Simulating the Effects of a Trunk Shaker on An Almond Tree Trunk to Determine the Cause of Ceratocystis Canker

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Introduction

The process of almond harvesting with a trunk shaker have been utilized for their efficiency but a problem that has been presented is the damage the trunk shaker causes on the almond tree bark. When the trunk shaker damages the almond tree trunk it leads to the cause of a Ceratocystis Canker. The canker eventually causes the almond tree to die out from its disease. In this study, a simulation is being constructed to determine the amount of displacement that is cause from the trunk shaker that leads to the production of a Ceratocystis Canker. As well as the relation amount of force and stress that correlates with the displacement so we can optimize the trunk shaker to prevent damage to the almond tree bark..

Background

Trunk Shaker: A mechanical device used for harvesting from trees such as almonds by applying a shaking force on the trunk. A clamping mechanism attaches to the trunk of an almond tree and applies a shaking force allowing for the almonds to drop from the tree (fig. 1A)

Ceratocystis Canker: A disease that occurs in trees when their surface, such as the bark, is damaged in this case from a trunk shaker. It is an open wound that eventually results in a canker making it prone to disease from bacteria such as Ceratocystis (fig. 1B).

(A) **(B)**

Figure 1: A) Trunk Shaker B) Ceratocystis disease on an almond tree

Methods

To replicate the trunk shaker on the almond tree a simulation had to be built. The simulation process was based on the simulation study from Fridley, R. B., et al. The 3D model of the almond tree trunk was built in Solidworks. The model itself had to have the mechanical properties inputted in order to accurately build the almond tree trunk. The properties had to be calculated based off the information present from other articles that presented the strength properties of the almond tree. As for the dimensions of the model, the average trunk diameter is around 12 inches and 48 inches (4 ft) for the height since we were only looking at the trunk. After having the model ready, the model would be inputted into ANSYS, where the simulation was going to be run. For the simulation, a harmonic response analysis was utilized to try and determine the amount of displacement based on the amount of frequency.

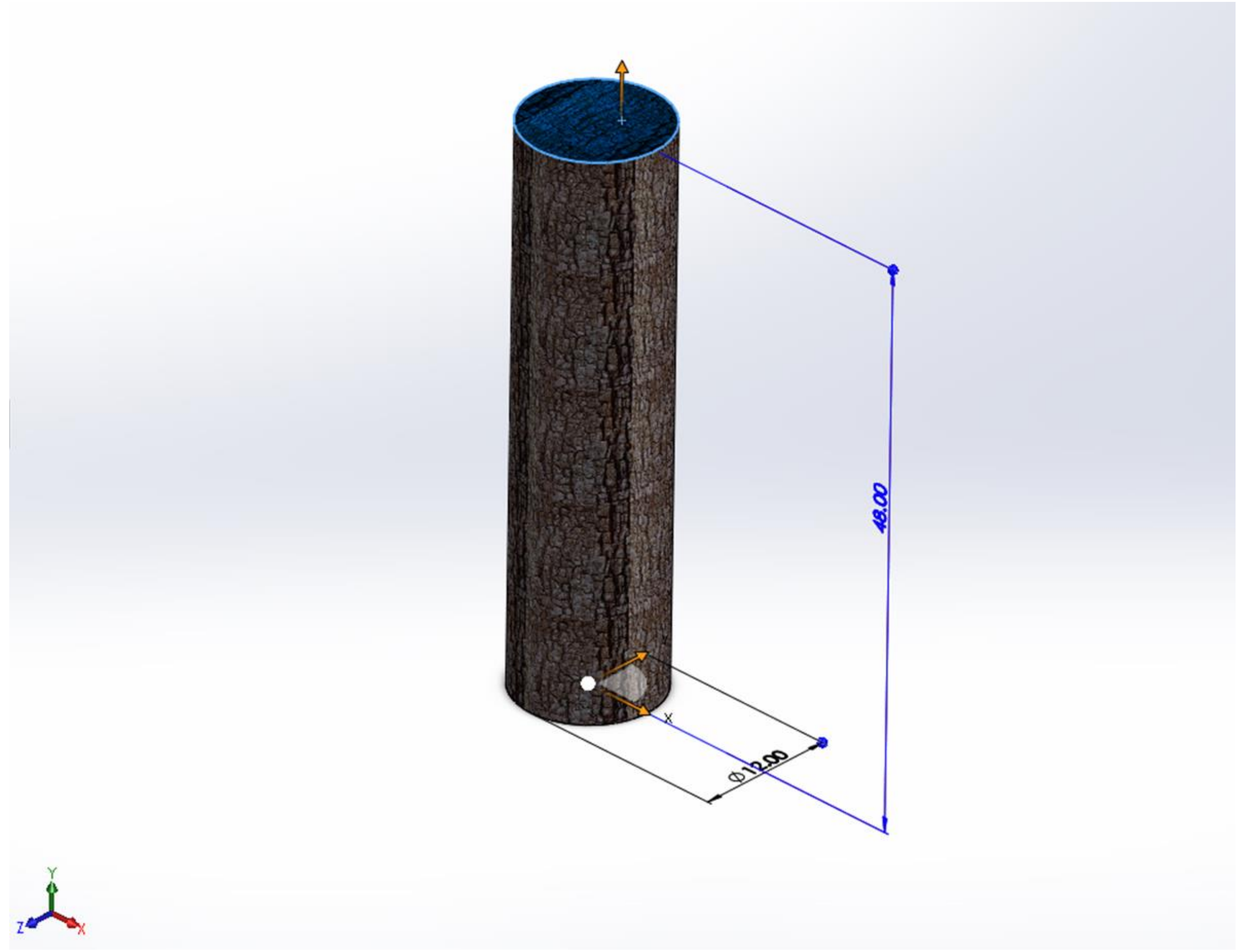

Figure 2: Solidworks 3D model of almond tree trunk (dimensions: inches)

Results/Discussion

The results at this time could not be obtain do to insufficient and inaccurate information to run an efficient simulation that would provide the desired results. What we would have liked to see was the amount of displacement from the bark to the rest of the trunk more specifically the cambial zone. The range of displacement we expect to replicate is between 4 to 6 mm (0.16 to 0.24 in) but the issue is determining the amount of force required to run the simulation accordingly. Once being able to determine the displacement associated to the force, we would be able to run the simulation to determine the stresses in the cambial zone.

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Conclusion

Due to the limitations from COVID-19, a virtual simulation and study was required to be conducted for the trunk shaker simulation. Moving forward, possible in lab tests could be ran to find more accurate material properties for the almond tree trunk model since the study from Fridley, R. B., et al. they were able to collect specimen samples and determine its physical properties more accurately. Once perfecting the model, we could move forward with the simulation and get the results we are looking for.

References

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