Table 13. Average variable and fixed costs ($ ac^{-1}) by field operation for an efficient eastern Washington machinery manager using a winter wheat-summer fallow rotation in the Horse Heaven Hills region.

Field Operation	5-year Average Variable Costs	5-year Average Fixed Costs
Sprayer, self-propelled	0.78	1.13
Disk + Tractor	3.34	0.68
Calkins Rodweeder + Tractor	1.35	0.42
Direct Seed Drill & Fert + Tractor	4.46	3.65
Combine	1.31	6.46
Grain Truck	7.57	0.75
Pickup	1.34	0.48
Misc. Equip. (ATV, Welder, Tools)	1.87	2

Table 14. Added costs and breakeven WW yield increases of selected practices to manage aluminum toxicity, 2015.

Practice	Added cost ($/ac/yr)	Breakeven WW yield increase (bu/ac/yr)
#0. Benchmark: Do nothing	0.00	0.00
#1. Cultivate every fourth year w/o lime	5.13	0.84
#2. Cultivate twice every fourth year w/o lime	10.27	1.69
#3. Broadcast 0.5 t/ac/yr lime & incorporate with cultivator	71.85	11.82
#4. Broadcast 0.5 t/ac/yr lime & incorporate with subsoiler	91.27	15.01
#5. Incorporate 0.5 t/ac/yr lime with w/ fertilizer applicator	52.00	8.55
#6. Apply 0.5t/ac/yr lime, seed & fertilizer w/ no-till drill	52.00	8.55
#7. Incorporate 0.5t/ac/yr lime w/ spoke-wheel applicator	91.27	15.01
#8. Adding $30/ac/yr micro-nutrients w/one cultivation/yr w/o lime	50.54	8.31
#9. Harrowing and mowing stubble each year with one cultivation w/o lime	34.69	5.71
#10.Subsoiler 10 to 12 in depth every fourth year w/o lime	9.99	1.64

Notes: All costs are on annual basis. For example, cost of practices implemented every fourth year are divided by four.

The only added cost reported for practices #5 and #6 is the cost of lime and of adding it to the implement ($10/ac) because fertilizer application and direct seeding would be done as part of standard operations.

Added costs are based on P. Patterson and K. Painter. Custom Rates for Idaho Agricultural Operations 2010-2011, Bul. 729, U. Idaho Extension, 2011. Use of custom rates enforces consistent machinery types and costs.

All costs are updated to 2015 using USDA/National Ag. Statistics Service, Quick Stats. Index for Prices Paid Ag Services Custom Rates and Index for Prices Paid for Crop Sector Production Inputs. Price of flour lime delivered to Pullman WA = $84/ton. SOURCE: Mike Harford, J.A. Jack & Sons, personal communication, 12/10/2015.

Break even yield increase = (Added cost)/(farm gate price soft white wheat)

Farm gate Psww = Average 2010, 2014 marketing year prices in Portland - $0.81/bu transportation equals $6.08/bu

Table 15. Farmers' evaluations of surveyed management practices (number farmers expressing evaluation among number answering question).

Practice	Preferred	Least expensive	Most expensive	Most difficult	Table 3 least expensive rank
#1. Single tillage every few years w/o lime	(1 of 5)	(2 of 7)	(0 of 6)	(0 of 2)	1'st
#2. Multi pass tillage every few years w/o lime	(0 of 5)	(1 of 7)	(1 of 6)	(1 of 2)	3'rd
#3. Broadcasting lime and incorporating with cultivator	(1 of 5)	(0 of 7)	(0 of 6)	(0 of 2)	7'th
#4. Broadcasting line and using subsoiler.	(1 of 5)	(1 of 7)	(3 of 6)	(0 of 2)	8'th
#5. Incorporating lime with fertilizer applicator	(1 of 5)	(0 of 7)	(0 of 6)	(0 of 2)	6'th
#6. Incorporating lime, seed and fertilizer with direct seed drill.	(1 of 5)	(3 of 7)	(0 of 6)	(0 of 2)	6'th
#7. Incorporating lime with a spoke-wheel applicator.	(0 of 5)	(1 of 7)	(2 of 6)	(1 of 2)	8'th
#8 Adding few micronutrients each year w/o lime but with 1 or two cultivations.	(1 of 5)	(0 of 7)	(0 of 6)	(0 of 2)	5'th
#9 Harrowing and mowing stubble & 1 or 2 cultivations.	(1 of 5)	(0 of 7)	(0 of 6)	(0 of 2)	4'th

Table 16. Regression data for five farmers supplying complete information for 2010-2014.

WW bu/ac	PPT in/yr	FAL	High Al	Outlier	TILL resist
35.8	12.3	1	7	0	50
64.3	13.0	1	7	0	50
59.0	11.6	1	7	0	50
51.5	10.0	1	7	0	50
36.9	8.1	1	7	0	50
71.0	16.4	0	27	0	50
88.0	20.1	0	27	0	50
85.0	21.2	0	27	0	50
84.0	18.6	0	27	0	50
72.0	13.7	0	27	0	50
64.0	16.3	0	72	1	50
75.0	23.0	0	72	1	50
66.0	21.9	0	72	1	50
55.0	17.6	0	72	1	50
51.0	18.0	0	72	1	50
90.6	17.2	0	84	0	33
99.2	25.2	0	84	0	33
104.8	23.1	0	84	0	33
101.6	18.8	0	84	0	33
77.2	19.8	0	84	0	33
86.6	18.9	0	68	0	50
115.5	25.4	0	68	0	50
105.1	22.8	0	68	0	50
102.7	19.2	0	68	0	50
77.5	20.5	0	68	0	50
97.8	24.3	0	17	0	47
111.0	21.6	0	17	0	47
93.4	24.7	0	17	0	47
105.4	16.6	0	17	0	47
86.8	19.3	0	17	0	47
31.6	12.1	1	30	0	50
38.6	14.2	1	30	0	50
22.3	10.4	1	30	0	50
24.4	10.2	1	30	0	50
12.6	10.0	1	30	0	50

Definitions: FAL = 1 if fallow in rotation, 0 otherwise;

High AL = the highest AL toxicity for the grower over sites, soil depths and seasons

Outlier = 1 for a grower with statistically different yield pattern due to unique management, = 0 for others

TILL resist = a multiplicative index of resistance to tillage based on grower's survey responses