SENIOR CAPSTONE/
SENIOR DESIGN EXPERIENCE
2024

Planter Row Unit Downforce

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Executive Summary

Row crop farmers face the challenges of consistent seeding depth when planting in inconsistent field conditions. Optimal crop emergence improves the potential for higher yields. Implementing affordable supplemental control to row units with pneumatic downforce systems, helps farmers generate sizeable ROIs. Testing revealed stiffer settings of an adjustable shock lessened the impact of disturbances on row units.

Research & Context

Pneumatic downforce systems are not typically as responsive as hydraulic systems. Upgrading to a hydraulic system is expensive.

Research by Golden Harvest showed that corn yielded 15% less when delayed by 2 days.

Researching magnetic, hydraulic, and pneumatic shocks showed that pneumatic shocks proved to be the best option.

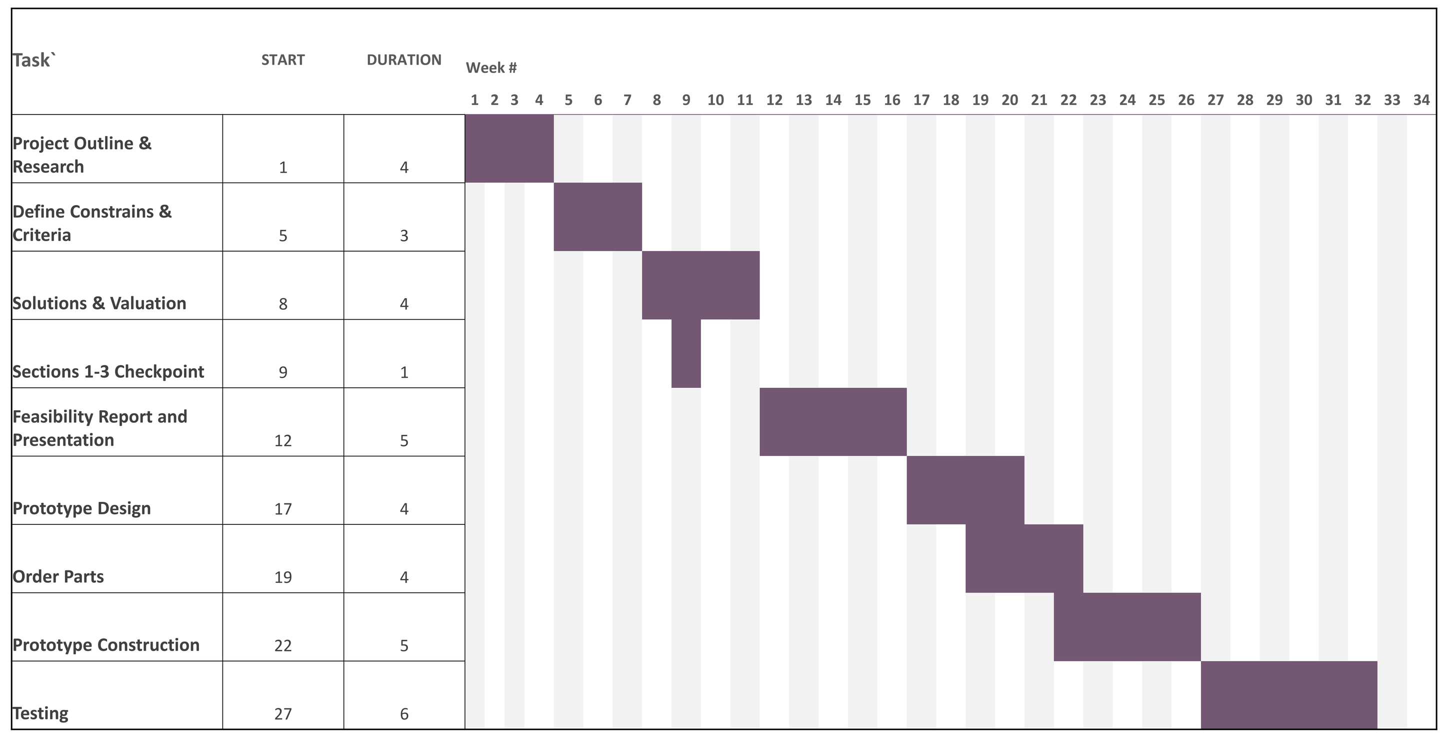

Figure 1. Gannt Chart Project Timeline

Characteristics & Limits

Constraints	Criteria
• $250 per row max cost • Adaptable to row units • Decrease settling times • Down pressure is unaffected	• Durable • Cost-Effective • Serviceable • Dampening ability

Deliverables

- Set of drawings and parts list
- Operational Prototype
- Graphically represented data results
- Feasibility Report

Solution Ideas & Selection

	Cost	Weight	Durability	Serviceability	Performance	Total
Weighted Score	0.3	0.05	0.2	0.15	0.3	1
Magnetic	2	6	8	6	9	6.1
Hydraulic Shock	5	7	7	8	7	6.55
Pneumatic	6	7	7	8	8	7.15
Springs	7	9	8	9	2	6.1

Table 1. Design Matrix for Proposed Solutions

Value Proposition

Farmers can become more efficient by reducing inputs, plating faster, and increased yields. This is accomplished through improved emergence and consistence seeding depth. Value on the whole is gained by decreasing oscillation times and creating higher yields without incurring large upgrade costs. ROI's dependent on price of grain, size of planter, and estimated improved yield which can range from $1.54 up to $4.63.

Design & Development

Figure 2. Final Prototype Design

Mounted Kinzie row unit on John Deere 7000 planter. The JD planter was modified to be 2 row and have a shorter tongue. Brackets were created to mount a pneumatic John Deere airbag and shock absorber to the row unit. A new adjustable shock absorber replaced the previous iteration's shock absorber.

Testing, Feedback, & Impact

Control (No Shock)		Previous Shock		New Shock (Setting 1)		New Shock (Setting 5)		New Shock (Setting 9)	
1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
0.4905	0.6007	0.5006	0.3402	0.5006	0.3402	0.3921	0.3503	0.3395	0.2652
0.4795	0.4902	0.4504	0.3902	0.4404	0.3302	0.3609	0.3504	0.3500	0.3506
		0.4005	0.3403	0.3504	0.3404	0.4722	0.4105	0.3508	0.4005
0.4850	0.5455	0.4505	0.3569	0.4305	0.3369	0.4084	0.3704	0.3467	0.3388

Table 2. Settling Times and Averages from Testing

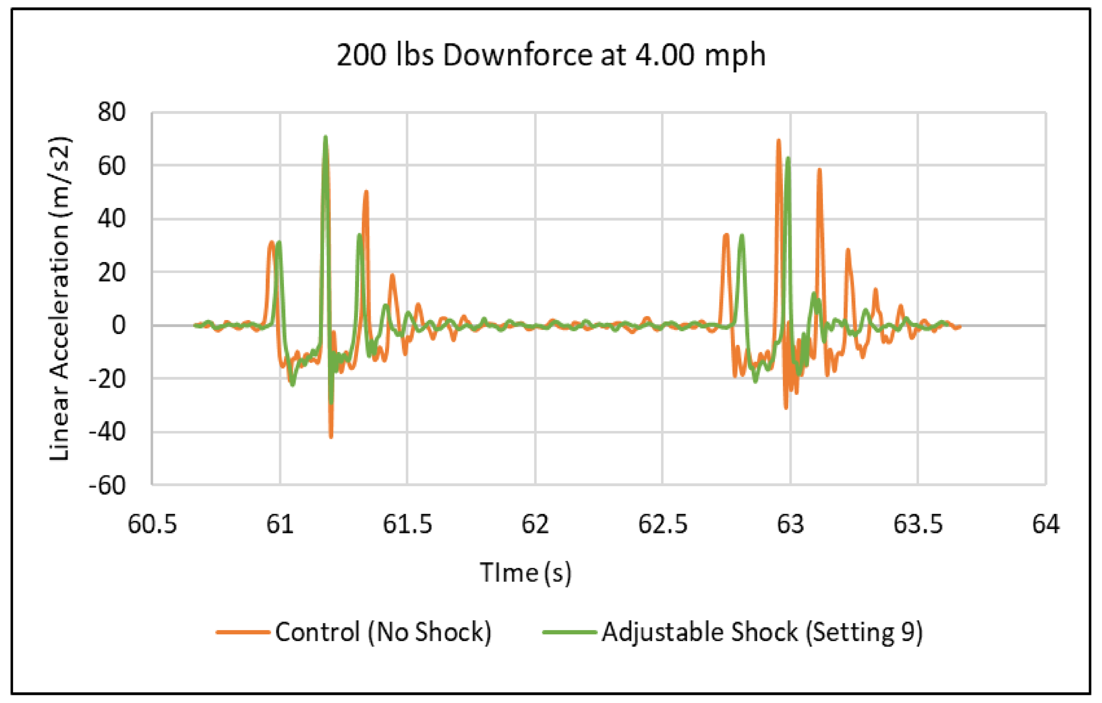

Figure 3. Results of Control and Adjustable Shock

Conclusion

Field testing is the next step forward for this project. Collecting data on the average number of disturbance per field and seed depth should be next. The project is easily adaptable to almost any planter which could allow farmers to trial this project as well.

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