Mixed crop-livestock farming systems for the inland Northwest U.S.

Stephen Bramwell[1], Lynne Carpenter-Boggs[2], David Huggins[3], John Reganold[1], Kate Painter[2], and Joel Huesby[4]

[1]Washington State University, Dept. Crop & Soil Sciences; [2]WSU Center for Sustaining Agriculture and Natural Resources; [3]USDA-ARS Soil Conservation and Land Management Unit; [4]Thundering Hooves

Mixed crop-livestock farming systems—aka integrated crop-livestock systems—consist of crops and livestock incorporated in spatially and/or temporally overlapping ways on individual farms, or between nearby farms.

Basic Types:

1. Single-year alternation between harvested annual crop (usu. grain) and grazed annual crop(s) on the same field
2. Longer rotations of 3 to 12 or more years of perennial grasses, legumes, or mixes followed by an equal or lesser duration of annual crops (phase systems)
3. Grazing and resource-sharing collaborations between separate crop and livestock producers in close proximity (ex: stubble grazing)

Common Benefits of Integration

- Efficient use of natural resources
- Utilize natural pest control mechanisms
- Make use of 'waste' resources
  - o livestock manure
  - o crop residues
- Improve soil quality and productivity

Disadvantages and Barriers to Integration

- Knowledge-intensive systems
- Changes in management and labor costs/demands
- Infrastructure: watering systems, livestock processing
- Difficulty balancing year-round forage supplies
- Other wintering issues: compaction, livestock facilities/location
- Marketing costs
- Livestock less profitable than wheat some years
- Possible water depletion under deep-rooted perennials
- New, complicated N loss pathways
- New weeds, transfer of weeds

Trials at Thundering Hooves

1. Can conservation tillage be applied to perennial-annual transitions in mixed crop-livestock systems?
2. What is the impact of tillage on soil N:
   Does more tillage mineralize more N?
3. What is most profitable: grazed alfalfa, a grazed alfalfa-wheat rotation, or a hayed alfalfa-wheat rotation?
4. Is N fixed by pasture sufficient to produce competitive grain yield?

Undercutting Sweep | Moldboard Plow | Control Alfalfa

Table 1. Triticale grain yield, aboveground biomass, surviving alfalfa crowns, and weed index July 12, 2007.

	Triticale grain yield (kg ha^{-2})	Biomass (g m^{-2})	Alfalfa crowns (# m^{-2})	Weed Index (0-5)
Plow	4200^{a}	383^{a}	5.5^{a}	0.38^{a}
Sweep	1630^{b}	601^{b}	8.25^{b}	1.13^{b}
Alfalfa	-	668^{c}	11^{c}	3.81^{c}

Table 2. Average annual variable costs, fixed costs and returns for three organic crop rotation options.

	Grazed alfalfa-wheat rotation	Hayed alfalfa-wheat rotation	Continuously grazed alfalfa
Revenue	$ 696.20	$ 1,448.20	$ 548.60
Seed	$ 13.99	$ 13.99	$ 5.50
Amendments	$ -	$ 70.00	$ -
Irrigation	$ 157.00	$ 160.30	$ 175.00
Labor	$ 71.29	$ 254.35	$ 92.18
Other:	$ 46.22	$ 225.64	$ 50.28
Overhead	$ 14.43	$ 36.21	$ 16.15
Operating Interest	$ 6.72	$ 16.88	$ 7.53
Ownership Costs	$ 218.61	$ 329.74	$ 162.24
Net Return	$ 167.94	$ 341.08	$ 39.72

Table 3. Effect of price variation for alfalfa, wheat and beef on net returns for three organic crop rotation options

Base prices	Alfalfa $200 ton^{-1}	Wheat $15 bu^{-1}	Beef: $1 lb^{-1}
Alfalfa price sensitivity	$150	$200	$250
GGR	$ 167.94	$ 167.94	$ 167.94
HGR	$ 57.78	$ 341.08	$ 624.38
CG	$ 39.72	$ 39.72	$ 39.72
Wheat price sensitivity	$11.25	$15	$18.75
GGR	$ 89.19	$ 167.94	$ 246.69
HGR	$ 262.33	$ 341.08	$ 419.83
CG	$ 39.72	$ 39.72	$ 39.72
Beef price sensitivity	$0.75	$1.00	$2.00
GGR	$ 156.34	$ 167.94	$ 214.34
HGR	$ 341.08	$ 341.08	$ 341.08
CG	$ (97.43)	$ 39.72	$ 588.32

CONCLUSIONS

- Conservation tillage (sweeps): 61% yield penalty
- More work needed for minimum-till pasture eradication
- Very little effect of tillage on nitrogen mineralization
- Grain yield after moldboard: 82% of County conventional average
- Considerable reduction of inputs is possible
- Integrated more profitable than non-integrated
- Livestock integration promises to provide significant economic and environmental benefits in the Palouse