Economics of No-Till Cropping Systems across the Landscape: Cook Agronomy Farm, Pullman WA, 2001-2006

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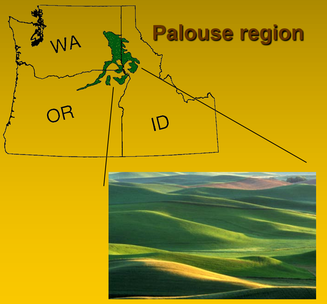
Palouse region



Background

System Inquiry

Cook Agronomy Farm

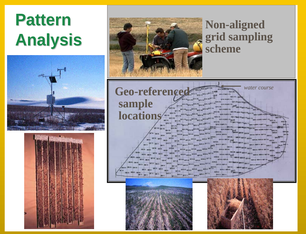
Direct Seed and Precision Farming Systems

Develop principles and strategies that reduce risk, increase profits and improve environmental quality

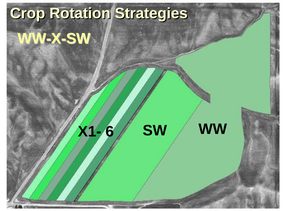
- Few farmers use continuous direct-seeding or precision agricultural practices in the dryland cropping region of the Palouse in eastern Washington.
- Research interest in field-scale direct-seed and precision conservation systems resulted in establishment of the WSU Cook Agronomy Farm in 1999.

Methods

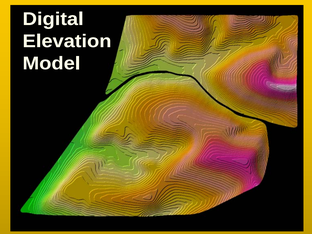
Pattern Analysis



Crop Rotation Strategies

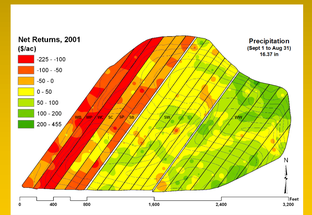


Digital Elevation Model



- Geo-referenced locations (369 points) were established for sample and data collection, including crop performance and biophysical variables.
- Three year crop rotations of hard red winter wheat-X-hard red spring wheat were established in 2001, where X represents six alternative crops: the winter and spring counterparts of barley, peas and canola. Winter lentils replaced winter canola in 2005. Strips of crop rotation alternatives were arranged perpendicular to the predominant slope in order to capture field variability in terrain and soils.
- Net returns to land and management were calculated for each crop at 369 geo-referenced locations. Costs included labor for operating machinery as well as variable and fixed costs for farm machinery. Land costs were excluded from the analysis.
- Net returns across the field were generated using inverse distance weighted (power of 2) interpolation method.

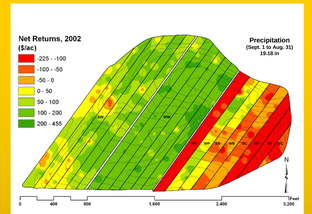
Results



Crop	WB	WP	WC	SC	SP	SB	SW	WW
Units	tons	lb	lb	lb	lb	tons	bu	bu
Yield (units/ac)	1,94	1338	0	2758	1845	2,34	75	86
Protein (%)	NA	NA	NA	NA	NA	NA	11,9	11,4
Price ($/unit)	$66,67	$0.08	$0.07	$0.07	$0.08	$66,67	$3.79	$3.72
Total Cost ($/ac)	$208	$188	$191	$212	$186	$204	$208	$211
Net Returns ($/ac)	-$75	-$114	-$191	-$13	-$32	-$58	$35	$76

2001

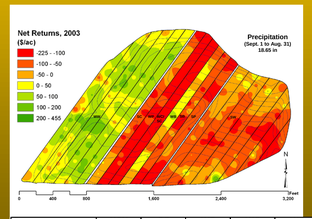
- Preceding crop was spring barley for all fields
- Winter wheat profits greatest on northern aspects and foot slopes; few locations had negative returns
- Low spring wheat profits were in part due to all spring applied N rather than split fall-spring applied N
- Net returns for alternative crops were largely negative; spring canola was the least unprofitable



Crop	SW	WW	WC	WP	SB	WB	SC	SP	SP	SC
Units	bu	bu	lb	lb	tons	tons	lb	lb	lb	lb
Yield (units/ac)	68	89	611	2629	2.14	1.53	2299	393	381	1864
Protein (%)	14.5	11.7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Price ($/unit)	$4.90	$4.62	$0.08	$0.10	$93.33	$93.33	$0.08	$0.08	$0.08	$0.08
Total Cost ($/ac)	$225	$213	$184	$200	$192	$201	$233	$158	$158	$233
Net Returns ($/ac)	$79	$162	($140)	$49	$9	($61)	($48)	($126)	($127)	($85)

2002

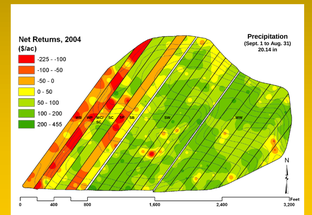
- Winter wheat followed spring wheat
- Spring wheat returns were lower than for winter wheat, with lowest profits on eroded uplands and depositional lowlands
- Winter peas were the most profitable alternative crop
- Recrop winter canola largely failed for second consecutive year



Crop	WW	SC	WP	WC	WB	SB	SP	SW
Units	bu	lb	lb	lb	tons	tons	lb	bu
Yield (units/ac)	81	1771	893	1630	2.32	1.46	958	50
Protein (%)	11.9	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	14.6
Price ($/unit)	$4.37	$0.10	$0.10	$0.10	$95.83	$95.83	$0.08	$4.81
Total Cost ($/ac)	$232	$240	$223	$311	$219	$228	$170	$285
Net Returns ($/ac)	$57	($61)	($134)	($149)	$2	($88)	($95)	($66)

2003

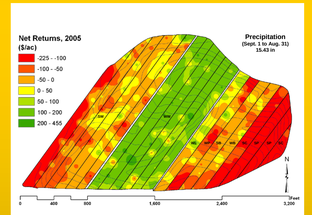
- Summer drought limited crop yields, resulting in negative returns for all spring crops
- Winter wheat and winter barley were the only profitable crops
- Crop rotation effects on net returns for wheat were not evident



Crop	WB	WP	WC	SC	SP	SB	SW	WW
Units	tons	lb	lb	lb	lb	tons	bu	bu
Yield (units/ac)	2.16	1329	2439	2748	1946	2.40	83	92
Protein (%)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	13.9	11.5
Price ($/unit)	$2.28	$0.11	$0.11	$0.11	$0.06	$95.00	$4.72	$4.20
Total Cost ($/ac)	$244	$225	$228	$227	$159	$197	$256	$251
Net Returns ($/ac)	($27)	($92)	$40	$73	($43)	$31	$100	$96

2004

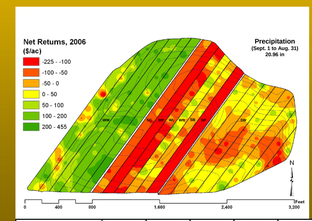
- Winter and spring wheat profits were similar, but WW returns were greatest on northern aspects and foot slopes while SW returns were highest on southern slopes and uplands
- Spring canola and spring barley produced the highest returns for alternative crops
- Winter barley profits were limited by increased weed pressure (Italian ryegrass)



Crop	SW	WW	WC	WP	SB	WB	SC	SP	SP	SC
Units	bu	bu	lb	lb	tons	tons	lb	lb	lb	lb
Yield (units/ac)	57	91	1704	1474	2.46	2.49	1130	0	0	869
Protein (%)	13.0	12.1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Price ($/unit)	$4.60	$4.61	$0.09	$0.11	$73.33	$73.33	$0.09	$0.05	$0.05	$0.09
Total Cost ($/ac)	$267	$258	$134	$221	$215	$211	$212	$170	$170	$212
Net Returns ($/ac)	($42)	122	$19	($68)	($36)	($29)	($112)	($170)	($170)	($134)

2005

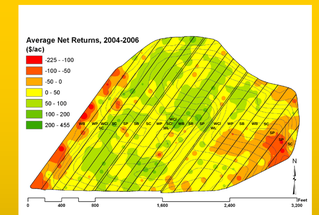
- This year had the lowest cumulative precipitation
- Winter wheat and winter lentils (substituted for winter canola) were the only profitable crops
- Spring peas increased the net returns of the following spring wheat crop more than any other alternative crop



Crop	WW	SC	WP	WC	WB	SB	SP	SW
Units	bu	lb	lb	lb	tons	tons	lb	bu
Yield (units/ac)	80	1359	241	1167	2.34	1.91	453	51
Protein (%)	12.1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	14.3
Price ($/unit)	$5.63	$0.10	$0.08	$0.13	$103	$103	$0.06	$5.82
Total Cost ($/ac)	$289	$209	$189	$188	$235	$217	$178	$279
Net Returns ($/ac)	$127	($73)	($185)	($92)	$24	($21)	($151)	($16)

2006

- Unseasonably warm temperatures in early summer limited crop yields
- Winter wheat and winter barley were the only crops with positive net returns
- Once again, spring peas increased the net returns of the following spring wheat crop more than any other alternative crop



Field A: Alternative Crop, Spring Wheat, Winter Wheat					
Crop	WB	WP	WC/SC	SC	SP	SB
Net Returns ($/ac)	$4	($2)	($17)	$44	$47	$38
Field B: Spring Wheat, Winter Wheat, Alternative Crop						
Crop	SC	WP	WC/SC/WL	WB	SB	SP
Net Returns ($/ac)	$41	$19	$14	$69	$33	$43
Field C: Winter Wheat, Alternative Crop, Spring Wheat								
Crop	WC/WL	WP	SB	WB	SC	SP	SP	SC
Net Returns ($/ac)	($41)	$30	$5	($15)	($1)	($40)	($48)	($42)

2001-2003

- Crop rotation with recrop winter canola was the least profitable
- Portions of field with southern exposure and eroded points had negative net returns
- Overall average returns to land and management of $9 per acre do not cover typical land rent and management charges

Field A: Alternative Crop, Spring Wheat, Winter Wheat						
Crop	WB	WP	WC/SC	SC	SP	SB
Net Returns ($/ac)	($43)	($6)	$46	$62	$41	$66
Field B: Spring Wheat, Winter Wheat, Alternative Crop						
Crop	SC	WP	WC/SC/WL	WB	SB	SP
Net Returns ($/ac)	$42	$26	$59	$66	$61	$24
Field C: Winter Wheat, Alternative Crop, Spring Wheat								
Crop	WC/WL	WP	SB	WB	SC	SP	SP	SC
Net Returns ($/ac)	$33	$31	$12	$11	$7	($34)	($36)	($46)

2004-2006

- Replacing winter canola with winter lentils improved profits
- Spring peas increased net returns of the following spring wheat crop more than any other alternative
- Weed infestation (Italian ryegrass) in WW-WB-SW rotation in western portion of field decreased net returns
- With the exception of the western strip, overall areas of positive net returns increased while areas with negative net returns decreased compared to 2001-2003

Summary

- Despite fertilizer input cost increases of over 40% during the study period, net profitability increased from an average of $9 per acre during years 1-3 to an average of $21 per acre in years 4-6, much more acceptable returns to land and management during this period of stagnant crop prices and rising input costs.
- Winter crops are frequently the only profitable crops during drought periods. Further research on alternative winter crops is warranted, given increasing fluctuations in precipitation and temperature.
- Applying sufficient nitrogen to meet protein goals of 14% in spring wheat was uneconomical in 4 of the 6 years. Premiums per 0.25% protein ranged from 1¢ to 11¢ while discounts ranged from 2¢ to 15¢ during the study period. High nitrogen application rates also negatively impact water quality.
- Reductions in nitrogen fertilizer inputs using precision nitrogen management could achieve yield and protein goals with less cost and less environmental damage.