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Grain Cart Compaction Impact

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Grain Cart Compaction Impact

Problem Statement

- Many factors influence the yield. Harvest is a busy time, and often there is not clear direction or guidance on where to drive or not drive the Grain Cart or other heavy equipment. Path of travel is something that could be changed by educating operators and growers on the benefits and tools they can use.
- Traffic in the field has inconsistent patterns across the field to minimize time to and from the combine. It is not clear where to place the "path" to the loading area. The heavy axle loads when full can and do contribute to compaction. It is not clear the impacts of compaction from grain cart traffic through the field on a micro or macro level as it relates to yield. It is expected there would be some benefit from having a recommended more controlled path of travel in a given field. The combination of where the cart goes and does not go empty or full and the soil conditions contribute to soil health deterioration and yield drag.

Disciplines

Bioresource and Agricultural Engineering | Industrial Technology

IOWA STATE UNIVERSITY

Department of Agricultural and Biosystems Engineering (ABE)

TSM 416 Technology Capstone Project

Grain Cart Compaction Impact

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1 PROBLEM STATEMENT

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Business Case Statement -

A. Soil compaction caused by heavy machines and implements in the field has a negative effect on plant health, causing a reduction in yield.
B. This is a worldwide issue with farms that use heavy farm equipment and large implements.
C. Grain carts carry lots of weight and compact the soil and affect the plants in and around the tire track.
D. Compaction causes yield loss, which then creates a loss of profits. By tracking compaction, we can begin to manage it and make more educated decisions on a specific field level.
E. Any farmer will be concerned about the effects of compaction, and simple to use cost-effective system to track compaction will help them to understand compaction impacts, make decisions and increase their margin per acre.

2 GOAL STATEMENT

1. From a set of documented data, identify paths of grain cart traffic through the field and # of passes through the field crossing the same paths. Show visual for comparison. Use secondary identifying information to infer if grain cart is loaded or unloaded. Best practices to measure actual compaction that are practical and efficient enough for a farmer to use on their operation.

2. Correlated example from 1 grower and one field. Propose logic to correlate grain cart and tractor traffic and generate R^2 for traffic areas where loaded and where compaction occurred affecting yield at harvest.

- **Main Objective(s) and Specific Objectives**
  - The main objective of this project is to find a way in which producers can begin making strides on being able to not only track and monitor the weight of the grain cart but to make agronomic based decisions from the collected data.

Specific objectives include:

- Project plan analysis of compaction from traffic and impact on the yield on single field analysis and also statistically valid sample size.
- Methods for gathering customer data in a way that is consistent with both ISU and John Deere data policies.
- Hypothesis for the model of grain cart path/plan to minimize effects on compaction with minimal impact on harvest efficiency.
- Recommendation for growers on how to communicate and minimize traffic in areas they want to keep grain cart out of using existing

- **Rationale**
  - Our Client will have the option to coordinate traffic routes while operating a tractor with the grain cart
  - Reduce/minimize the negative impact of uncontrolled overlapping grain cart traffic which results in lower yields
- **Project Scope**

- Our boundaries included a short period of time where testing was possible
- Permission to test on client's land and access to scalable data
- Most variables are too time-consuming or impossible to quantify
- Implementation of more technology and load sensing capabilities would generate more usable data

3 PROJECT PLAN/OUTLINE

A. Methods/Approach

- **Data collection**:
  - Access to the client's field and data by Garner, IA
  - Calculated different ground pressure points of grain cart tracks, ground that was not affected by grain cart activity, and areas of highly compacted traffic with a penetrometer averaging a 50 psi difference according to our data
- **Skills**:
  - Determine which variables contribute most to compaction and how to integrate an efficient traffic system
  - TSM 330, TSM 433, John Deere Ops Center, and having agricultural backgrounds
- **Solutions**: Create a grain cart traffic map generated from tractor cab display, reduce overall coverage of traffic grain cart traffic.
  - The weight of the grain cart and its location will generate our traffic map.
  - Reduce overall coverage of grain cart traffic by setting AB lines to utilize controlled traffic through the field.
  - Reduce PSI in tires, only go in the field in proper soil conditions, reduce axle load to decrease the size of the footprint
- **Organization:** Our team met our sponsor at various locations and communicated through phone calls/emails
  - We separated tasks amongst ourselves during meetings
  - Major milestones were fall in-field testing, compaction research post-harvest, and spring data collection to make a recommendation for client
  - We adapted to group member changes and schedule changes

4 RESULTS

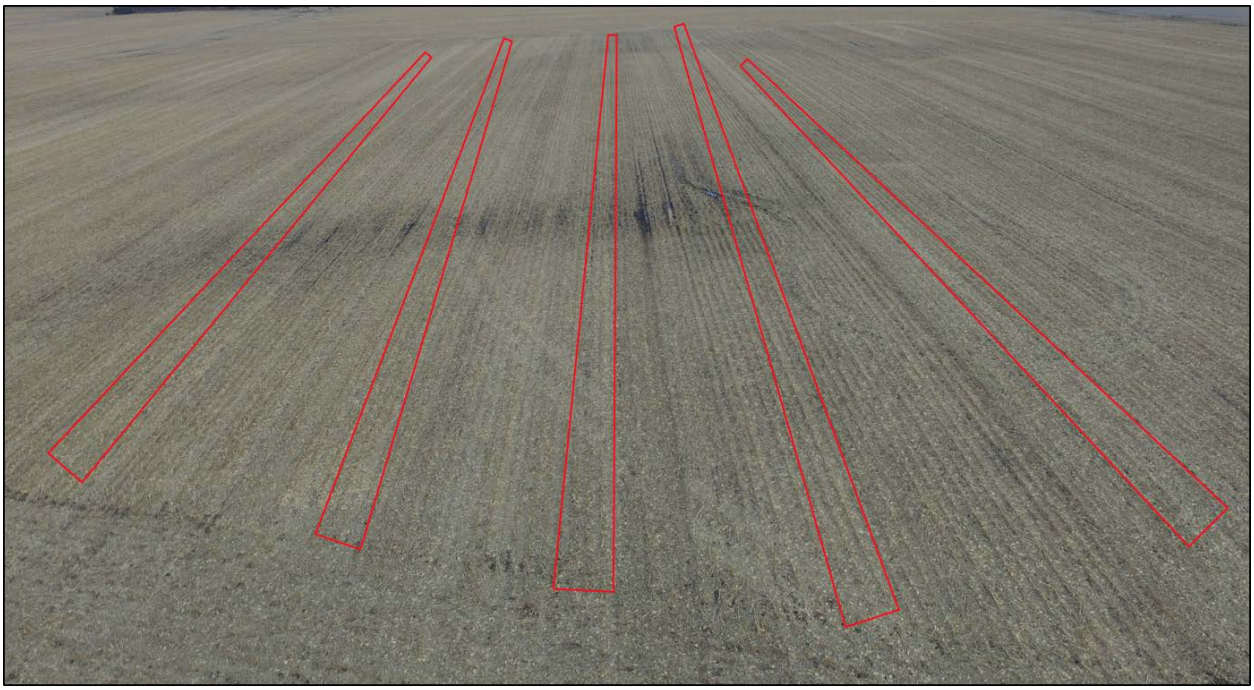
Results/Deliverables

- The proposed solution to track compaction specifically from the grain cart in the John Deere Operations Center
- The more data that can be collected on a specific field, more specific and well-informed decisions can be made by the producer
- Impact: From test data on clients field, 80.69 acres of 288.66 total acres were covered by grain cart traffic. That correlates to 28% of the field area. ISU Research dictates a 10%

reduction in yield loss from compaction. That equates to 18.75 bu/ac loss across the 80.69 acres x $3.50 corn results in a $5,295 loss for this field alone.

- Key recommendations include:
  - Operations Center interface for compatibility with scale data
  - Operations Center map that is color-coded based on tractor path and grain cart scale information
  - Weigh system that would be compatible with 2630/Gen 4 Deere displays
- Follow up steps:
  - It is recommended the project continue in order to study the impact of compaction on spring plant health. It will be beneficial for the project to follow a Spring-Fall capstone sequence in order to collect needed data.

5 GRAPHICAL ABSTRACT



6 REFERENCES

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