenic fungus is far from zero. In fact, the control agent of Methyl Bromide and steam sterilization was researched by both Ristaino and Thomas in 1997 and Merriman in 1976, and was found to be successful.

Why don't we use this method and save these farmers from a distressing and expensive problem? Well, chemical gases have been recognized as extremely harmful for the climate, especially during our climate crisis.

In fact, it is so bad that these gases has been phased out by the United States unless for critical reason. I had the idea of using biocontrol agents as a predator of the fungus, but clearly I wasn't the first to think this. I found articles dating back to the late 1970s utilizing this idea, which then placed me on a track to search for articles with the same principle. Research was done into pH and temperature and how that can affect the fungus, and I found that these changes are only somewhat effective when they are drastic, a change that will never be met realistically in a farm.

The next thing I looked at was Coniothyrium minitans, which frequently came up as a possible biocontrol method as a significant number of articles showed that it's effective at degrading the pathogen within soil. However, this was proven to only work in chemically controlled regimes and when massive Sclerotinia species was low.

This leaves us with arbuscular mycorrhizal fungus, which will be abbreviated to AMF and the store bought Eco Fungicide. A significant number of research showed that AMF has a histological examination to show that it impedes the growth of pathogens, with older research papers suggesting the fungus as a possible biocontrol agent.

This is likewise for the store bought fungicide as research showed that fungicide contains microorganisms, specialized fungi, and bacteria used to control pathogenic growth. Keep in mind that this is quite universal though, and it's not specific to the Sclerotinia species. It's important to note that apart from the research which consistently suggested these two fungi as a control agent for the pathogenic fungi, these two fungi also fulfilled my goal of being readily available to the public, as the Eco Fungicide was bought from Bunnings and the AMF is easily accessible online.

This leads me onto my experiment. At this stage within my journey, I had two possible remedies towards the problem, and in order to examine which remedy would inhibit the growth of the pathogenic fungus best, it was obvious that an experiment would provide me with clear empirical data. This also lined up with the chosen research method of papers tackling a similar issue. The experiment was narrowed down to one that involved the usage of agar plates, which was inspired by a study conducted by Rahman and his team in 2009, researching a similar issue but with different fungi. A problem I encountered was the unavailability of the Sclerotinia Sclerotiorum species. It's a wild fungus, thus it is hard to obtain and it wasn't available to me, a high school student. After being informed a research completed by Atallah & Yassin in 2020, the fungus was substituted for Aspergillus niger, which is a fungus I could attain that had similar properties to S.Sclerotiorum. And finally, as a result of the extensive literature available, I hypothesized that AMF would perform better in this experiment.

And to give you a brief overview of my experiment, six agar plates were prepared. Three were used with the other three used to replicate the experiment. One was used as the control variable and was contaminated with Aspergillus niger contaminated paper disc, which was placed on the left margin of the plate. The other two agar plates followed a same principle, putting the Aspergillus niger contaminated disc on the left margin, but then on the right margin of the agar plate was the antagonist fungi, so either the Eco Fungicide or the arbuscular mycorrhizal fungi, AMF.

This leads us on to my results. As we can see in both trials one and two, the Eco Fungicide failed to impede the growth of the pathogenic fungus. Whereas for the AMF, it was successful in both trials with slight variation, with 40% of inhibition of radial growth of the Aspergillus niger in trial one, and 20% inhibition in trial two. And the yellow tint referred to within the results table is what was observed on the control agar plates in which we saw the clear agar jelly gain a yellow tint exposing a degree of contamination by the Aspergillus niger. And as you can see, there's 40% of inhibition over there. That's from trial one and trial two to your right, 20% inhibition.

With these results, this led me on to future research. My results satisfied my hypothesis. It showed AMF to be successful in both trials in impeding the growth of a pathogenic fungus. It also clearly proved the previous idea that the broadness of the store bought Eco Fungicide may be the reason as to why it was ineffective in impeding the growth of the Aspergillus niger. I'd like to say that my research adds another depth to the beneficiary qualities of AMF and can hopefully be applied to future research to inspire a permanent solution.

The problem of Lettuce Drop is no doubt a significant one, one that causes trouble and disturbance for farmers all over Australia and worldwide. Because the problem of Lettuce Drop is intrusive and common, I wanted to obtain data that would help create a solution available for the general public, wanting to equip home gardeners and farmers alike.

What further steps can we take now? Well, first I would like to acknowledge the occurrence of random error that may have taken place during my experiment. In reality, three, four, five, maybe even six trials would've been desirable, but because of restrictions on time, this was not feasible to me. As a solution to these restrictions on time, and as a way of taking the first steps to branch off of my research, I completed further research into AMF and its effects on vegetation. My research showed that even outside lettuce Drop AMF is viewed as a powerful tool for the agriculture industry. With research completed by [inaudible 00:09:51] and his team in 2015, showing AMF isn't only capable of fighting off pathogenic fungi, but also capable of improving the overall quality of the vegetable.

Perhaps most applicable to my research, [inaudible 00:10:02] also found that the efficiency of AMF inoculation varied depending on environmental conditions, biotic interactions, and genotype combinations, which may be used to explain the difference in results between the two conducted trials. I sought out to help the agriculture industry by deepening the research into Lettuce Drop and its possible remedies. And I hope that my findings on the efficiency of AMF within the Lettuce Drop research field will aid future research into the disease and maybe one day become a contributor to a permanent solution itself. Thank you.