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Row Crop Headland Management Economic Opportunity: Applicator Pathway

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Problem Statement

Our Client, Bob Recker with Cedar Valley Innovation, presented us with a problem that most, if not all farmers are faced with when it comes to the time of year when they need to apply fertilizer or spray their crops with insecticides and fungicides. Secondary applications such as fertilizers and sprayers are coming into the field and running down or knocking over the crop. This has a negative economic impact in the headlands, specifically these run over crops and those around it. The negative economic impact can be addressed to decrease the chances of the crop being run over and in the long run increase yield, increase return on investments and stabilize soil conditions.

Disciplines

Bioresource and Agricultural Engineering | Industrial Technology

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TSM 416 Technology Capstone Project

Row Crop Headland Management Economic Opportunity: Applicator Pathway

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Client: Cedar Valley Innovation, 116 W Schrock Rd, Waterloo, IA 50701, http://cedarvalleyinnovation.com/

- Contact(s): Robert(Bob) Recker, Owner/Founder of Cedar Valley Innovation, cedarvalleyinnovation@gmail.com

1 PROBLEM STATEMENT

Problem Statement

- Our Client, Bob Recker with Cedar Valley Innovation, presented us with a problem that most, if not all farmers are faced with when it comes to the time of year when they need to apply fertilizer or spray their crops with insecticides and fungicides.
- Secondary applications such as fertilizers and sprayers are coming into the field and running down or knocking over the crop. This has a negative economic impact in the headlands, specifically these run over crops and those around it.

- The negative economic impact can be addressed to decrease the chances of the crop being run over and in the long run increase yield, increase return on investments and stabilize soil conditions.

Business Case Statement: Headlands, which are the end rows in a field, are a common area for machinery to turn around and start their next pass. When this area is planted, the crop is often run over or damaged by machinery such as sprayers and fertilizers. This damage causes the crop to yield below average if it will even be able to produce at all (Recker, 2017). This problem is common among all fields and farmers in the world. It makes strategic sense to address this problem and develop a better way to manage the headland area and reduce negative economic impact.

2 GOAL STATEMENT

A. Take advantage of recent planter technology development in precision control of seed placement to reduce the negative economic impact of headland traffic through the full season.

B. The improvements were measured in seed cost savings and yield improvements.
   - Yield average data was measured
   - The results that we expected to see back are profits in the headland area due to increased yields as compared to the damaged crop. Estimated seed savings and yield improvements are 5%
   - It was difficult to measure how much money is lost due to damaged crop and then make an estimate on how much money was saved because of planting technology

Main Objective(s) and Specific Objectives

- In order to solve this problem, we looked into using new planter technology to plant a path that machines can follow and not have to run over the planted crop. Using this technology, we can create a planting prescription for the planter to follow originally and then the secondary equipment can use the same map.

Rationale

- When reducing the amount of crop that is run over we improve yields, reduce negative economic impact, save on seed and improve the life of the crops as well as the soil conditions.

3 PROJECT PLAN/OUTLINE

A. Methods/Approach

- Our plan was to look at yield maps to calculate the amount of yield lost from running over headland rows, and the economic impact of the headlands being run over. First, we had to acquire yield data to see if we could find any difference in yield in places where the headland is run over. From there, we had to calculate the amount of corn run over and the loss of profit associated with it. We determined the amount of profit that is lost to headlands being run over. The way to remove the headlands being run over is to use precision planting technology to create paths for an applicator to drive in to eliminate crops being run over. The results that we are trying to achieve with this project are to be able to offer a solution to farmers who are trying to eliminate headland damage and to also show them the economic impact that it would have to use our solution.

B. Data collection:

- The data collection method used to analyze the feasibility of developing a method to create turn around rows in the headlands started with an excel file. Our team was given a basic excel file with some calculations to roughly estimate the economic impact of running down corn in the headlands with late season application. With this excel file, we expanded it to include more variables to get a more precise number. Based off of this file, we found that on the economic side there was not much of an impact to be shown. For example, within a 75 acre field that is close to Ames, Iowa, we found that a sprayer runs down roughly 0.3% of the crop in that field. Money amounts are based off of larger variables such as corn price per bushel, and yield. We assumed $3.31 per bushel corn, and 174.6 bushels per acre in the field, and only saw $132.86 total over the 75 acres of lost corn. This came out to be roughly 0.308% of the total revenue of the field. Also, as the field sizes increase, the percent of corn knocked down begins to shrink, causing the value of the corn knocked down in comparison to the entire field to also shrink.

- **Skills**: The ability to work with and understand SMS as well as other Precision Planting Technologies. This enabled our team to think in perspective as we can measure and correlate between systems. TSM 433, AGEDS 311, TSM 340, and TSM 115 were all classes that helped us gain confidence and the skill sets required for this project.

- **Solutions**: While we were not able to come up with a clear solution, we were able to identify some of the factors that will need to be taken into account in order for this to be a realistic possibility in the future. This was a similar outcome to the previous project from the same client where an intriguing idea of wide-spaced corn growing was analyzed with a limited set of data (Bane et al., 2017). In this project, we found that we do have the planter technology for this to be realistic, but we do not yet have the software to create a precise enough border on the planting prescription for the applicator to follow. Also, we found that the economic impact of implementing this project would be much more realistic for a larger scale farm that can afford the planter technology and the software whenever it may be available.

- **Organization:** Our team met with our client one time at the beginning of the year to sit down and have a presentation prepared by our client given to our group as well as two other groups that worked with CVI. We had several phone calls and video conferences with our client to discuss our group's progress as well as any setbacks that were encountered. Work each week was divided amongst members by collaborating on a weekly group report in order to achieve desired deliverables. Our major milestones were primarily research findings conducted by group members. Discovering that current technological requirements were not yet up to the standards of our needs for our project was a major breakthrough for our group as from that point we were able to move onto the next step of: What technology or what other advances need to be made in order for this to work?

B. Results/Deliverables

- Data and research showed that the economic impact of damaged corn is not substantial enough to justify the purpose. The purpose being: Integrating sprayer turn-around pathways in the headlands.
- Our project was fully completed. We investigated the economic impact, conducted research to determine if this is feasible and then went an extra step to find what is needed for this to work.
- Our key recommendation is that since such a small percentage of the field is affected by the sprayer turn around and our data shows that the dollar value per acre of damaged corn is minimal, while it might possess some benefit to the farmer it is not large enough to justify the purchase of precision planting machinery.

4 BROADER OPPORTUNITY STATEMENT

A. The average person who has no interest in agriculture would not be attracted or compelled to this project. An agriculture business/firm or a farmer is the primary audience for this project. This would appeal to them if meant less work, less labor, seed savings and shorter payoff time for the purchase of their precision planting equipment.
B. This project would not make a huge adjustment to any party but would certainly affect the primary audience. Making the process of planting, combining and field maintenance more accurate and in turn saving the farmer valuable money in today's economy is a thought to consider.
C. If the technology required for this project were to advance and become more precise it would affect any person or company that uses precision agriculture. This includes more than corn producers and could expand into other businesses.
D. Agriculture companies and farmers are the primary audience for this study and project. Since these are the two customers that would sell or use this technology.
E. Due to technology and spatial data limits were forced to determine that this idea is not applicable in today's market. With the advancement of technology and the precision that comes along with it, this idea could evolve into a success.
F. Similar studies have been done to investigate the opportunity of the financial impact that damaged corn has on yield.
G. We have knowledge that this project has been worked on prior to our discovery and it has potential to be something that is very sought after. Agriculture companies would greatly benefit from this and would encourage more research.

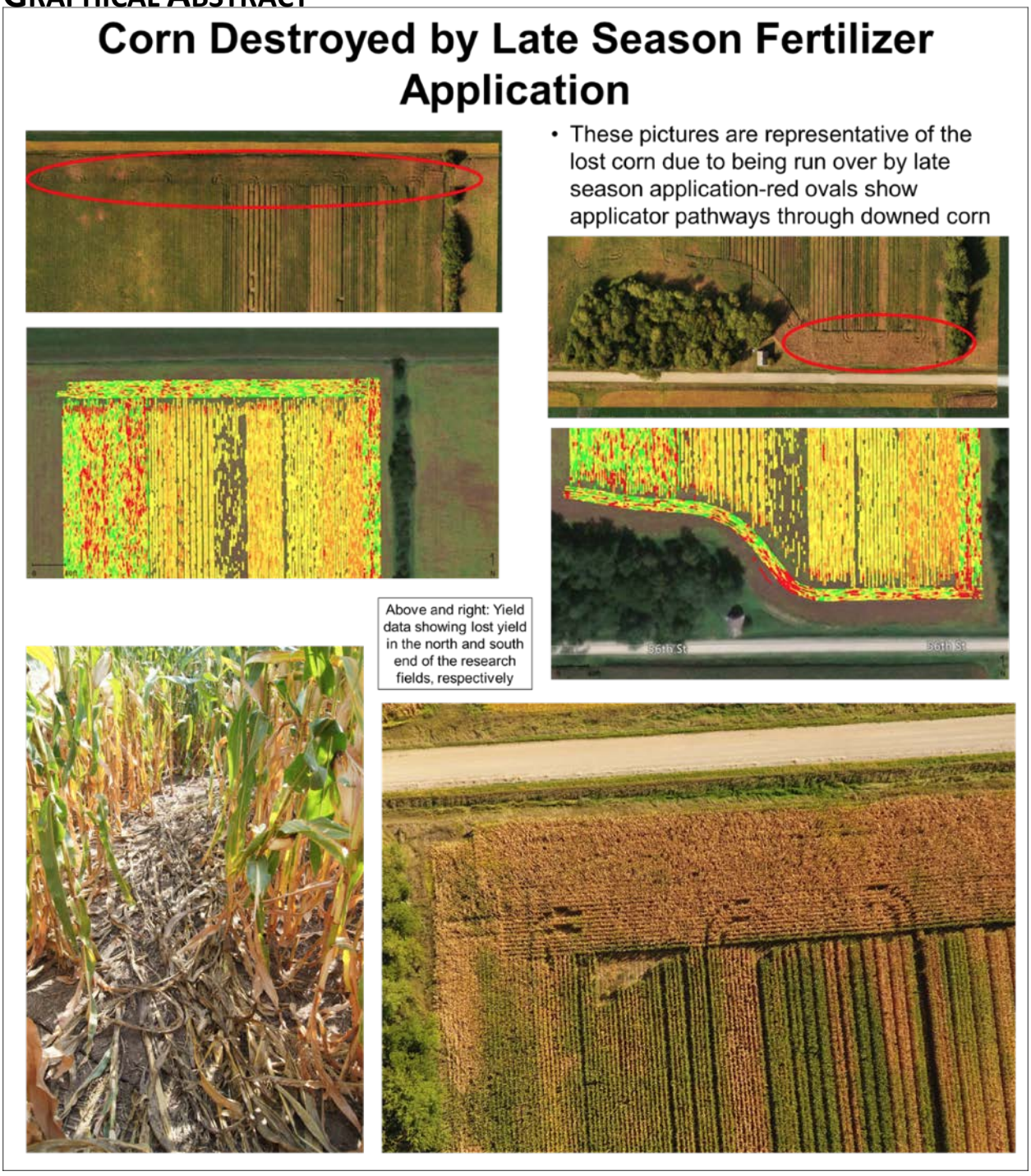
5 PROJECT SCOPE

The project scope was to research and develop a way to use precision planting software and technology to create paths in headlands for sprayers or other applicators so they don't run over crops in the headlands. We were also tasked with figuring out the economic impact of implementing our process. We were given yield maps from the client to show the yield impact of running over crops in the headland, and from those we also can calculate the economic impact of the project. Our largest constraint was the accuracy we can receive from precision planting software. With this limiting factor, other options can not be defined. We have discussed the benefit that this accuracy will portray, if it progresses as we think, within the next ten to fifteen years.

- **What is needed for Headland Pathway success**
    - Higher precision capabilities with SMS, Ag Leader and other precision agriculture manufactured software
    - More significant impact of damaged corn in the headlands

- Making this software and the precision agriculture equipment more affordable for the average farmer

6 GRAPHICAL ABSTRACT



Images come from: Bob Recker

7 REFERENCES

- Chandler Bane, Mitchell Hora, Gabe Lorack, Nick Lane, Joseph R. Vanstrom and Jacek A. Koziel. Harvest the Sun, Build the Soil. Final Report. TSM 416 Technology Capstone Project, April 28, 2017.
- Robert Recker, Owner of Cedar Valley Innovation, Personal Communication, March 18, 2018.
- Chris Murphy, Precision Agriculture Program Coordinator in Agricultural & Biosystems Engineering, Personal Communication, February 23, 2018.
- Matt Darr, Professor in Agricultural & Biosystems Engineering, Personal Communication, February 23, 2018.

8 APPENDIXES

Original data from our client was used in order to calculate the percentage of corn that is knocked down in a field. Our Excel file uses this data from Bob with revisions and corrections that accurately portray the economic analysis of damaged corn in the headlands due to sprayer and secondary applicator turn arounds. Pictures and visual abstract come from Bob as well as from Dr. Matthew Darr (ABE) and Chris Murphy (ABE).