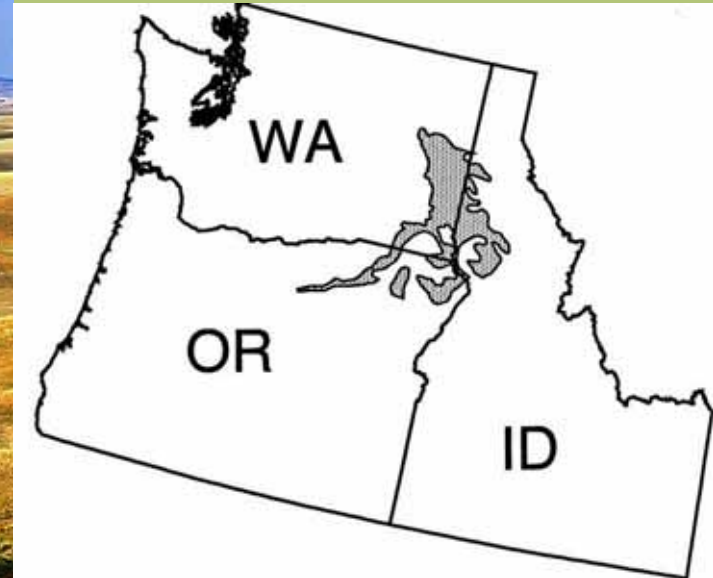


Integrating livestock and organic grain production in the Inland Northwest, U.S.

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The Palouse



- 0.8 million ha
- 300-600 mm annual rainfall
- 7-50 % slopes
- Elevation: 760 m
- Export-oriented annual grains
- Chemical intensive
- Highly productive: ~200 bu wheat/ha

What is crop-livestock integration/mixing?



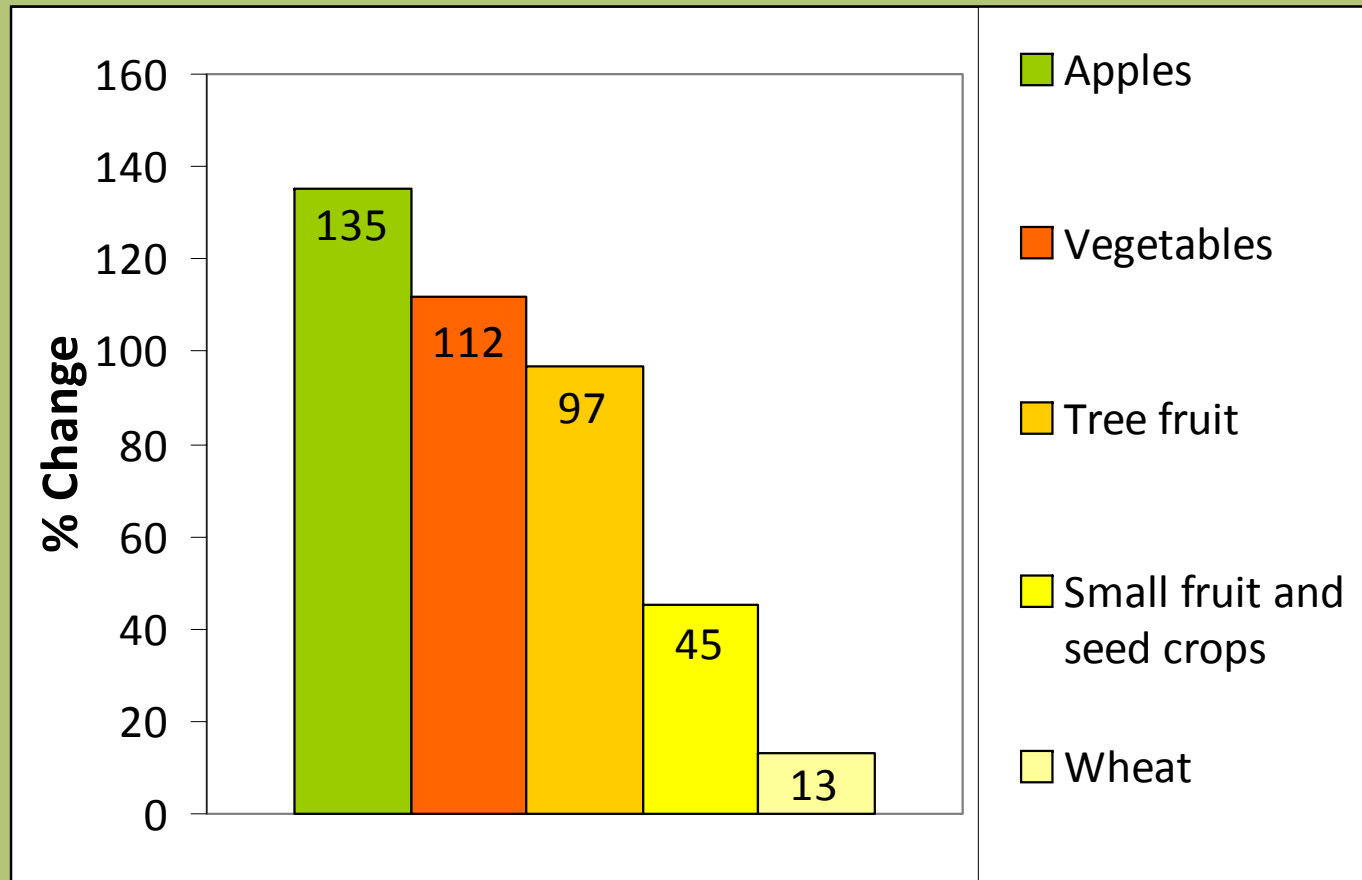
Basic: Various combinations of crop and livestock production, different length phases

Essential: same fields, same crop rotation, cycling of inputs and “wastes”

Why crop-livestock integration?

1. Shortage of organic grain production in the US northwest
2. Monoculture wheat production in the Palouse is dependent on fossil fuel and fertilizers
3. Current farming practices have degraded the natural resource base and are not sustainable
4. Integrating livestock into farming systems has economic and environmental benefits

% change in acreage of certified organic land in Washington State, 2000-2006



Wheat monocultures depend on chemicals

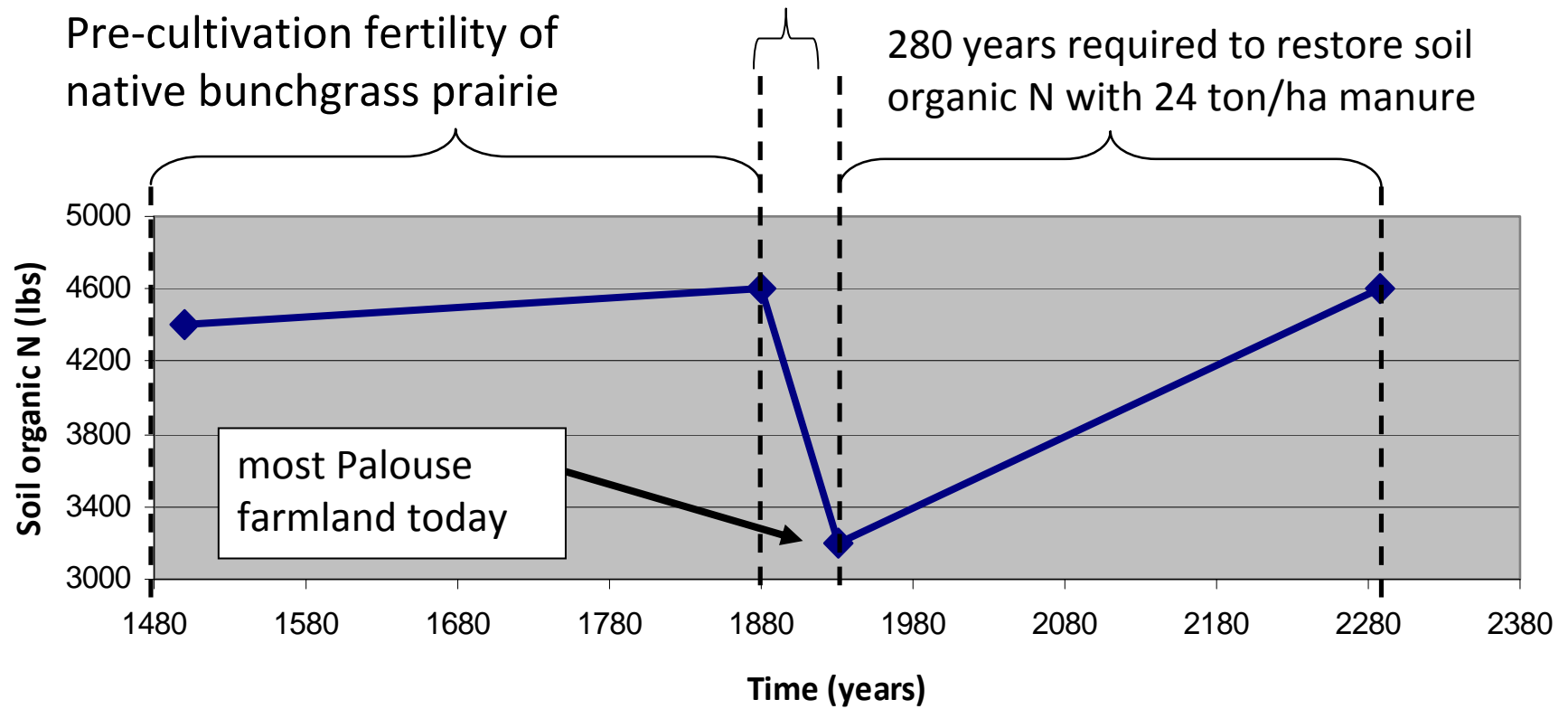
Washington, 2005:

- % wheat acreage receiving N fertilizer 88.5
- Kg N fertilizer applied annually 93.3 million
- % nitrogen recovery 30-50
- Kg a.i. biocides applied annually 453,000

Significance

Impact of agriculture on soil organic nitrogen in the Palouse

50 yrs intensive agriculture



4000 years of resource eliminated in 60 years

adapted from Rasmussen, 1989

Soil and water conservation in crop-livestock systems

Hydraulic properties in Palouse prairie an 10x “better”
than 27 years no-till (Fuentes, 2004)

First steps for crop-livestock research in the Palouse

Research objectives:

1. Determine the impact of tillage on grain yields following grazed alfalfa pasture
2. Determine the impact of tillage on soil nitrogen concentrations
3. Determine the impact of soil moisture on soil nitrogen concentrations
4. Identify potential nitrogen leaching when transitioning from a perennial to an annual
5. Assess profitability of crop-livestock integration

Hypotheses

1. Minimum tillage will work for perennial pasture to grain without herbicides
2. Soil nitrogen fertility following legume pasture is sufficient for good grain yields
3. More disruptive tillage—plow—will result in higher soil inorganic N concentration
4. Soil moisture should impact soil inorganic N
5. Termination of leguminous pasture may result in N accumulation, possibly a problem in organic systems

Three tillage treatments to transition:

from pasture...



...to wheat

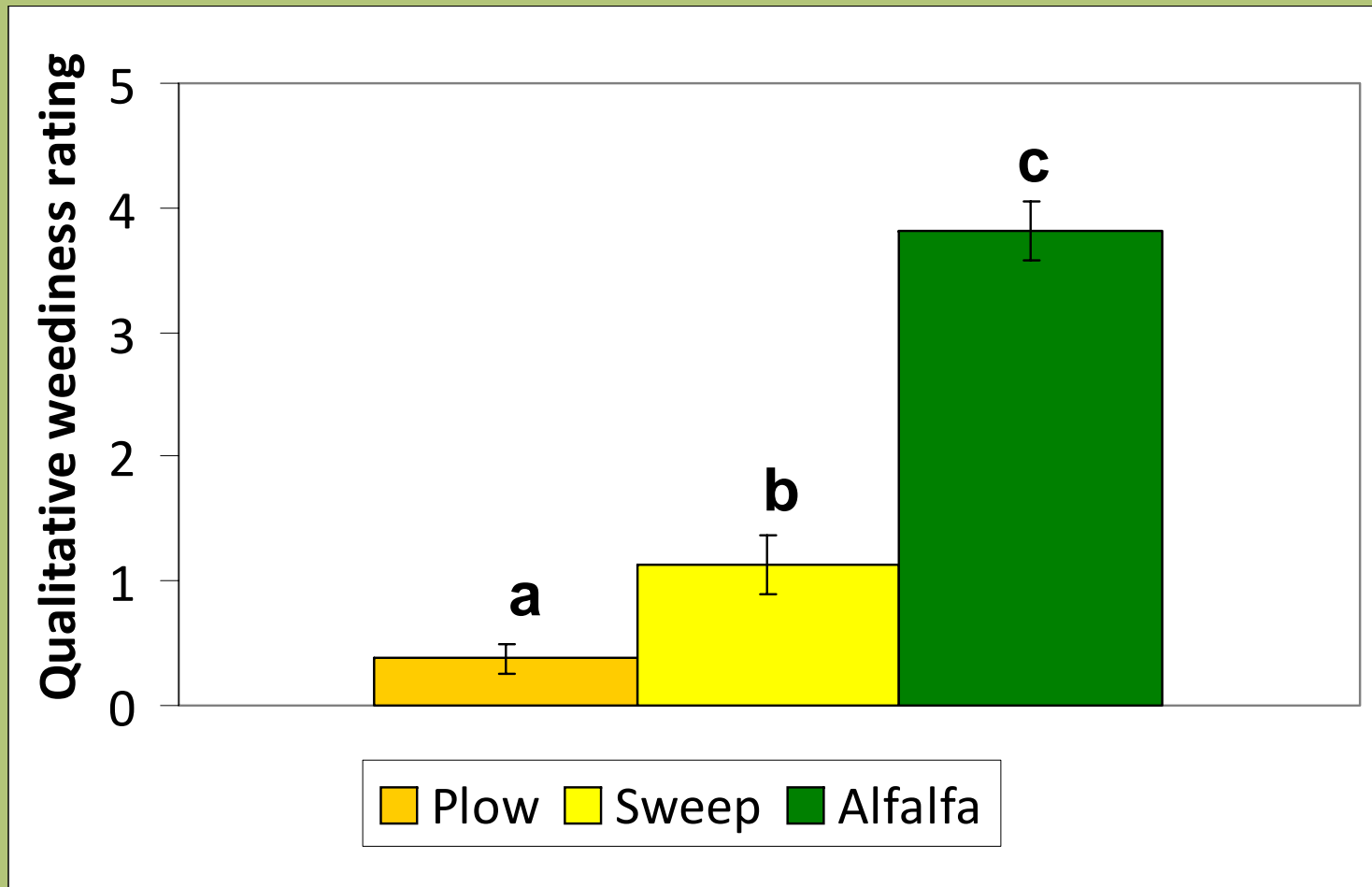


1. Moldboard plow
2. Under-cutting sweep
3. Alfalfa control

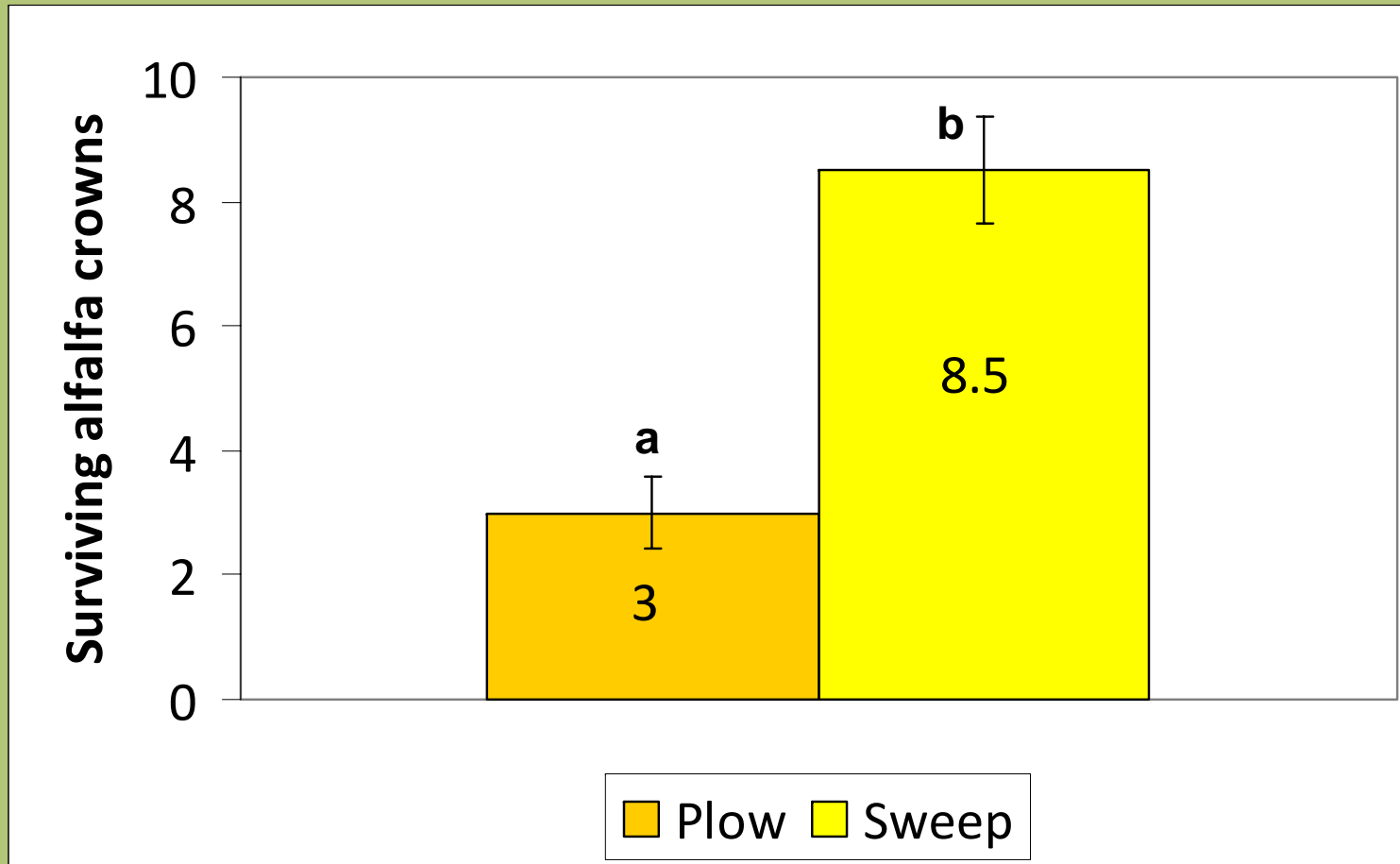
Data collection

1. Weediness
2. Alfalfa kill
3. Grain yield
4. Soil nitrogen
5. Soil water content
6. Economic data

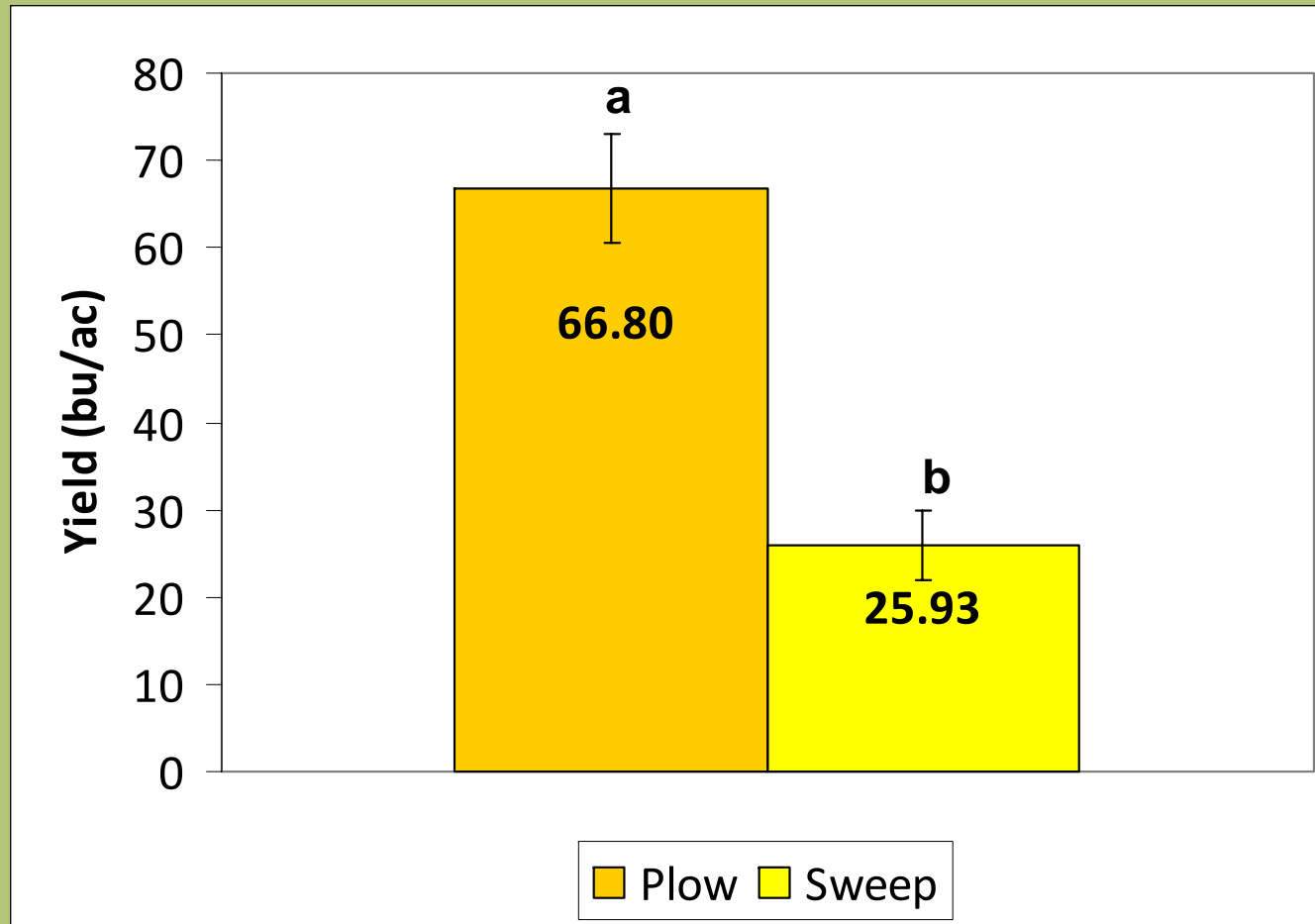
Effect of tillage on weediness



Effect of tillage on alfalfa crown survival



Effect of tillage on grain yield (bu/ha)



Results

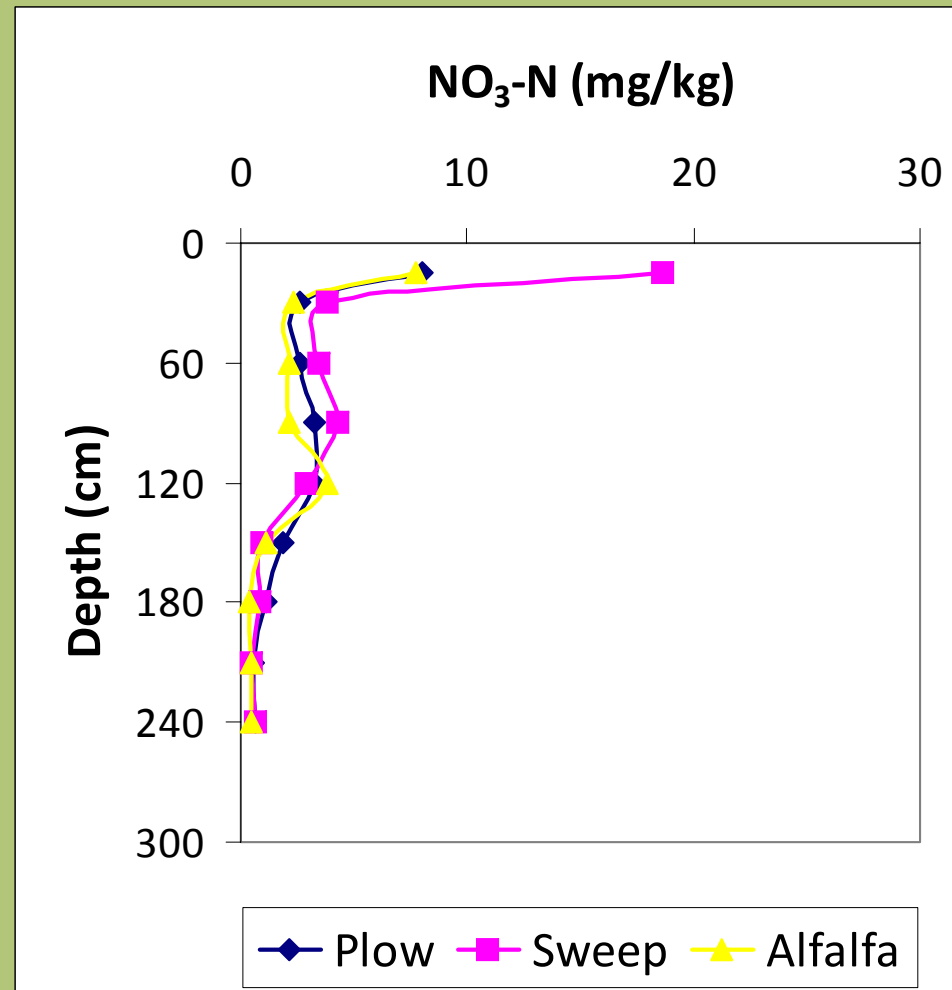
Effect of tillage on soil NO₃-N

fall 2007, non-incubated

Sweep vs alfalfa $P > 0.0149$

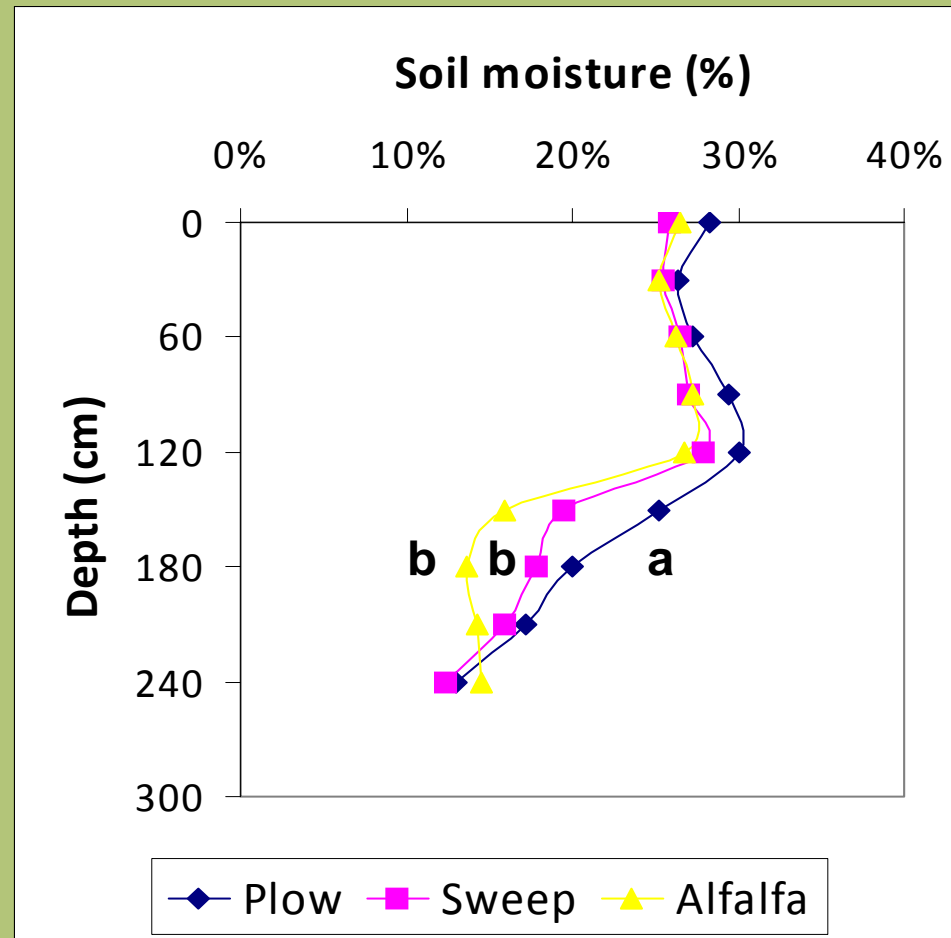
Sweep vs plow $P > 0.0542$

Alfalfa vs plow $P > 0.5938$



Statistical model: repeated measure

Effect of tillage & depth on soil moisture fall 2007



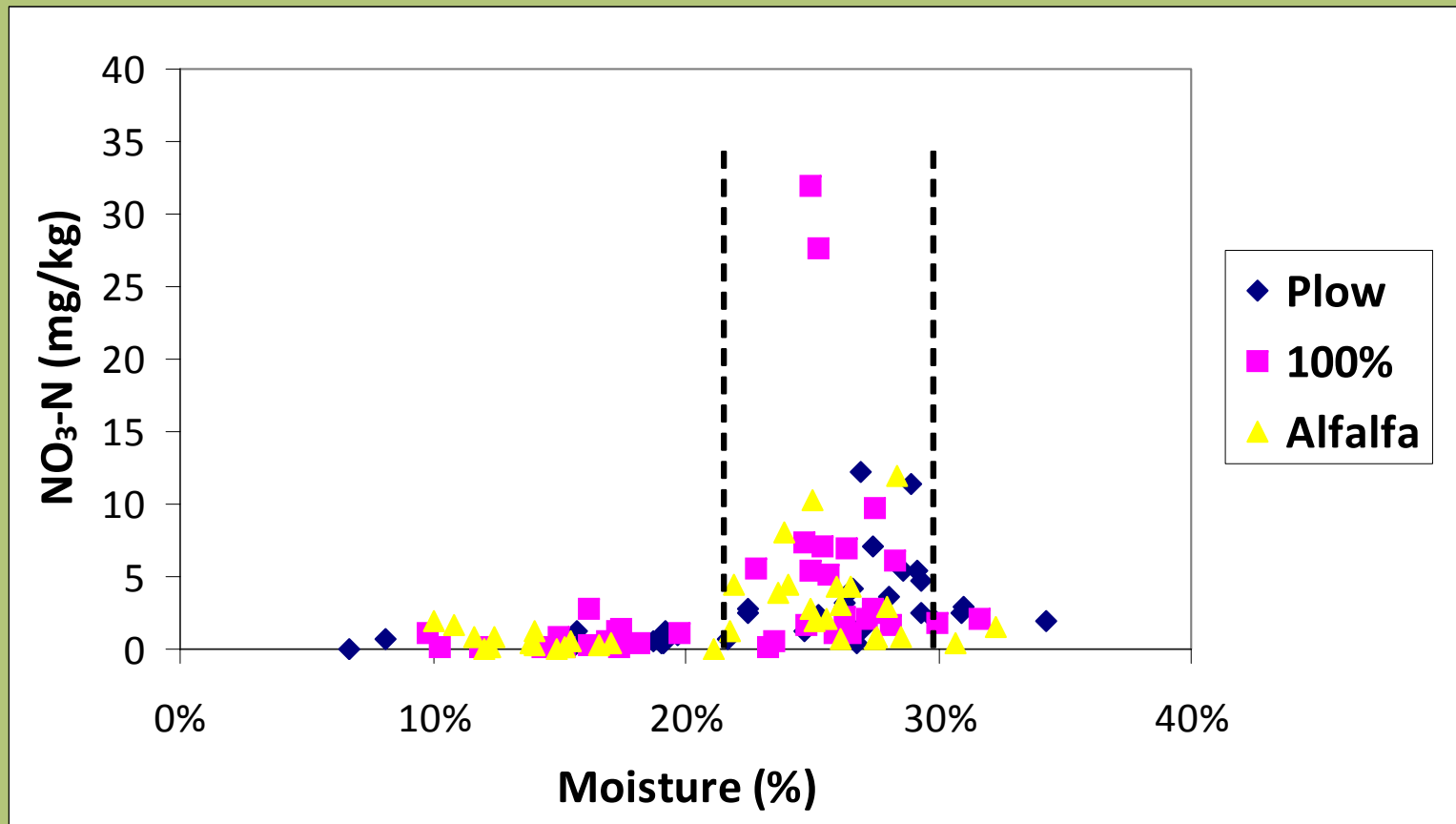
Statistical model: repeated measure

Results

Effect of soil moisture on soil NO₃-N

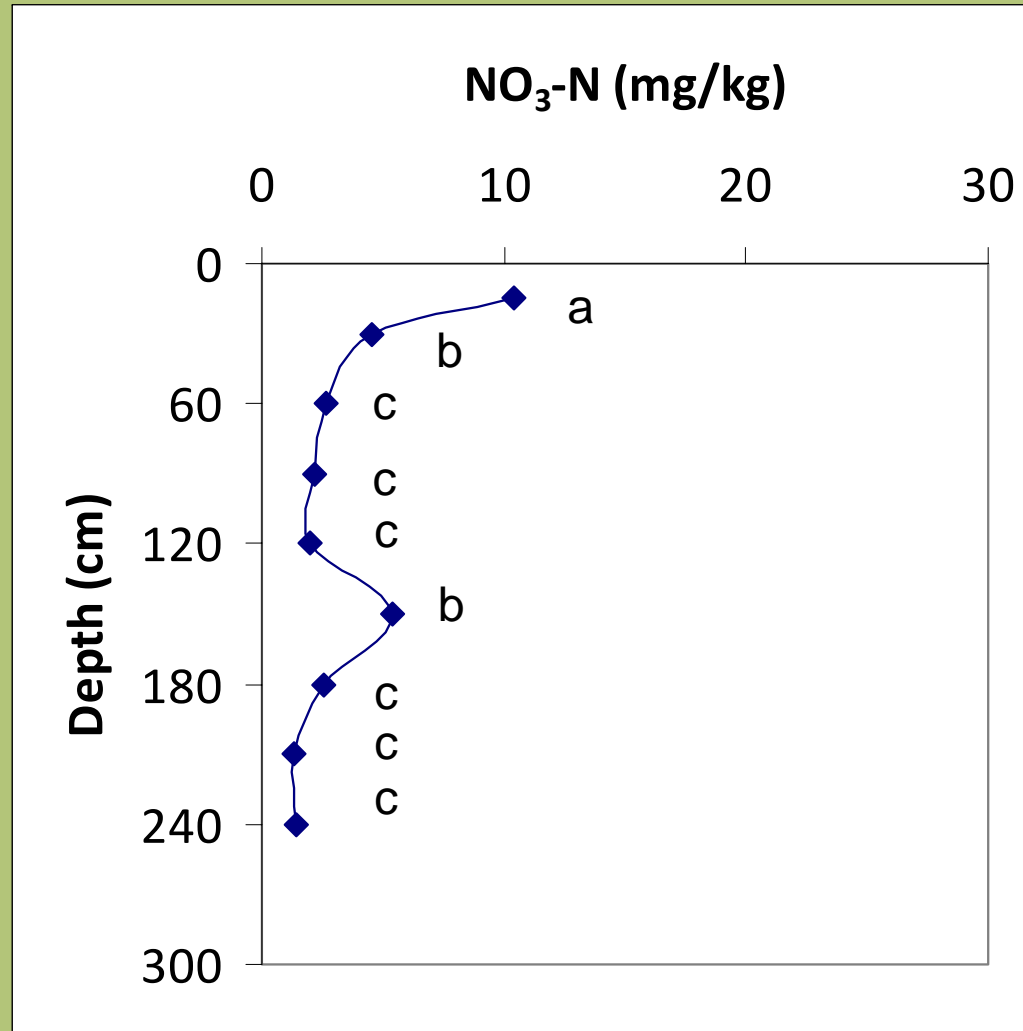
moisture as a covariate effect: $P > 0.2124$

Fall 2007, non-incubated



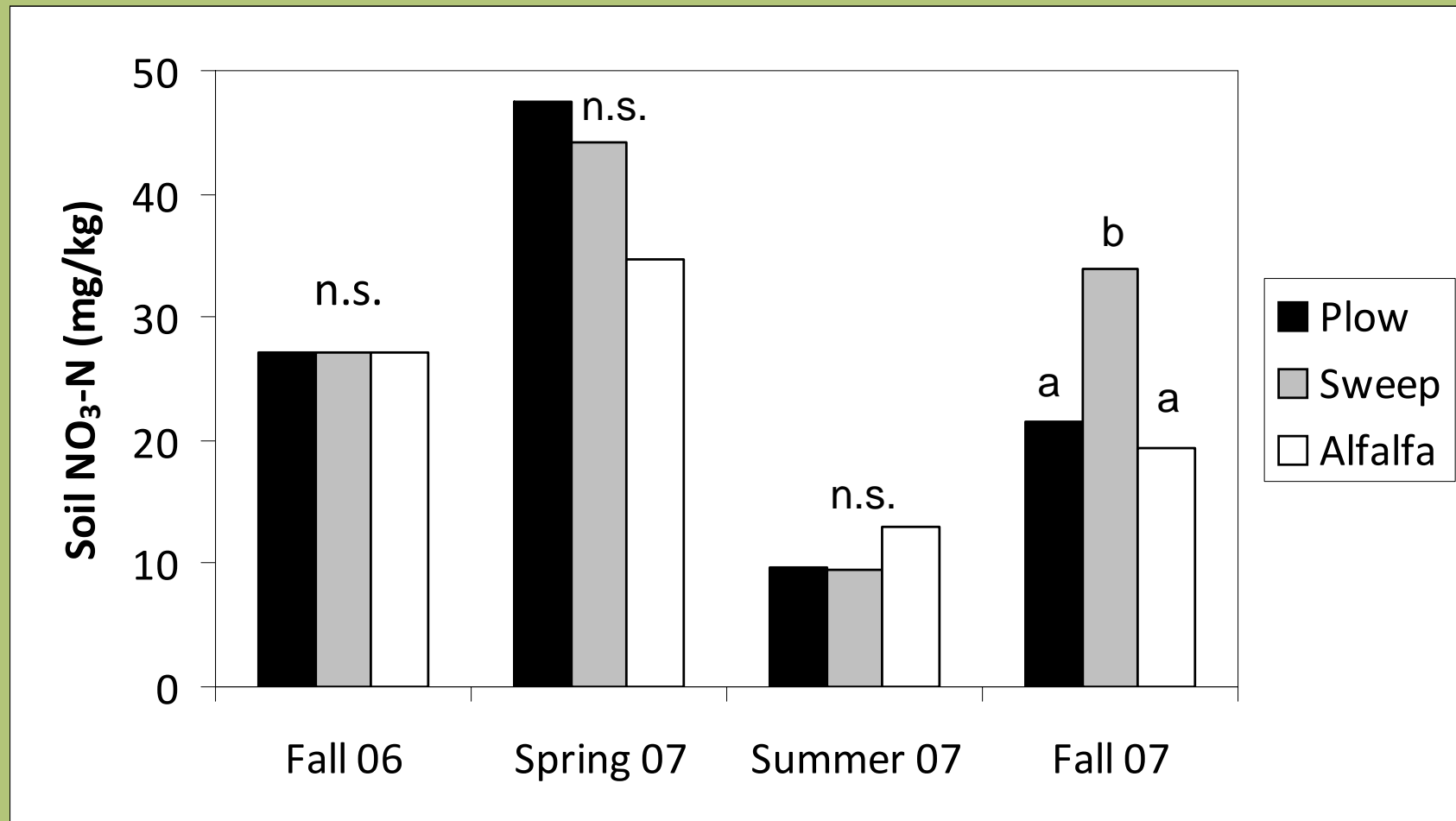
Statistical model: ANCOVA

Effect of depth on soil NO₃-N in alfalfa



Statistical model: repeated measure

Summary of tillage effects on soil nitrogen over time



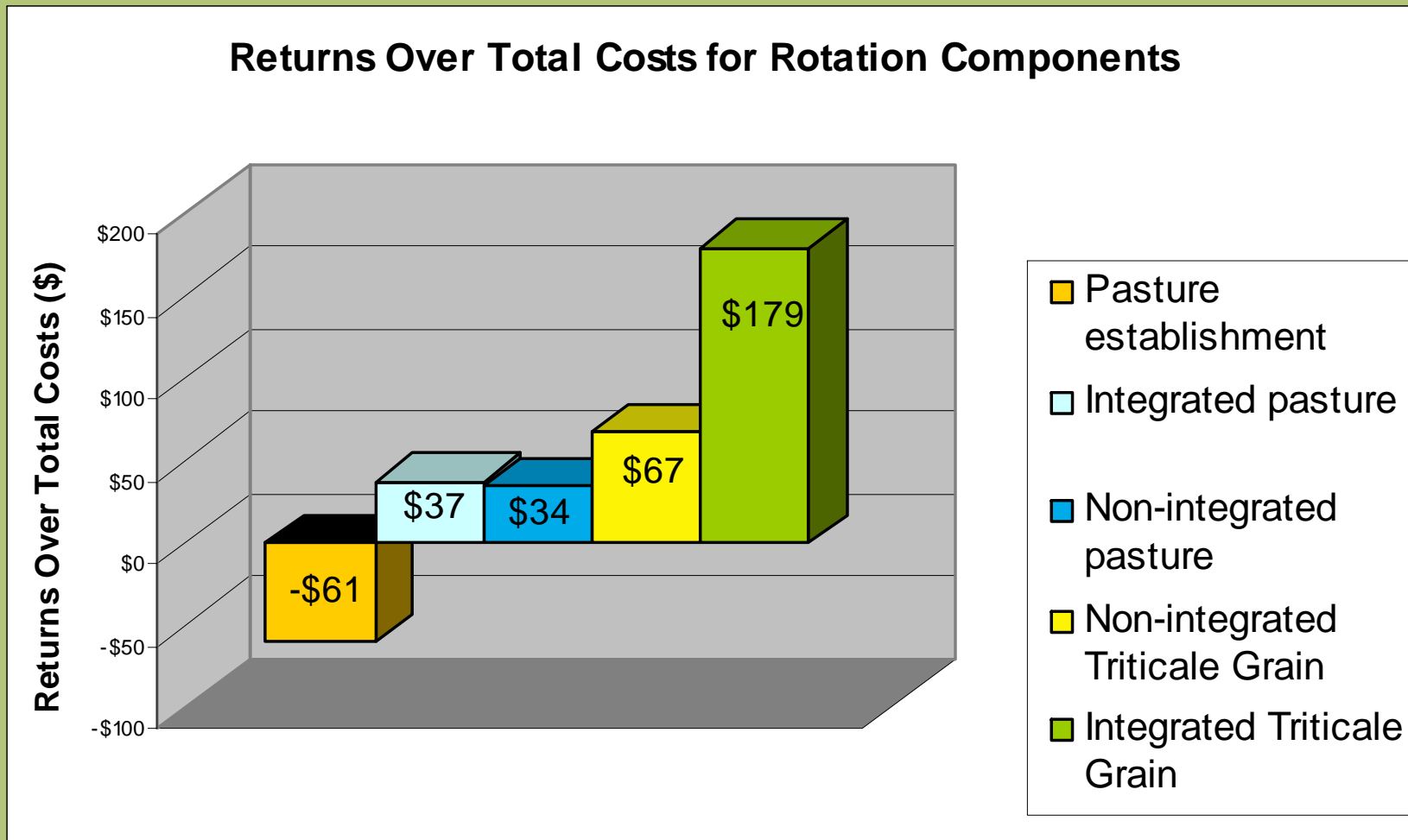
Statistical model: depth as repeated measure

Profitability of integrated vs. non-integrated

Returns over total costs for:

- Pasture establishment
- Grazing
- Grains following pasture
- Grains alone

Profitability of integrated vs. non-integrated



Results

How?

from manure...

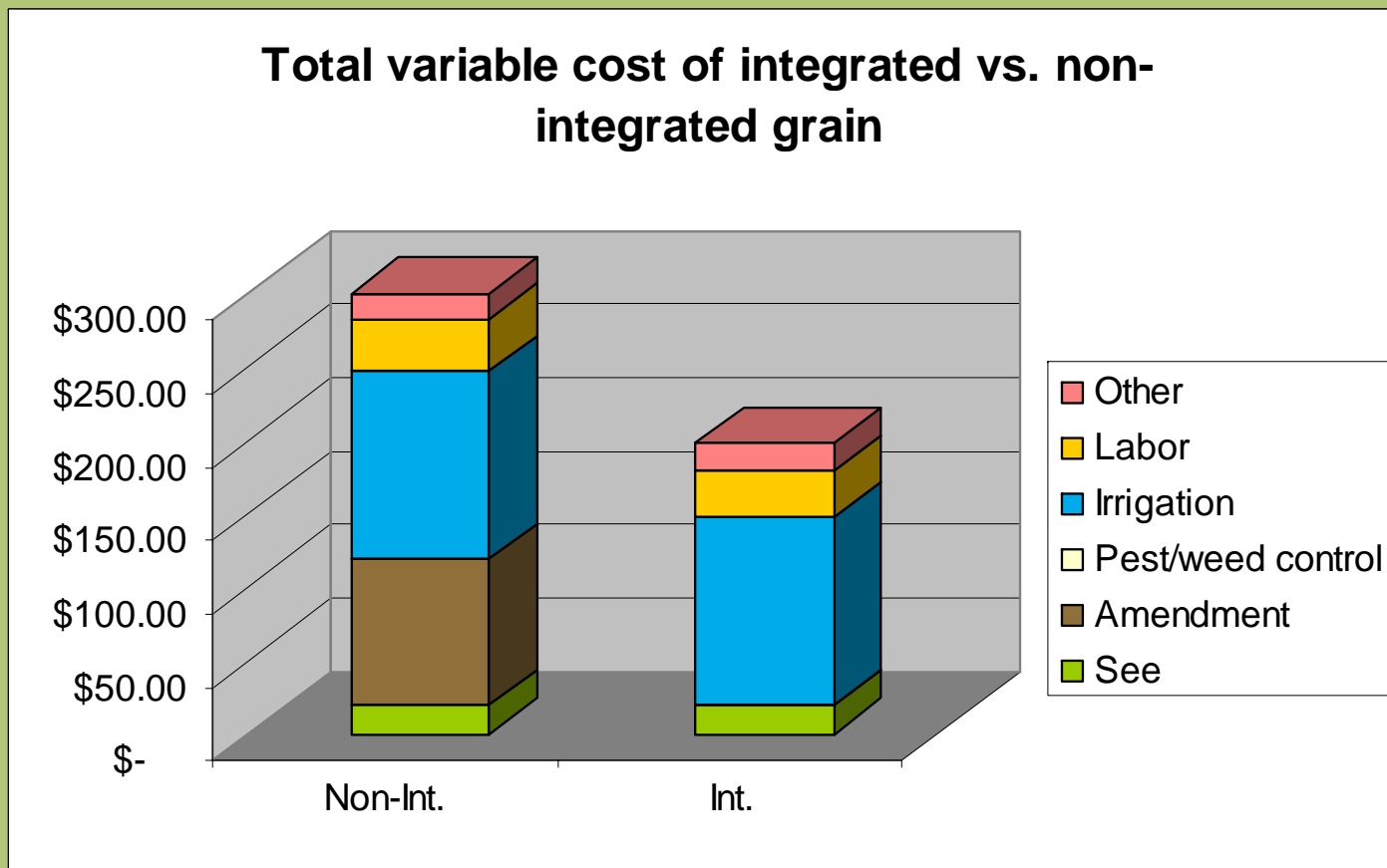


...to fertility



Crop-livestock integration reduced inputs

Pesticides: 0 kg, fertilizers: 0 kg



Discussion & conclusions

- Minimum tillage: 38.8 percent yield of plow
- Grain yield: 82 percent of County average*
- Profitability of grain rotation phase: integrated 2.67x more profitable than non-integrated
- Profitability of whole rotation: integrated 10 percent more profitable than non-integrated
- Very little effect of tillage on nitrogen mineralization
- No effect of soil moisture on nitrogen mineralization

* zero inputs in integrated system compared to high input conventional system

Discussion & conclusions

- Minimum-till pasture termination: inadequate as yet
- Amendments: may improve grain yield to average
- Fertilizers and pesticides: reduce substantially or eliminate in some cases
- Tillage impact on soil N: not what we expected...more subsampling (block x treatment interactions)
- Soil moisture: no clear relationship using a linear statistical model, part of the picture of N mineralization
- Profit: reduced inputs costs may be very important

Thank you



photo by John McAnulty