Planting Technologies for Uniform Emergence

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CORN SCHOOL – 2017

K-State Precision Ag

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- Many industry partners and producers

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Recent advances

- Precision Planting Technologies for seed placement
  - Seed spacing
    - Electric Seed Meters
      - Variable rate seeding
      - Turn Compensation
      - Multi-hybrid Planter
  - Seed depth
    - **Gauge wheel load uniformity?**
    - **Row to row variability?**

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Key Factors

- Downforce requirement dynamically change to achieve seeding depth under field conditions
  - Soil type
  - Moisture
  - Terrain
  - Planting speed
  - Compaction from wheel traffic

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Mechanical Downforce?

- Identify real-time gauge wheel load variability
  - What is the row-to-row gauge wheel variability?
  - Need for section control?
  - Does tire tracks and no-tire racks have difference in gauge wheel load variability?
  - Id soil type a major factor in deciding required gauge wheel loading?
  - Do we need active downforce control?

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Planter Setup

- HORSCH 12 row planter
- Row spacing - 30"
- Locations - Kansas
  - Olsburg, Junction City and Clay Center
- Variable field terrain
- Seed rate – cooperator desired (26k to 28k)
- Target gauge wheel load – 150 lbs
- Seed depth – 2" and 2.25"
- Planting speed – variable (typical 7.0-7.5 mph)

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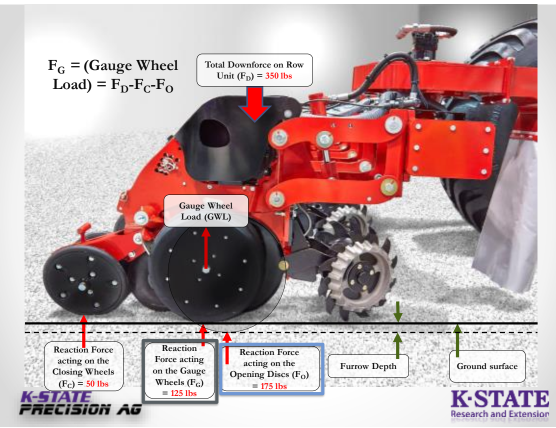
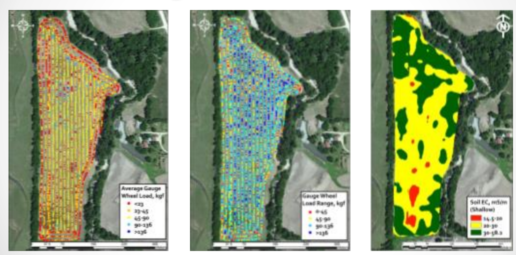


Measurements

- Gauge wheel load sensor – all rows
- RTK GPS for mapping
- Accelerometer for row unit ride quality
- Hydraulic pressure sensor
- Potentiometer for toolbar status
- Ground speed radar
- DAQ programmed to record at 10 Hz

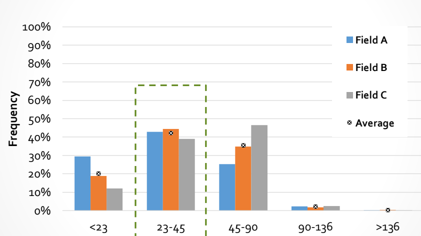
Soil EC and Moisture

Gauge Wheel Load



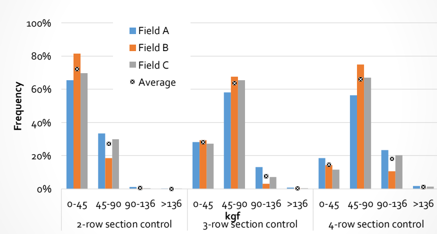
Significantly different gauge wheel loading based on spatial soil CEC

Average Gauge Wheel Load Variability

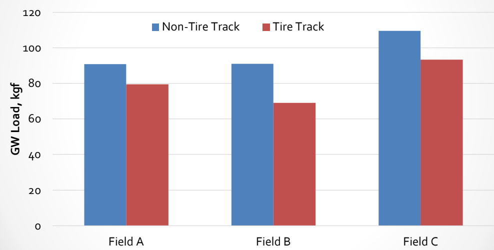


Varying gauge wheel load within fields

Control Section



Tire Vs Non-Tire



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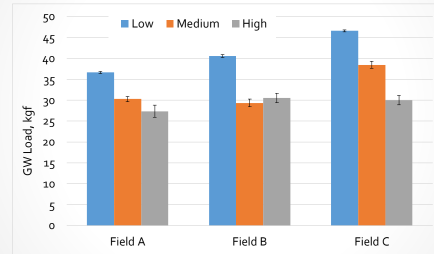
Gauge wheel Load and Soil EC



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Key Learnings

- ✓ Gauge wheel load variability exists
- ✓ Correlation between gauge load variability and soil CEC
- ✓ Gauge wheel load range indicate section control
- ✓ Smaller control section could provide more accurate gauge wheel loading management
- ✓ Significant gauge wheel load difference for row units running on "Tire" and "Non-Tire" tracks

Automatic downforce control system

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Goals

- Quantify the active downforce control system accuracy
- Evaluate seed depth uniformity, emergence and seed spacing uniformity with active downforce control
- Develop technology implementation practices

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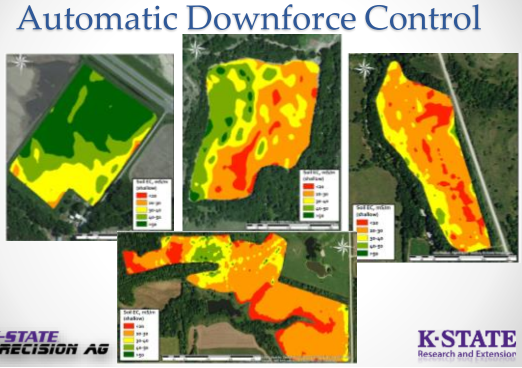
Automatic Downforce Control



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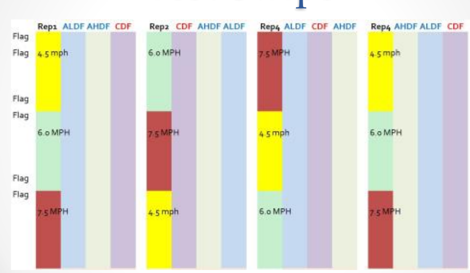
Test Strips



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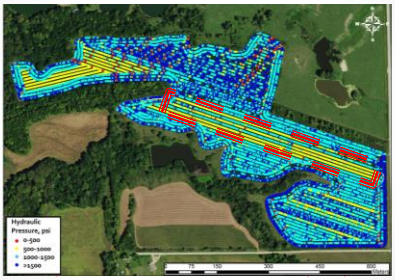
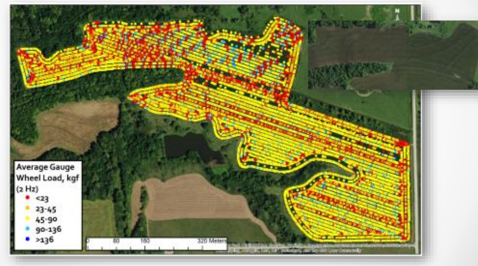
Hydraulic System Performance



(Highlighted region represented test strips with different downforce settings)

Average gauge wheel load and hydraulic pressure

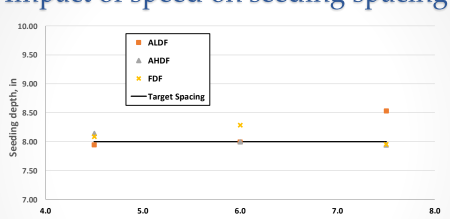


(Open regions represented test strips with fixed downforce settings)

Post-Planting Data

Post-Planting Data

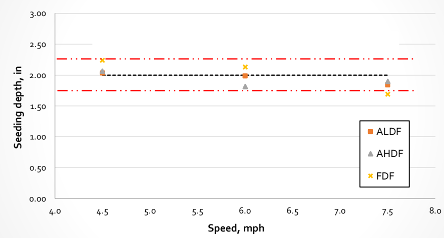
Impact of speed on seeding spacing



Average Spacing

Speed	ALDF	AHDF	FDF
4.5 mph	7.95 (19.0, 97.4)	8.14 (24.1, 96.0)	8.09 (28.9, 94.7)
6.0 mph	7.99 (26.4, 95.4)	8.00 (26.1, 92.7)	8.28 (24.5, 94.0)
7.5 mph	8.53 (28.1, 88.8)	7.94 (25.3, 95.3)	7.95 (28.7, 93.5)

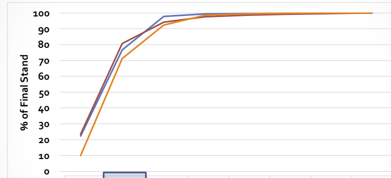
Impact of speed on seeding depth



Average Seeding Depth (2.25")

Speed	ALDF	AHDF	FDF
4.5 mph	2.03	2.06	2.24
6.0 mph	1.99	1.81	2.13
7.5 mph	1.84	1.90	1.69

Effect of downforce method on emergence



	17-May	18-May	19-May	20-May	21-May	22-May	23-May	24-May
ALDF	22	77	98	99	100	100	100	100
AHDF	23	81	94	98	99	99	100	100
FDF	10	71	92	99	99	100	100	100

Overall

- Significant effect on seeding depth due
  - downforce setting and ground speed
    - Active downforce and lower speed could provide more consistent seeding depth
  - Soil EC/moisture and speed
  - Row unit ride good and did not impact seed placement
- Future work
  - Study impact of downforce selection and operating conditions on
    - depth and emergence
  - System response and accuracy in dynamic conditions

Key Benefits

- Maintains planting depth
- Automatically maintains the optimum gauge wheel load - seed placement
- Greater control resolution
- Minimize row unit bounce and vibration – due terrain and field conditions (e.g. rocks, clods, etc.)
- Adjustment of applied downforce or margin from the cab
- Ability to collect as-planted data for verification and identification of in-field variability

Questions and Feedback

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