Assessment of Equipment Performance and Energy Requirements for the Development of Tillage Managements Strategies

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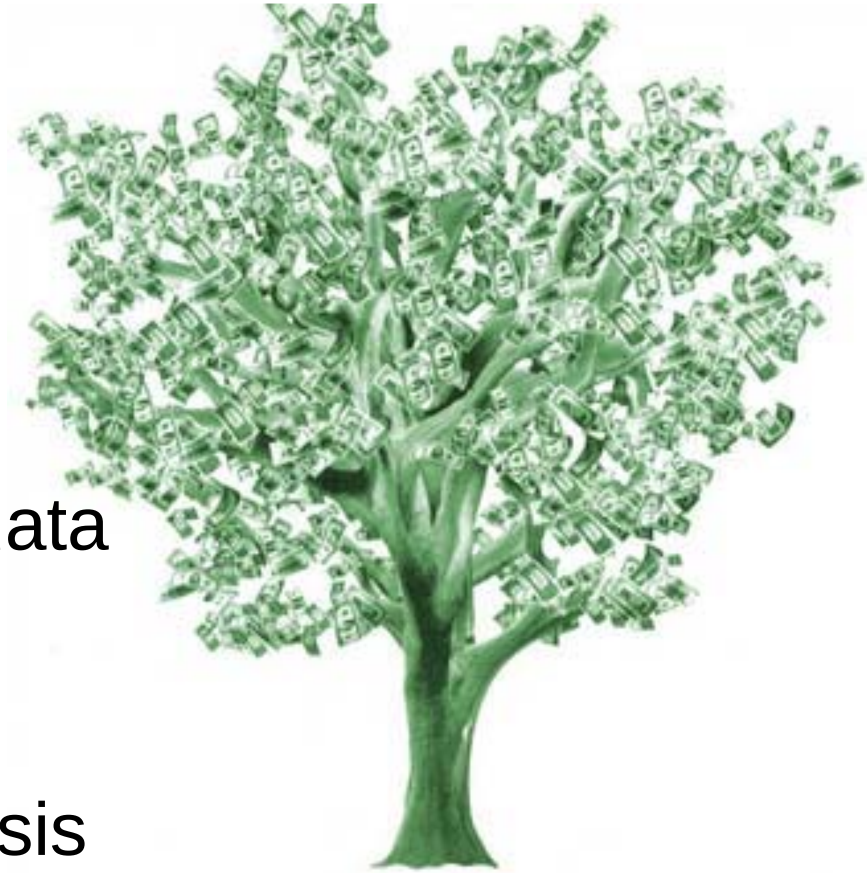
Presentation Overview

- Motivation
- Data acquisition system
- Multiple-depth test
- Multiple-implement tillage frequency
- Conclusions

The “Bottom Line”



- Areas to save
  - Equipment management
  - Tillage practices
- How to save
  - Equipment performance data
  - Get specific
- Evaluate equipment performance to provide a basis for improved efficiency and money saving management decisions

Research Objectives

- Develop a data acquisition system to monitor tractor performance parameters.
- Collect and analyze spatially linked tractor performance and draft data for different site-specific experiments.

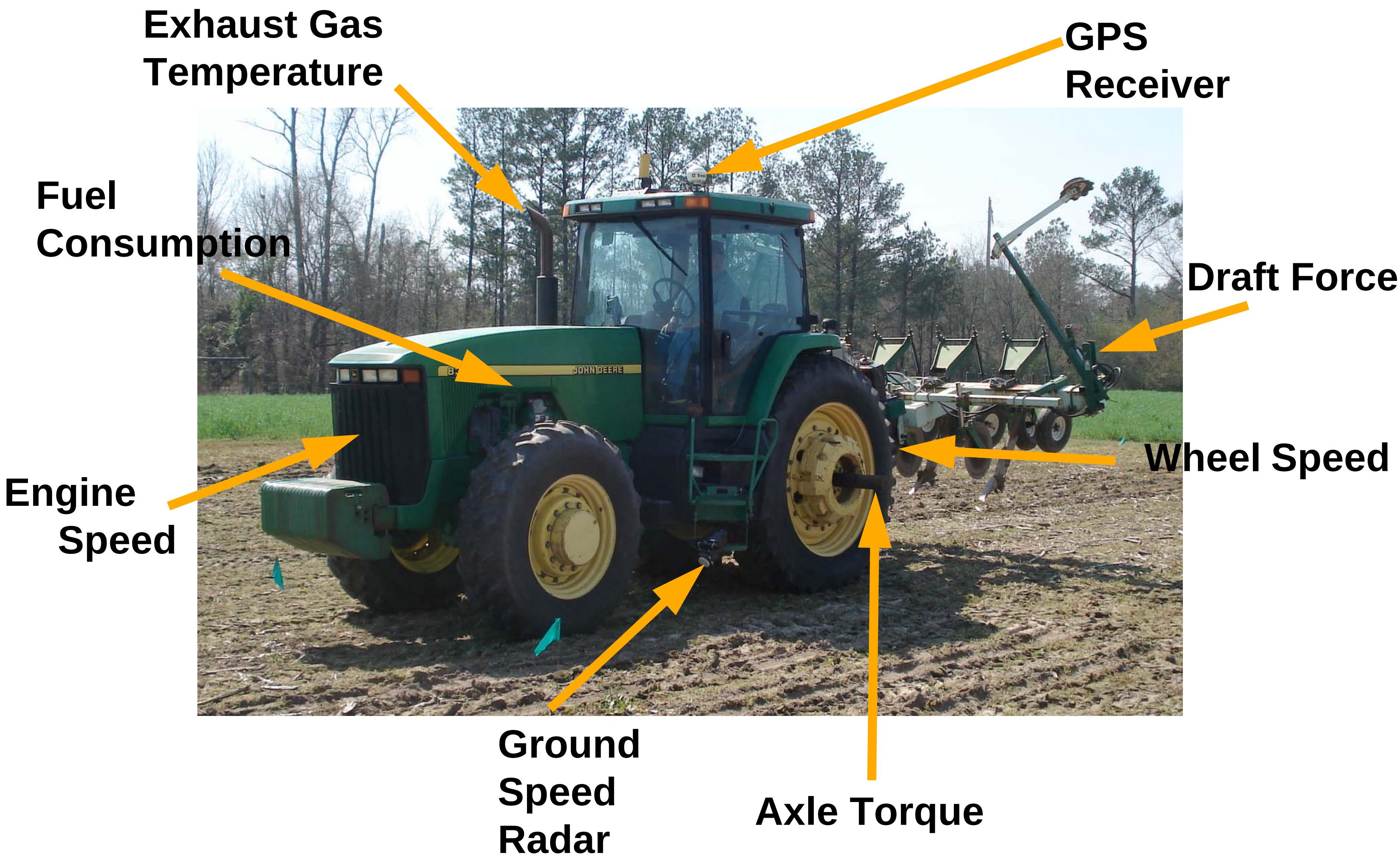
Site-Specific Tillage

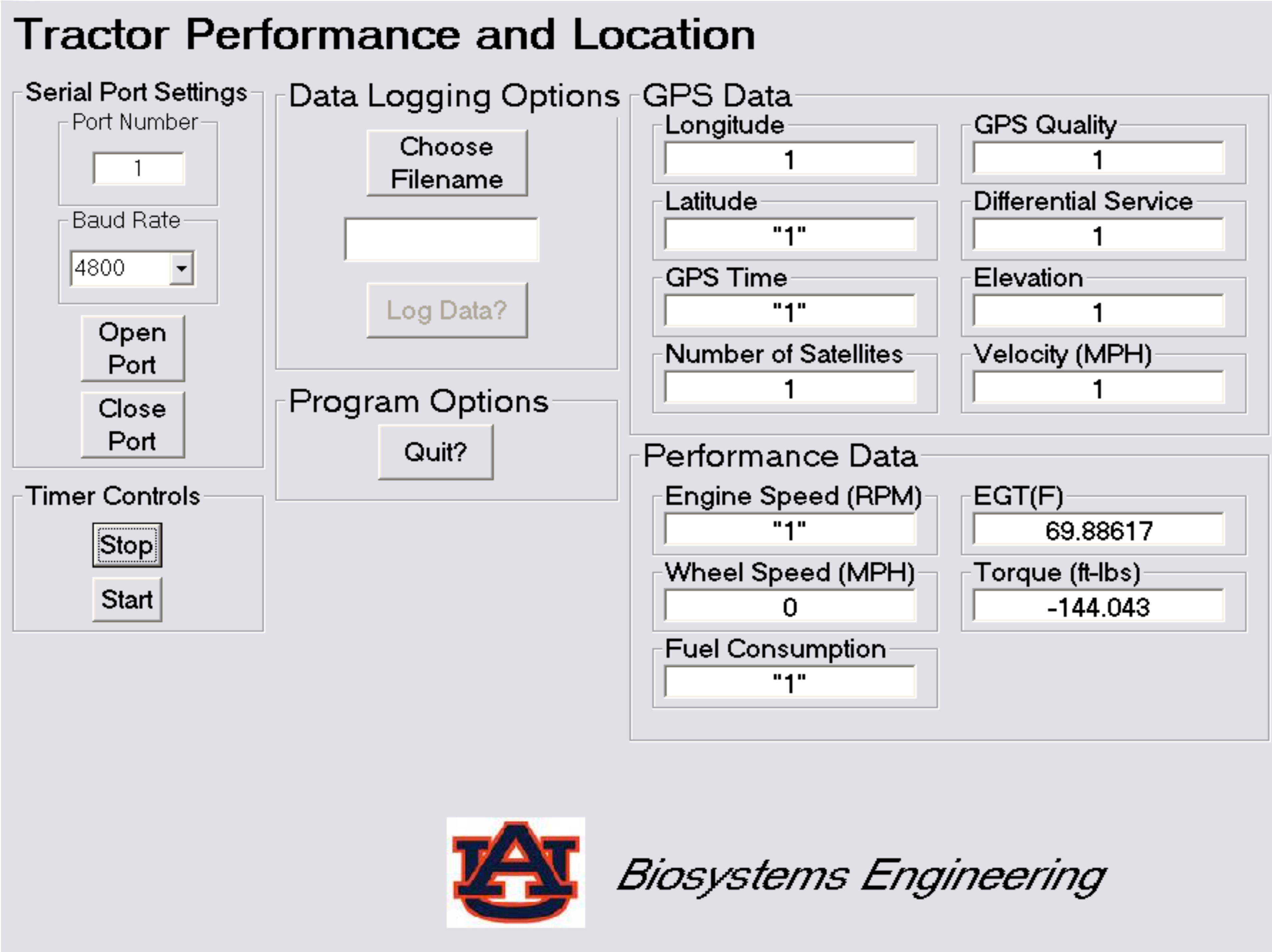
- Depth of hardpan determined
  - Electrical conductivity
  - Cone index
- Tillage performed by zone
- Controlled energy utilization
  - Reduce draft loads
  - Reduce fuel usage
  - Reduce equipment wear

Data Acquisition

- Computer based
  - Graphical User Interface (GUI)
  - Logging capabilities
- D/A and counter modules
- Sensors
  - 3-D draft loads
  - Fuel consumption

Direct Parameters

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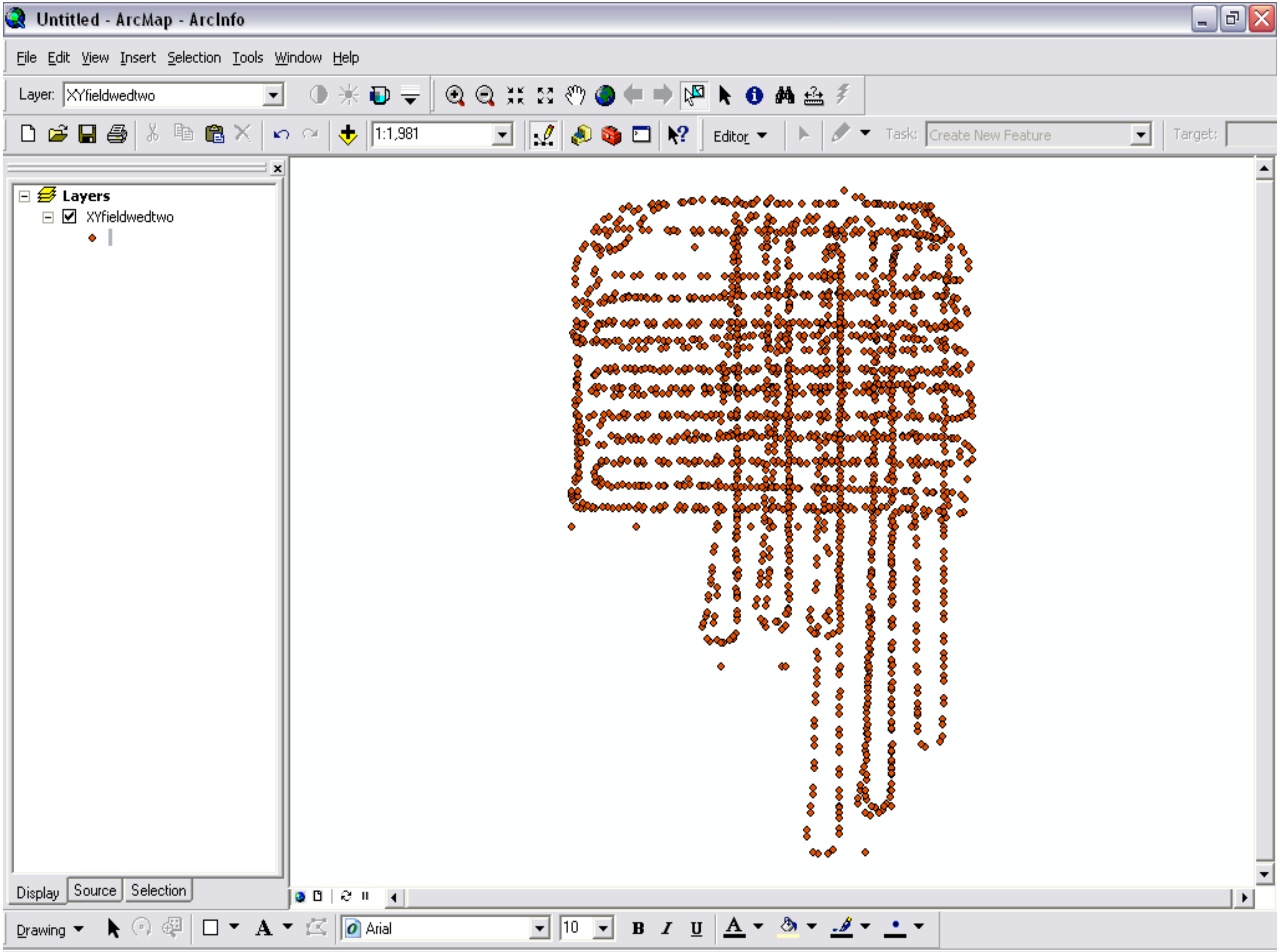
Biosystems Engineering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Multiple Depth Experiment

- Equipment
  - KMC in-row subsoiler
  - JD 8300 MFWD
- Data
  - Draft forces
  - Fuel consumption
- Methods
  - Shallow – 9 in.
  - Deep – 14 in.
  - 4 treatments / 4 replications
  - 3 mph

Multiple Depth Experiment

Depth (in.)	Treatment	Draft (lbs)		Fuel (gal/acre)	
		Mean*	S.D.	Mean*	S.D.
9	1	2,461[b]	80	0.93[b]	0.10
9	2	2,176[b]	75	0.89[b]	0.14
14	3	5,129[a]	357	1.11[a]	0.13
14	4	5,039[a]	172	1.07[a]	0.15

Note: *Means with similar letters in columns have no statistical differences ($\alpha = 0.05$).

Multiple Depth Experiment

- Energy Savings
  - 120% draft increase
  - 20% fuel consumption increase
- Site-specific tillage
  - Less energy with shallower depth
  - Extensive savings over large areas

Economic Savings

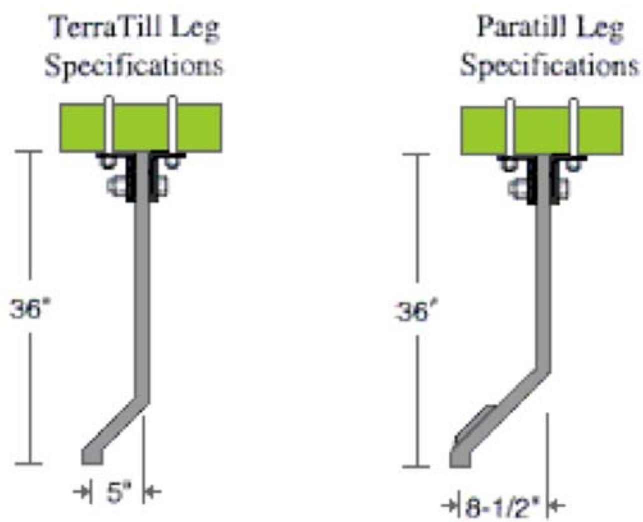
- $2.80 / gallon
- 1000 acres
- 0% - 17% savings for 9 in. depth

Tillage Depth	Fuel	Cost
9 in.	910 gal.	$2548
14 in.	1090 gal.	$3052

Multiple Implement Experiment

- JD 8300 MFWD @ 3 mph
- 13 in. tillage depth
- 9 treatments / 4 replications
  - 3 tillage rotations
    - Annually, biennial, triennial
  - 3 implements
    - KMC in-row subsoiler
    - Bigham Brothers TerraTill®
    - Bigham Brothers Paratill®
- Parameters measured
  - Fuel Consumption
  - Draft Forces
  - Axle Torque

TerraTill® vs. Paratill®



Courtesy: Bigham Brothers.

Multiple Implement Experiment

Implement	TRT	Rotation (yrs.)	Fuel Usage (gal/acre)		Draft (lbs)		Torque (ft-lbs)	
			Mean*	S.D.	Mean*	S.D.	Mean*	S.D.
KMC	1	1	0.91[c]	0.2	2,882[d]	265	6,023[d]	1,448
	2	2	0.93[c]	0.2	3,075[cd]	190	6,405[cd]	538
	3	3	0.97[bc]	0.2	3,685[c]	324	7,325[bc]	581
Paratill®	4	1	1.01[b]	0.2	4,854[b]	530	7,626[bc]	1,573
	5	2	1.01[b]	0.2	4,655[b]	531	8,142[b]	999
	6	3	1.09[a]	0.3	5,953[a]	793	9,516[a]	620
TerraTill®	7	1	1.11[a]	0.0	5,683[a]	148	9,713[a]	507
	8	2	1.11[a]	0.1	5,625[a]	117	9,675[a]	597
	9	3	1.13[a]	0.1	5,975[a]	404	10,066[a]	229

Note: *Means with similar letters in columns have no statistical differences ($\alpha = 0.05$).

Multiple Implement Experiment

- KMC in-row subsoiler
  - Increase in triennial rotation
    - 6% fuel consumption
    - 24% draft forces
    - 18% axle torque
- Bigham Brothers Paratill®
  - Increase in triennial rotation
    - 8% fuel consumption
    - 25% draft force
    - 21% axle torque
- Bigham Brothers TerraTill®
  - No significant differences within group

Economics

- $2.80 / gallon
- 1000 acres
- 8% savings with Paratill
- 16% savings with KMC

Implement	Fuel (gallons)	Cost
KMC	940	$2632
Paratill	1040	$2912
TerraTill	1120	$3136

Summary

- Real-time or spatial tractor performance can be used to effectively manage equipment site-specifically.
- Site-specific tillage can save energy and minimize costs.
  - Two-depth experiment
    - 120% draft increase
    - 20% fuel consumption increase
  - Multiple implement experiment
    - TerraTill® - highest values
    - KMC – Lowest values
    - Triennial increase in energy required for tillage.

Thank You

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