



FARM JOURNAL

VIRTUAL CONFERENCE



PRECISION AGRICULTURE
Making Sense of it All

PRECISION AGRICULTURE

Making Sense Of It All

Rising commodity prices comes along with a high cost of production. In order to take full advantage of these historically high prices, farmers need to look for ways to become more efficient in their operations by controlling costs and ensuring that every input counts all through the growing season.

Farm Journal is hosting a Virtual Precision Agriculture event to help make sense of today's ever-changing technology. Join us in November and December for this special event. Hear it live or on-demand. All live events will start at 12:00 noon CT the day of the live events. If you can't make it to the live event, check back to hear the recorded version.

- Hear from farmers and retailers and how they calculate ROI.
- Learn how farmers can shut off individual nozzles and planter units to save big dollars.
- Add it up: Discover how you can save time and profit from data collected.
- Viewers can submit questions directly during the live webcasts.

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Precision Simplified®

Precision Simplified. Since 1978, Raven has helped define the concepts of precision agriculture and simplicity and continues to bring groundbreaking new ideas and easy-to-use products together in virtually every product category to help growers improve their efficiency, productivity and stewardship of the land.

Session 1 November 3, 2011

How Precision Pays Back

Success stories from farmers and retailers who have successfully adopted precision farming techniques and how they incorporated the technology into their business.

Session 2 November 10, 2011

Autoswath Control

This is an emerging area of precision agriculture that allows farmers to shut off individual spray nozzles and planter row units.

Session 3 November 17, 2011

Adapting Precision Equipment to Your Equipment

It doesn't take brand new equipment to adapt precision technology to your fleet. Learn from farmers who have integrated precision technology into their existing equipment, whether it is 20 years old or brand new.

Session 4 December 8, 2011

Connectivity from the Field to the Farm Office

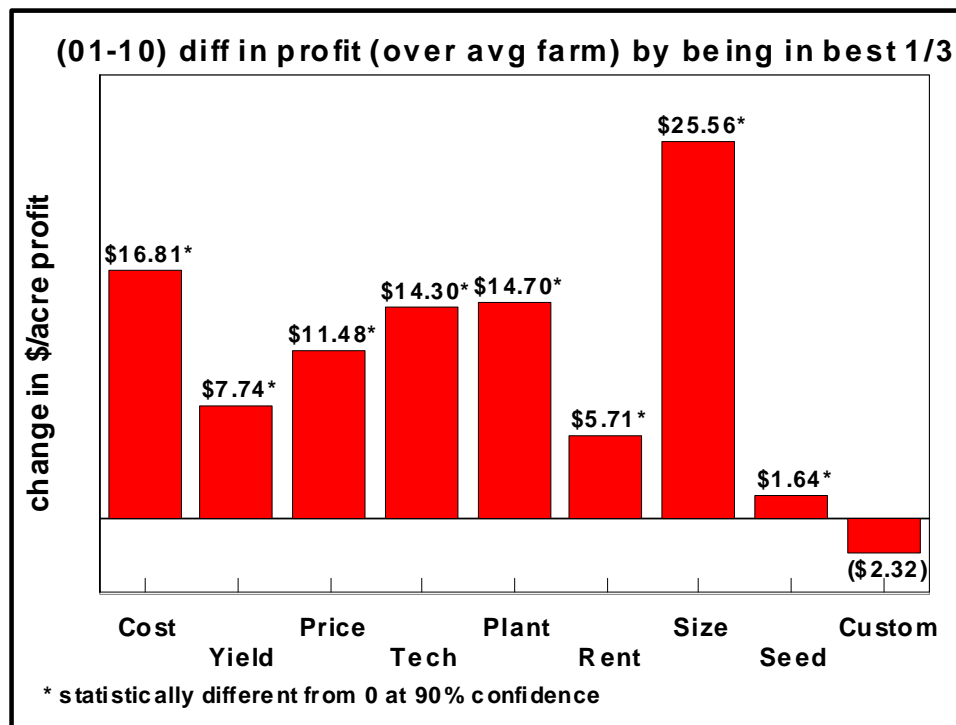
Telematics is a new and innovative system that allows farmers to directly upload data from the tractor to the farm office in real time. Learn what systems are available, how it works and how you can save time and profit from data collected.

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The Economics of Autoswath Control

A little background info to begin...

Factors impacting profitability differences of KS producers...

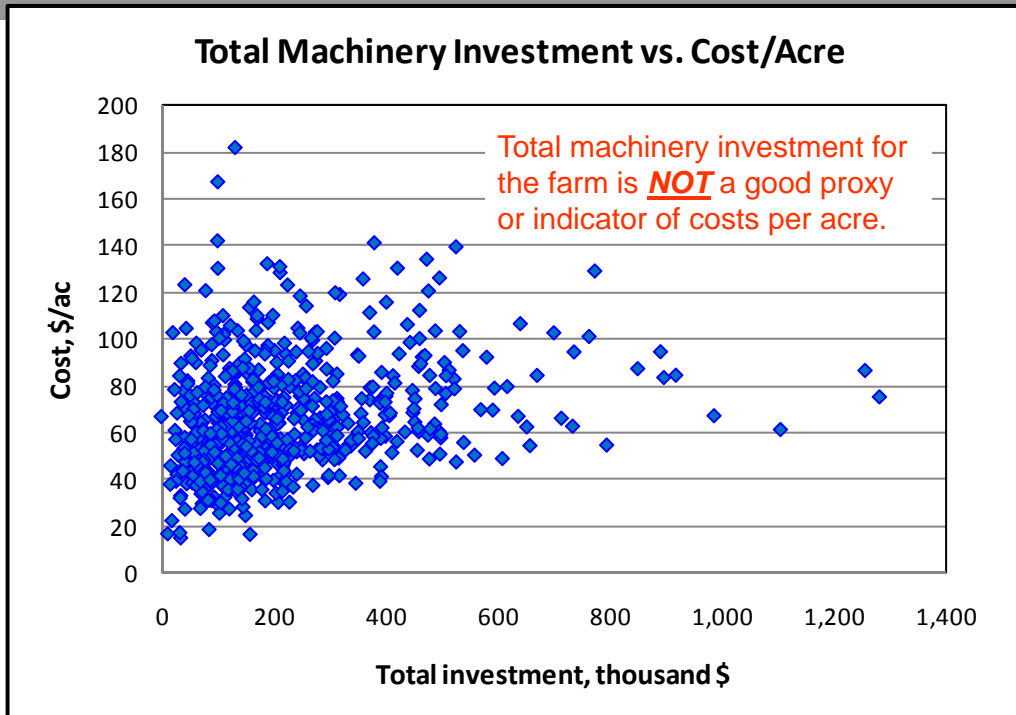


Key drivers of profitability differences among producers...

- Costs
- Technology adoption
- Farm size

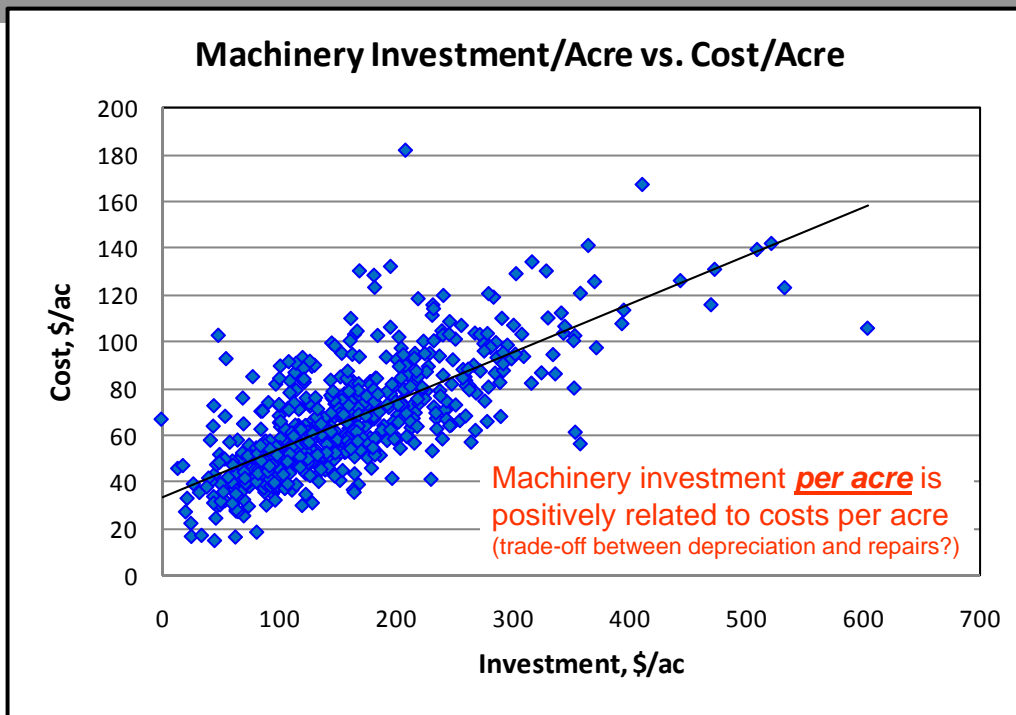
... machinery investment and costs are directly related to these three factors.

Machinery investment is not the same as machinery cost



Source: KFMA non-irrigated crop farms having continuous data from 2005-2009
(minimum of 160 acres and machinery cost/acre > \$10/ac; costs do not include labor – total of 614 farms)

It is important to use assets efficiently...



Source: KFMA non-irrigated crop farms having continuous data from 2005-2009
(minimum of 160 acres and machinery cost/acre > \$10/ac; costs do not include labor – total of 614 farms)

What leads to some producers having lower costs?

- 1) **Hard to beat intensity of use as a cost reducer**
- 2) **Hard to beat machinery size as a cost reducer
(at least historically)**



Machinery size issues...

- **Large equipment requires major investment**
 - investment is not the same as cost
 - ability to use capacity is critical
- ***Per acre*, larger machines require**
 - similar or a bit lower investment
 - much lower labor costs (the big driver)
- **But, since field size has not kept up with machine size, per acre, larger machines:**
 - require more road time (reduces efficiency)
 - have more headland overlap (reduces efficiency)

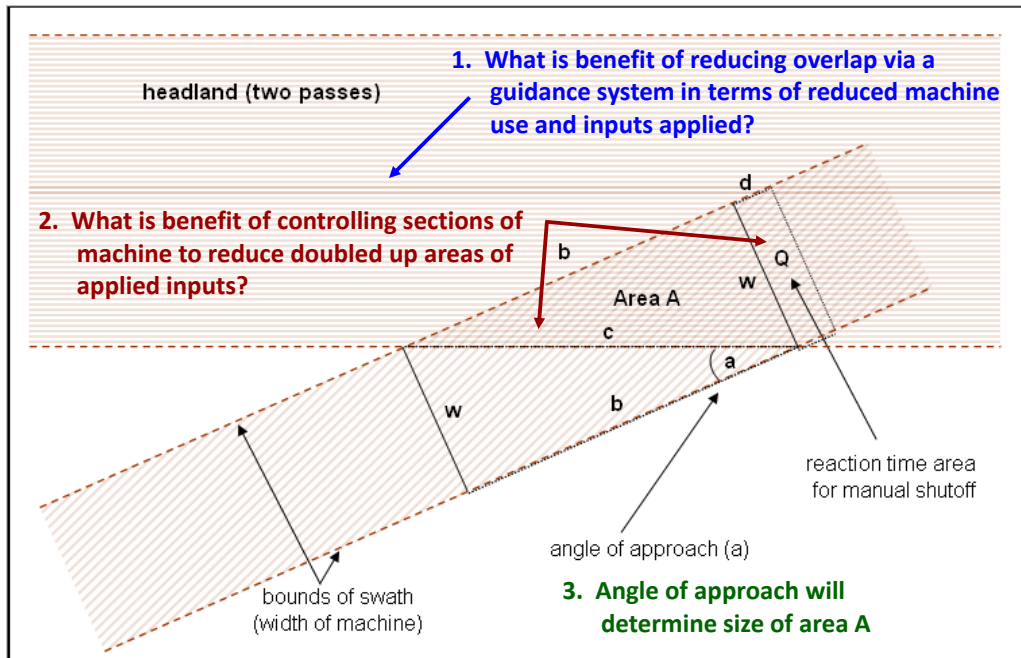
Large (wide) machine issues

- **Need large turnaround area, increasing the area of the field in headlands**
- **Can we make the larger machines behave as though they were smaller, at least in terms of the portion of a headland affected by input doubling-up?**
 - boom or section shut-offs

Field headland issues (where the action is)

- **Headlands cause economic problems:**
 - Increase cost of machine operations
 - Doubling up of machine operations
 - Machines need to slow down for turnaround
 - Increase crop input costs due to doubling up
 - Double-planting, -applying, -tilling, and extra compaction can reduce crop yield, thus revenue
- **Portion of field covered by headlands:**
 - Affects *costs* and *revenues*
 - Greatly affected by field size and shape
 - Especially affected by width of machine

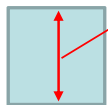
Field headland



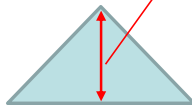
Areas A and Q and turnaround counterparts will have a) doubling-up of inputs and b) possible yield losses due to this doubling-up. After the turnaround there will be overlap along b, also accounted for.

Stylized field shapes (farm left to right)

Maximum width of field, perpendicular to direction of swaths (passes) = 2,640 feet



Square; hit ends at 90 degree angles, 5,280 feet of headlands in 160 acre field



Isosceles right triangle; hit ends at 60 degree angles, 7,467 feet of headlands in 160 acre field



Equilateral triangle; hit ends at 45 degree angles, 8,024 feet of headlands in 160 acre field

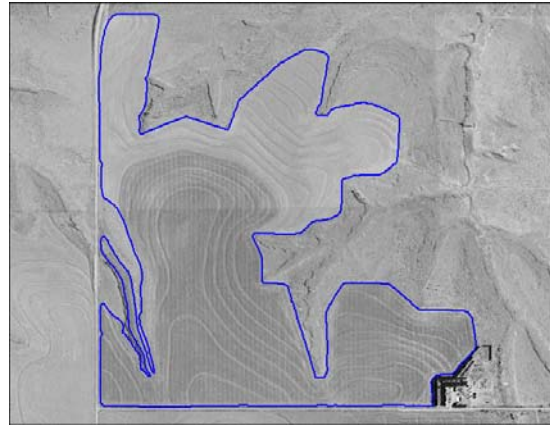


Circle; hit ends at angles varying from 0 to 90 degrees (avg. 40 degrees) 9,359 feet of headlands in 160 acre field

Kastens fields – less efficient than squares, triangles or circles



Ranch field (Odd 1):
167.4 acres;
headland is 16,700 feet;
average angle at headland is 28 degrees
90' pass = 20% of field



TT field: (Odd 2)
269.9 acres;
headland is 30,690 feet;
average angle at headland is 21 degrees
90' pass = 23% of field

- **All situations are quite site- and machine-specific**
 - Hard to make general rules of thumb across operations
 - Requires individual-situation analysis
 - So, we developed several decision tools (Excel spreadsheets and web dashboard) to aid such decisions, called
 - KSU-GPSguidance.xls and GuidanceSectionControlProfitCalculator (available at www.agmanager.info)
- **To get some understanding, economic results for an example farm will be reported**

GuidanceSectionControlProfitCalculator.xls --- available on www.AgManager.info

Economic Analysis of Guidance Systems and Section Controls

Section A: Whole-farm information -- INPUTS

Size of typical field	acres	75
Maximum width of field, perpendicular to direction of swaths (passes)	feet	2,571
Running distance of headlands to cover for field	feet	8,000
Average angle of approach to headland in degrees (0-90)	degrees	40.00
Interest rate for investment analysis, percent	interest	8.00%
Number of years for amortization	years	4
Annual non-ownership costs for current technology (e.g., subscriptions, fees, support)	\$/farm	\$0
Annual non-ownership costs expected for new technology (e.g., subscriptions, fees, support)	\$/farm	\$2,500

Percent of category to include in net benefits total

Machine costs	1
Input costs	1
Yield revenue	1
Non-ownership costs	0

Non-ownership costs – might these be negative?

	units	Sprayer	Planter	Fertilizer	Other	Other	Farm Total/Avg
Include in whole-farm analysis (1=Yes, 0=No)		1	1	1			

Section B: Equipment-specific information -- INPUTS

Number of swaths (passes) needed to cover headlands	count	2	2	2			2
Width of machine	feet	90	40	48			71
Turnaround speed is this portion of field speed	percent	67%	75%	67%			68%
Area in headlands	acres	32.48	14.55	17.45	0.00	0.00	25.62
Number of machine or boom sections to be controlled	count	5	16	4			6.3
Reaction distance (overlap) on manual shutoff of boom	feet	15	10	10			13
Custom rate of machine operation, \$/application acre		\$5.00	\$15.00	\$10.00			\$7.86
Cost of input (fertilizer, herbicide, etc.), \$/application acre		\$15.00	\$90.00	\$62.50			\$39.29
Lost yield revenue for doubling up, \$/doubled-up acre		\$0.00	\$55.00	\$0.00			\$7.86
Current overlap to consider	percent	7.00%	0.00%	7.00%			6.00%
Expected overlap to consider	percent	1.75%	0.00%	1.75%			1.50%
Total acres of use annually	acres	6,000	1,500	3,000			10,500
Expected autoguidance investment							
autoguidance	dollars	\$15,000	\$15,000	\$7,500			\$37,500
boom section/control	dollars	\$10,000	\$15,000	\$10,000			\$35,000
autoguidance, \$/acre		\$2.50	\$10.00	\$2.50	n/a	n/a	\$3.57
boom/section control, \$/acre		\$1.67	\$10.00	\$3.33	n/a	n/a	\$3.33

GuidanceSectionControlProfitCalculator.xls --- available on www.AgManager.info

Economic Analysis of Guidance Systems and Section Controls

Section A: Whole-farm information -- INPUTS

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Percent of category to include in net benefits total

Machine costs	1
Input costs	1
Yield revenue	1
Non-ownership costs	0

Toggle lets user include any or all impacts...

	units	Sprayer	Planter	Fertilizer	Other	Other	Farm Total/Avg
Include in whole-farm analysis (1=Yes, 0=No)		1	1	1			

Section B: Equipment-specific information -- INPUTS

Number of swaths (passes) needed to cover headlands	count	2	2	2			2
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GuidanceSectionControlProfitCalculator.xls --- available on www.AgManager.info

Economic Analysis of Guidance Systems and Section Controls

Section A: Whole-farm information -- INPUTS

Size of typical field	acres	75					
Maximum width of field, perpendicular to direction of swaths (passes)	feet	2,571					
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Number of years for amortization	years	4					
Annual non-ownership costs for current technology (e.g., subscriptions, fees, support)	\$/farm	\$0					
Annual non-ownership costs expected for new technology (e.g., subscriptions, fees, support)	\$/farm	\$2,500					
Percent of category to include in net benefits total							
Machine costs		1					
Input costs		1					
Yield revenue		1					
Non-ownership costs		0					

View Results of Guidance System and Section Control

View Results of Guidance System

View Results of Section Controllers

	units	Sprayer	Planter	Fertilizer	Other	Other	Farm Total/Avg
Include in whole-farm analysis (1=Yes, 0=No)		1	1	1			

Section B: Equipment-specific information -- INPUTS

Number of swaths (passes) needed to cover headlands	count	2	2	2			2
Width of machine	feet	90	40	48			71
Turnaround speed is this portion of field speed	percent	67%	75%	67%			68%
Area in headlands	acres	32.48	14.55	17.45	0.00	0.00	25.62
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boom/section control, \$/acre		\$1.67	\$10.00	\$3.33	n/a	n/a	\$3.33

Can include multiple machines to get results for whole farm.

GuidanceSectionControlProfitCalculator.xls --- available on www.AgManager.info

Economic Analysis of Guidance Systems and Section Controls

Section A: Whole-farm information -- INPUTS

Size of typical field	acres	75					
Maximum width of field, perpendicular to direction of swaths (passes)	feet	2,571					
Running distance of headlands to cover for field	feet	8,000					
Average angle of approach to headland in degrees (0-90)	degrees	40.00					
Interest rate for investment analysis, percent	interest	8.00%					
Number of years for amortization	years	4					
Annual non-ownership costs for current technology (e.g., subscriptions, fees, support)	\$/farm	\$0					
Annual non-ownership costs expected for new technology (e.g., subscriptions, fees, support)	\$/farm	\$2,500					
Percent of category to include in net benefits total							
Machine costs		1					
Input costs		1					
Yield revenue		1					
Non-ownership costs		0					

View Results of Guidance System and Section Control

View Results of Guidance System

View Results of Section Controllers

	units	Sprayer	Planter	Fertilizer	Other	Other	Farm Total/Avg
Include in whole-farm analysis (1=Yes, 0=No)		1	1	1			

Section B: Equipment-specific information -- INPUTS

Number of swaths (passes) needed to cover headlands	count	2	2	2			2
Width of machine	feet	90	40	48			71
Turnaround speed is this portion of field speed	percent	67%	75%	67%			68%
Area in headlands	acres	32.48	14.55	17.45	0.00	0.00	25.62
Number of machine or boom sections to be controlled	count	5	16	4			6.3
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autoguidance, \$/acre		\$2.50	\$10.00	\$2.50	n/a	n/a	\$3.57
boom/section control, \$/acre		\$1.67	\$10.00	\$3.33	n/a	n/a	\$3.33

Sprayer has benefits of both reduced overlap (i.e., guidance) and reduced input use (section controllers), no yield effect.

GuidanceSectionControlProfitCalculator.xls --- available on www.AgManager.info

Economic Analysis of Guidance Systems and Section Controls

Section A: Whole-farm information -- INPUTS

Size of typical field	acres	75	
Maximum width of field, perpendicular to direction of swaths (passes)	feet	2,571	
Running distance of headlands to cover for field	feet	8,000	View Results of Guidance System and Section Control
Average angle of approach to headland in degrees (0-90)	degrees	40.00	
Interest rate for investment analysis, percent	interest	8.00%	View Results of Guidance System
Number of years for amortization	years	4	
Annual non-ownership costs for current technology (e.g., subscriptions, fees, support)	\$/farm	\$0	
Annual non-ownership costs expected for new technology (e.g., subscriptions, fees, support)	\$/farm	\$2,500	View Results of Section Controllers
Percent of category to include in net benefits total			
Machine costs		1	
Input costs		1	
Yield revenue		1	
Non-ownership costs		0	

Include in whole-farm analysis (1=Yes, 0=No)

units	Sprayer	Planter	Fertilizer	Other	Other	Farm Total/Avg
	1	1	1			

Section B: Equipment-specific information -- INPUTS

Number of swaths (passes) needed to cover headlands	count	2	2			2
Width of machine	feet	90	40			
Turnaround speed is this portion of field speed	percent	67%	75%			
Area in headlands	acres	32.48	14.55			
Number of machine or boom sections to be controlled	count	5	16			
Reaction distance (overlap) on manual shutoff of boom	feet	15	10			
Custom rate of machine operation, \$/application acre		\$5.00	\$15.00			
Cost of input (fertilizer, herbicide, etc.), \$/application acre		\$15.00	\$90.00			
Lost yield revenue for doubling up, \$/doubled-up acre		\$0.00	\$55.00			
Current overlap to consider	percent	7.00%	0.00%			
Expected overlap to consider	percent	1.75%	0.00%			
Total acres of use annually	acres	6,000	1,500	3,000		10,500
Expected autoguidance investment						
autoguidance	dollars	\$15,000	\$15,000	\$7,500		\$37,500
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autoguidance, \$/acre		\$2.50	\$10.00	\$2.50	n/a	\$3.57
boom/section control, \$/acre		\$1.67	\$10.00	\$3.33	n/a	\$3.33

Planter has benefits of reduced input use and improved yields in headland (row controllers). Example does not share cost of guidance system (i.e., autoguidance investment equals \$15,000).

90-ft sprayer example – Results based on machine and input cost savings

Analysis of Precision Ag Technologies for Crop Sprayer vs. Acres Sprayed

	4,800	5,400	6,000	6,600	7,200
Acres covered annually (average field size = 75 acres)	4,800	5,400	6,000	6,600	7,200
Guidance system (going from 7% to 1.75% overlap)					
Sum of net annual benefits, \$/applied acre	\$0.75	\$0.75	\$0.75	\$0.75	\$0.75
Investment supported by net annual benefits	\$11,973	\$13,470	\$14,967	\$16,463	\$17,960
Payback in years for given investment	5.24	4.54	4.01	3.59	3.25
Sum of annual net benefits including cost of investment, \$/applied acre	-\$0.19	-\$0.09	\$0.00	\$0.07	\$0.12
ROI given benefits, years, and investment, %	-1.5%	3.3%	7.9%	12.3%	16.6%
Section control (controlling 90' boom in 5 sections)					
Sum of net annual benefits, \$/applied acre	\$1.42	\$1.42	\$1.42	\$1.42	\$1.42
Investment supported by net annual benefits	\$22,523	\$25,339	\$28,154	\$30,969	\$33,785
Payback in years for given investment	1.63	1.44	1.28	1.16	1.06
Sum of annual net benefits including cost of investment, \$/applied acre	\$0.79	\$0.86	\$0.91	\$0.96	\$1.00
ROI given benefits, years, and investment, %	56.7%	66.6%	76.2%	85.6%	94.9%
Guidance system and Section control ROI, %	24.1%	30.9%	37.5%	43.9%	50.2%

Analysis of Precision Ag Technologies for Crop Sprayer vs. Acres Sprayed

The graph plots Investment supported (\$) on the left y-axis (0 to 40,000) and Payback years on the right y-axis (0.00 to 6.00) against Acres sprayed annually on the x-axis (4,800 to 7,200). Four data series are shown: Inv. Supported (Guidance) in blue, Inv. Supported (Section Ctrl) in red, Payback (Guidance) in green, and Payback (Section Ctrl) in orange. The red line (Section Ctrl investment) increases from ~\$22,500 to ~\$33,800, while the green line (Guidance investment) decreases from ~\$35,000 to ~\$22,000. The blue line (Guidance payback) increases from ~1.6 years to ~1.1 years, and the orange line (Section Ctrl payback) decreases from ~5.2 years to ~3.3 years.

90-ft sprayer example – results based on machine and input cost savings

Impact of Acres Covered on Economics of Guidance System¹

Annual acres	Investment supported ²	Return on investment ^{2,3}	Payback years ³
12,000	\$29,933	47.5%	1.9
10,000	\$24,944	35.2%	2.3
8,000	\$19,956	22.1%	2.9
6,000	\$14,967	7.9%	4.0
4,000	\$9,978	-8.2%	6.6
2,000	\$4,989	-28.6%	20.7
1,000	\$2,494	-43.2%	won't pay

¹ Machine and input cost savings reducing overlap from 7.0% to 1.75%

² Based on four-year amortization

³ Given \$15,000 investment

Impact of Acres Covered on Economics of Section Control¹

Annual acres	Investment supported ²	Return on investment ^{2,3}	Payback years ³
12,000	\$56,308	166.6%	0.6
10,000	\$46,923	137.2%	0.8
8,000	\$37,539	107.2%	1.0
6,000	\$28,154	76.2%	1.3
4,000	\$18,769	43.2%	2.0
2,000	\$9,385	5.2%	4.3
1,000	\$4,692	-19.4%	10.8

¹ Automatic control of 5 boom sections, input cost savings (guidance exists)

² Based on four-year amortization

³ Given \$10,000 investment

As with most all technologies, the returns to investing in guidance systems and section controls is not scale neutral...

Given the assumptions for this example, the returns to investing in section controls are much higher than guidance systems (but you need the guidance system to realize these benefits)

90-ft sprayer example – results based on machine and input cost savings

... but, as input costs increase, these technologies will pay for smaller operations as well (plus investment required likely will fall over time).

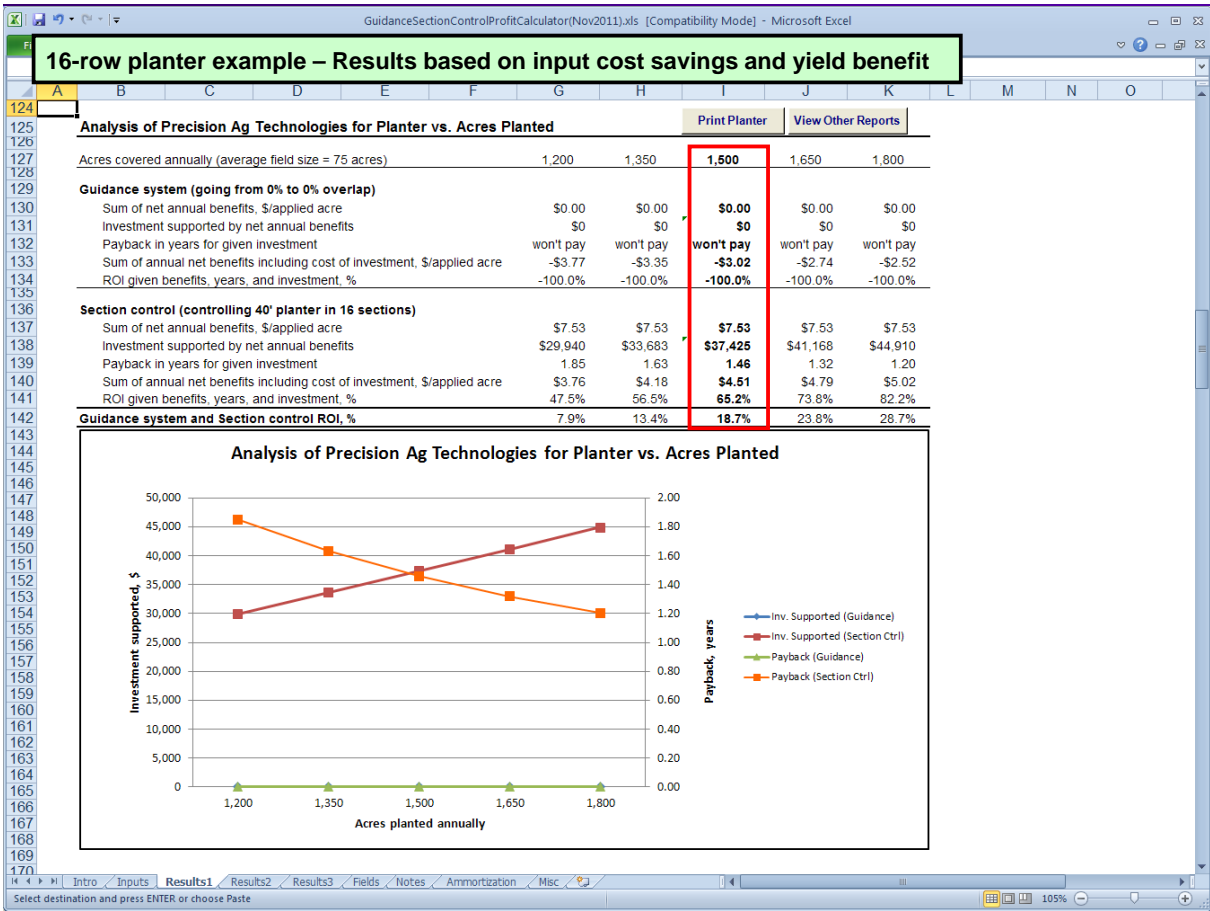
Guidance System and Section Control ROI ¹					
Annual acres	Average cost of input, \$/application acre				
	\$5.00	\$10.00	\$15.00	\$20.00	\$25.00
12,000	18.2%	59.9%	97.1%	132.9%	167.6%
10,000	9.4%	46.0%	78.2%	108.6%	138.0%
8,000	-0.2%	31.3%	58.4%	83.6%	107.9%
6,000	-10.7%	15.5%	37.5%	57.6%	76.7%
4,000	-23.0%	14.6%	14.6%	29.6%	14.6%
2,000	-39.1%	-24.5%	-13.1%	-3.4%	5.4%
1,000	-51.0%	-40.2%	-32.1%	-25.2%	-19.2%

¹ Machine and input cost savings reducing overlap from 7.0% to 1.75%

Automatic control of 5 boom sections, input cost savings

Based on four-year amortization

Given \$25,000 investment



16-row planter example – results based on input savings and yield improvement

Impact of Acres Covered on Economics of Section Control ¹			
Annual acres	Investment supported ²	Return on investment ^{2,3}	Payback years ³
2,500	\$62,375	120.2%	0.9
2,000	\$49,900	93.2%	1.1
1,750	\$43,663	79.4%	1.2
1,500	\$37,425	65.2%	1.5
1,250	\$31,188	50.6%	1.8
1,000	\$24,950	35.2%	2.3
750	\$18,713	18.7%	3.1

¹ Automatic control of individual rows, input cost savings and yield benefit

² Based on four-year ammortization

³ Given \$15,000 investment – guidance already exists

Impact of Acres Covered on Economics of Section Control ¹			
Annual acres	Investment supported ²	Return on investment ^{2,3}	Payback years ³
2,500	\$62,375	50.6%	1.8
2,000	\$49,900	35.2%	2.3
1,750	\$43,663	27.1%	2.6
1,500	\$37,425	18.7%	3.1
1,250	\$31,188	9.8%	3.8
1,000	\$24,950	0.2%	5.0
750	\$18,713	-10.4%	7.2

¹ Automatic control of individual rows, input cost savings and yield benefit

² Based on four-year ammortization

³ Given \$30,000 investment – guidance investment included

Investing in individual row controllers is pretty much a “no brainer” for operations with sufficient acres, especially if auto-guidance system already exists...

GuidanceSectionControlProfitCalculator.xls --- available on www.AgManager.info

Economic Analysis of Guidance Systems and Section Controls

Section A: Whole-farm information -- INPUTS

Size of typical field: 75 acres

Section B: Equipment-specific information -- INPUTS

Number of swaths (passes) needed to cover headlands: 2

Width of machine: 90 feet

Turnaround speed is this portion of field speed: 67%

Area in headlands: 32.48 acres

Number of machine or boom sections to be controlled: 5

Reaction distance (overlap) on manual shutoff of boom: 15 feet

Custom rate of machine operation, \$/application acre: \$5.00

Cost of input (fertilizer, herbicide, etc.), \$/application acre: \$15.00

Lost yield revenue for doubling up, \$/doubled-up acre: \$0.00

Current overlap to consider: 7.00%

Expected overlap to consider: 1.75%

Total acres of use annually: 6,000 acres

Expected autoguidance investment: \$15,000

boom section/control autoguidance, \$/acre: \$2.50

boom/section control, \$/acre: \$1.67

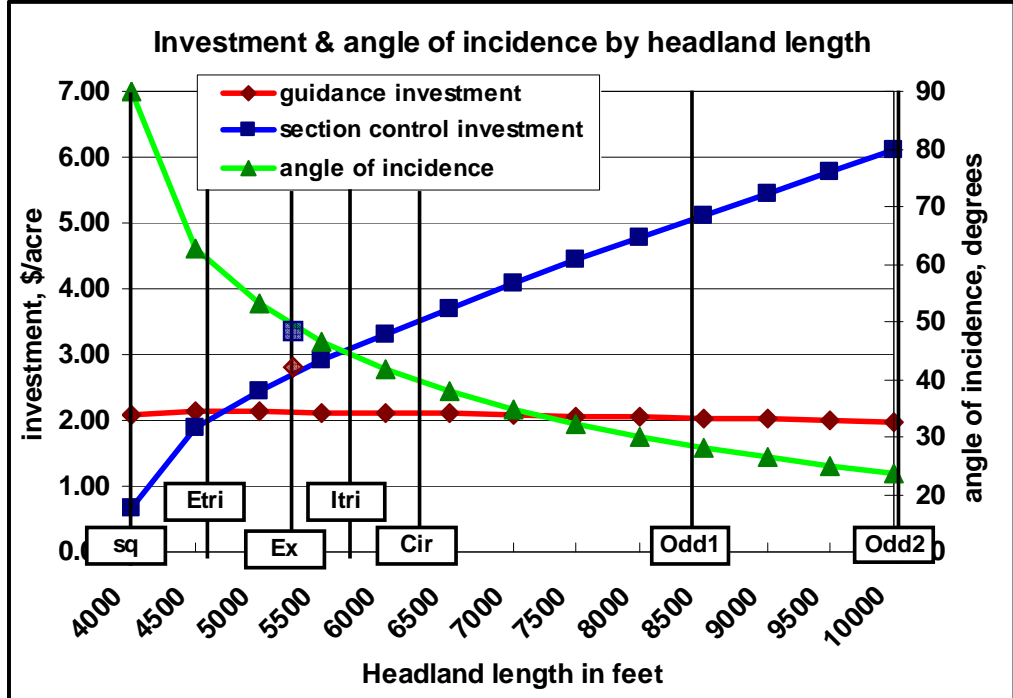
Guidance System and Section Control ROI¹

Annual acres	Average cost of input, \$/application acre				
	\$60.00	\$75.00	\$90.00	\$105.00	\$120.00
2,500	34.6%	42.7%	50.6%	58.2%	65.7%
2,000	21.6%	28.5%	35.2%	41.7%	48.0%
1,750	14.8%	21.0%	27.1%	33.0%	38.7%
1,500	7.5%	13.2%	18.7%	24.0%	29.1%
1,250	-0.2%	4.9%	9.8%	14.4%	19.0%
1,000	-8.5%	-4.1%	0.2%	4.2%	8.2%
750	-17.8%	-14.0%	-10.4%	-7.0%	-3.7%

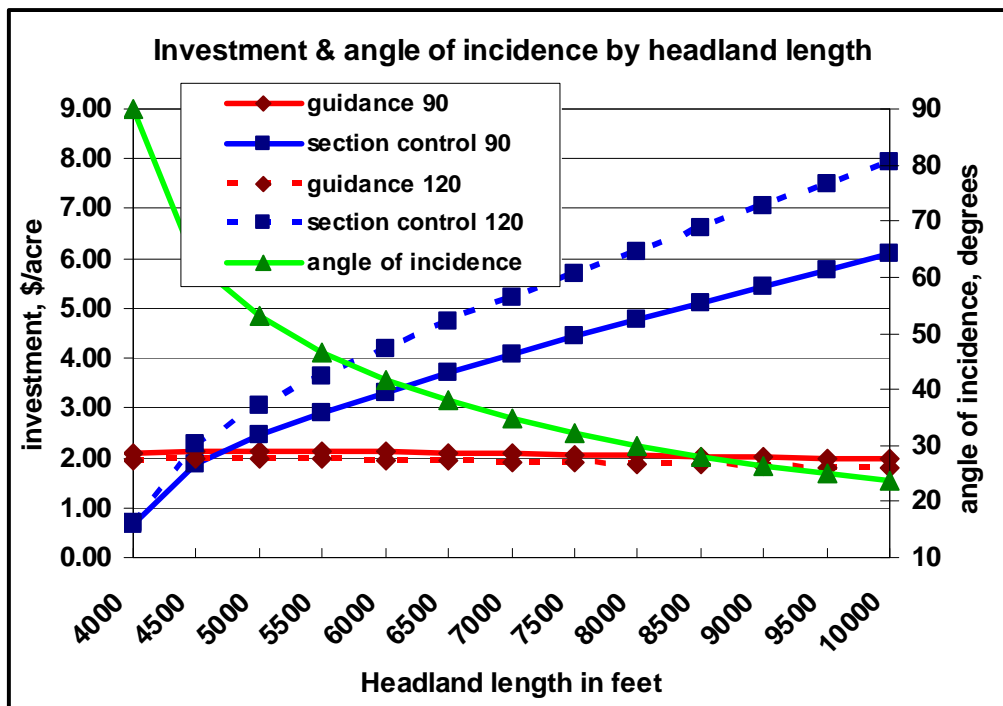
¹ No machine and input cost savings associated with overlap reduction
Automatic control of individual rows, input cost savings and yield benefit
Based on four-year amortization
Given \$30,000 investment -- guidance investment included

As cost of inputs increase (or value of crops increase if yield reduction exists), this technology will become ever more feasible for smaller operations.

As a reminder, results depend heavily on field shape...



As a reminder,
results depend heavily on field shape and equipment size.



Comparing a 120-foot sprayer with the 90-foot one

Summary...

- Keep in mind that a tractor is multi-purpose, so GPS benefits can be additive.
- Think carefully about expected yield losses on doubled-up headland acres.
- Field size and shape doesn't much impact benefits to GPS autoguidance,
 - but really impacts benefits to section shutoff.
 - autoguidance and section control share GPS items.
- GPS technologies should help to differentiate custom rates and ultimately land rental rates by field size and shape.
 - Section control may help stabilize these numbers.
- We didn't account for reduced operator fatigue.



For more information and decision tools related to farm management, marketing, and risk management go to www.AgManager.info



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