Colonel Corn: Developing a Maize Seed Singulation for Use in a Robotic Planter

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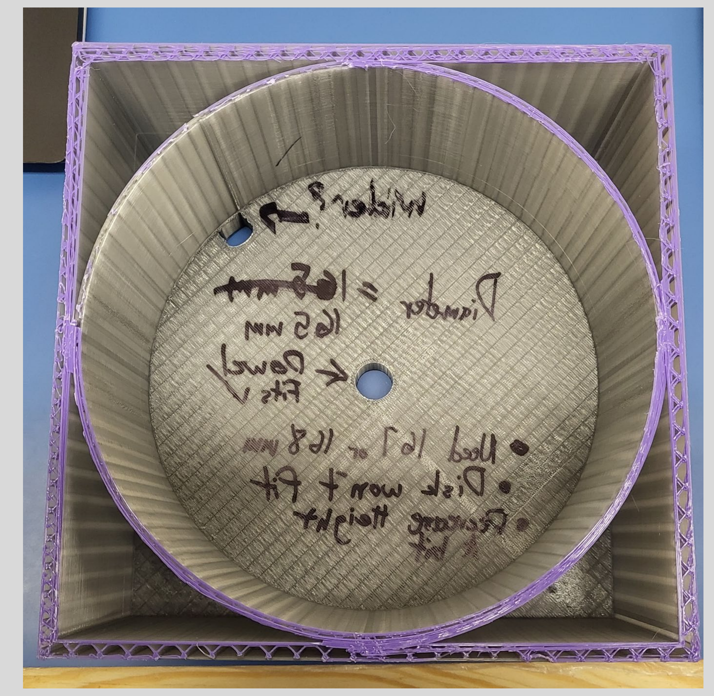
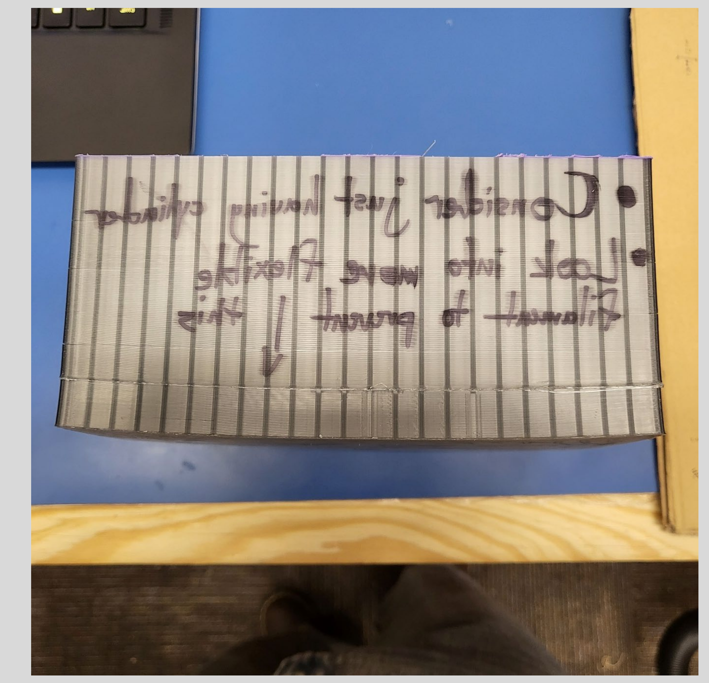
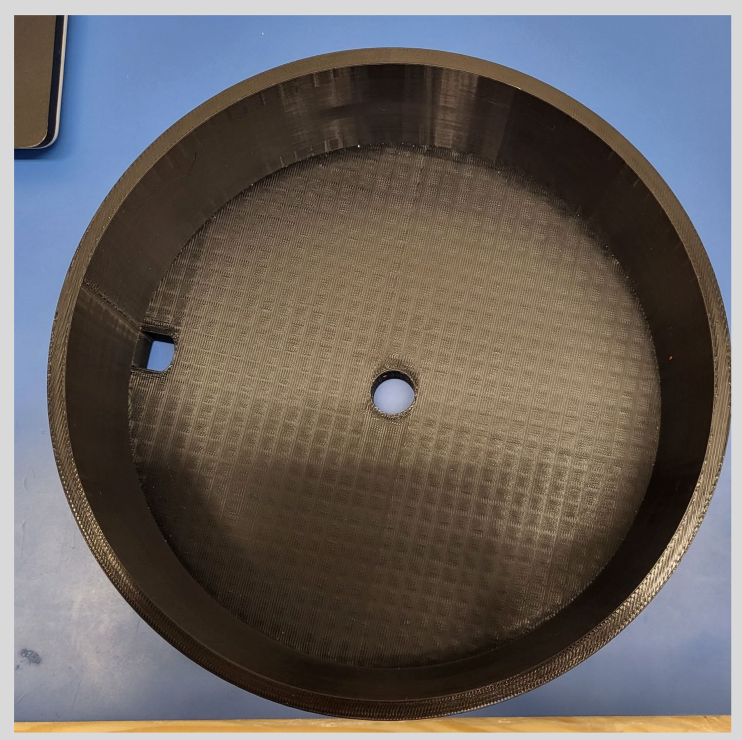
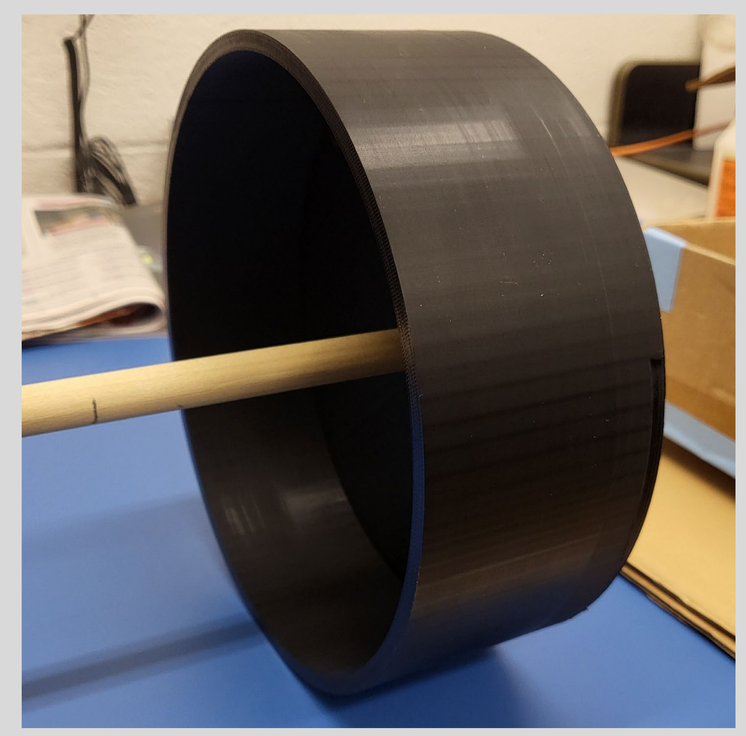
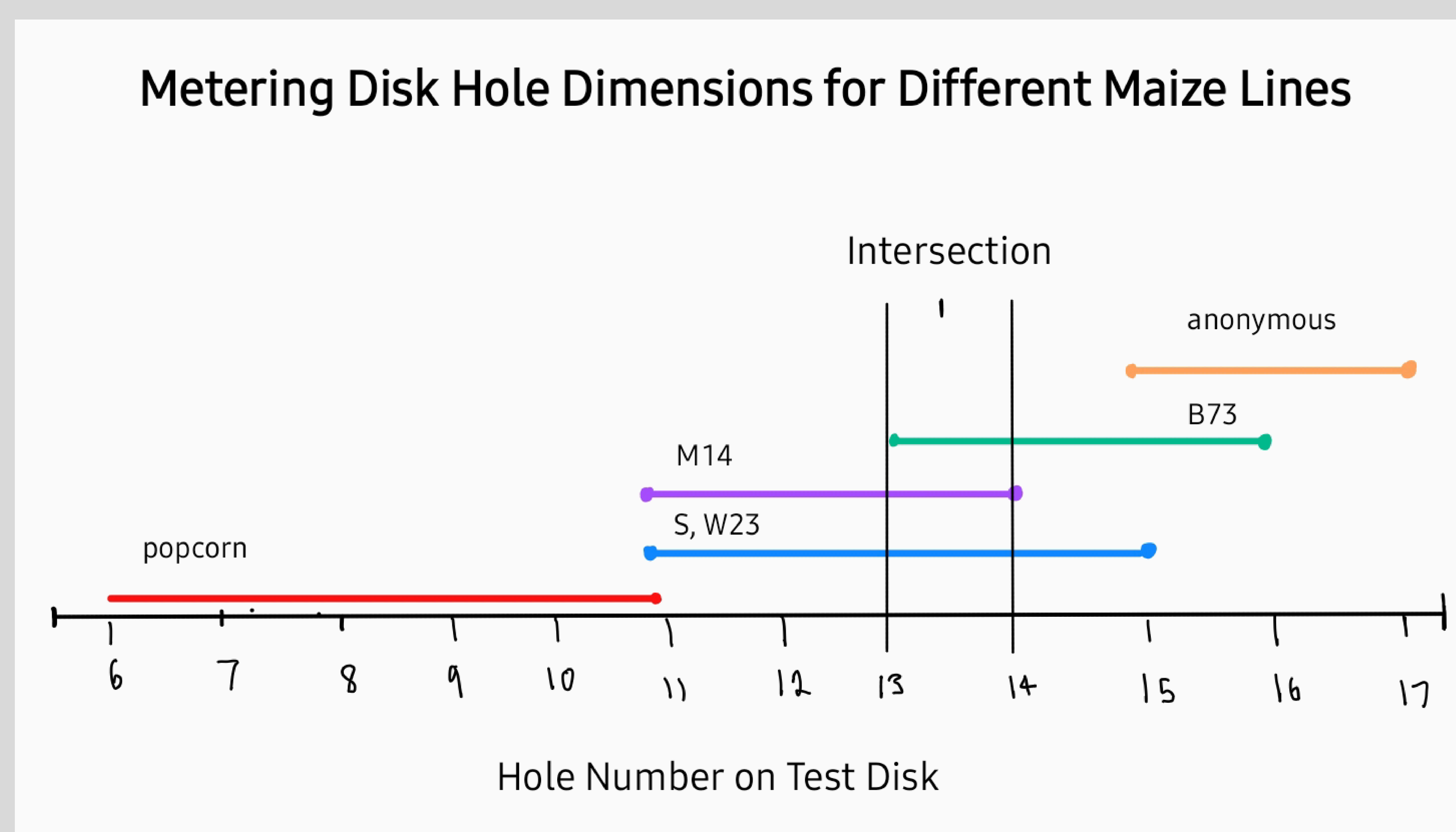
Abstract

The goal of this research is to build a robotic planter that can plant genetically different maize lines in a field. To do this, seed packed in packets must be singulated so that the kernels are planted with defined, consistent spacing and that all the seed in a packet is planted. The goal is to plant at least 95% of the seed in each packet in its row at a specified spacing with no carry-over of seed from row to row.

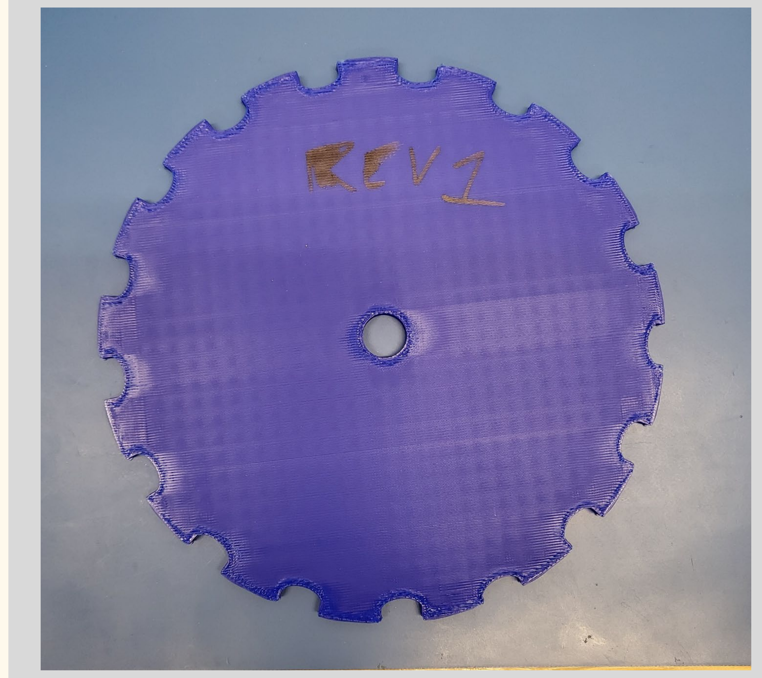
To improve the efficiency of singulation, I am experimenting with different singulation designs by using various materials to prototype the mechanism itself. The first prototype I created I fabricated out of cardboard because it was easy to manipulate, allowing me to quickly translate the concept from my mind into a tangible model for initial testing and validation. After observing some success with the cardboard prototype, I transitioned to using CAD to refine the design and fabricate it with 3D printing, enabling me to produce multiple iterations of the metering disk and the main chamber of the singulation mechanism for more precise testing and optimization.

Design and Experiment Results

- The first prototype included the main chamber and an adjustable component to vary the angle for singulation. Later designs improved fabrication precision using CAD, reduced 3D printing time, and lowered the print's overall weight.
- The test disk, with varied hole dimensions, identified the best hole size for achieving one kernel per hole. Each number on the graph represented the dimensions for the corresponding hole on the disk.
- Holes 13 and 14 performed best for the most common maize lines.




The metering disk dimensions were revised to ensure proper fit in the singulation mechanism and to guarantee each hole holds one kernel, avoiding multiple kernels per hole. The "test disk" was created with varying hole sizes to determine the optimal dimensions for effective singulation.

Conclusion and Next Steps

- The angle of the main chamber is important for planting as it ensures seeds pool at the bottom, preventing skidding between the disk and kernels. It also relies on gravity to dislodge excess kernels when two occupy the same hole.
- The metering disk's speed also plays a key role in achieving effective singulation.
- An object, for example a brush, can also be used to dislodge excess kernels early in the disk's rotation.

Next steps involve

- Modifications to the current planter including, improve its drivability, power, and ease of use.
- Printing the remaining parts of the seeding mechanism.
- Experiment with the planter out in the field to see how it handles the outdoor conditions.