Optimization of Field Traffic Patterns using Precision Agriculture Technologies
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Cropping History
While PA technology adoption continues to increase, cropping patterns and machine management remain the same.
- Row orientation based on historical field management (habit)
- No evidence that row patterns are optimum in irregular shaped fields (maximize field capacity)

Objective of Study
Hypothesis:
An optimized path can be determined for an individual field, based on equipment size and the grower’s management strategy
Objective:
To develop an algorithm to determine the optimum field paths (AB lines) for a farmstead.

Farm Background
- Year 1: Farmer adopted RTK autoguidance
- Fields fairly flat
- Constraint: all rows had to be straight
- Adjust row patterns to improve field capacity?
- Are the patterns correct patterns?

Methods
- Rows were established when planting: optimizing planting patterns enable to optimize all the following operations
- Spatial Data
  - Field boundaries (shapefile)
  - Current AB lines
- ArcMap -> Spatial Component
- MS Excel -> Optimization
Final Analysis

Results divided into 3 Categories:

1. Long-narrow regular shaped fields (Intuitive AB line)
2. Irregular shaped field (slight change to existing AB line)
3. Irrigated fields (e.g. major change to existing AB line)

- Field boundaries eventually revised to equipment and Precision Ag. Technologies used at the farm.

Category 1
Regular Shaped Fields

- Intuitive to establish AB lines

Category 2
Irregular Shaped Fields

Required a slight change to existing AB line bearing

Optimization Routine

- Distance vs. time
- 3 Indices computed for each bearing:
  - Total number of turns (minimize)
  - Length of passes (maximize)
  - Total turning distance (minimize)
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Irrigated Fields

Planting patterns were always guided by the use of irrigation travelers and the location of valves along the field exterior.

Precision Ag technology enabled major changes to the planting strategy, greatly increasing field capacity.

Irrigation valves

Field

<table>
<thead>
<tr>
<th>Category</th>
<th>Field</th>
<th>AB Line</th>
<th>Original</th>
<th>Optimized</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4A</td>
<td>97°</td>
<td>104°</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>100°</td>
<td>165°</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4C</td>
<td>178°</td>
<td>77°</td>
<td>79°</td>
</tr>
</tbody>
</table>

Row clutches – generate no plant zones for alleyways

Summary

• Methodology is simple, quick and provided suitable results.
• Recommended AB lines were adopted in 2012 with success.
• Method can be expanded to other row patterns (curved paths) or other field characteristics (slopes or terraces)

Precision Agriculture: Crop Sensors

Precision Ag technologies simultaneously enhance production efficiency and environmental stewardship.