TITLE: Developing Flex Cropping Options for Wheat-Fallow Rotations

INVESTIGATORS:

Principal Investigators: Don Wysocki, Extension Soil Scientist, OSU, and Pendleton
Grower Cooperators: Bryan Jones, Robert Newtson, Jeff Shaw, and Jerry Simpson, Helix and Pilot Rock Oregon
University Cooperators: Bill Payne, Agronomist, OSU Pendleton; Dan Ball, Weed Scientist, OSU Pendleton; Dale Wilkins, Agricultural Engineer, USDA-ARS, Pendleton.
NRCS Cooperators: Tom Gohlke, Agronomist, Portland.

FINAL REPORT

PROJECT OBJECTIVES:

1. To describe and identify workable flex cropping (FC) systems.

2. To Establish on-farm and research center trials to address grower's most critical FC soil and crop management questions

3. To conduct an economic analysis of FC system

KEY WORDS: Annual cropping, direct seeding

STATEMENT OF PROBLEM: Major changes in the Federal farm program and continued decline of soil resources pose two difficult challenges to wheat producers throughout the dryland Pacific Northwest. This is particularly critical for producers who have traditionally practiced winter wheat-summer fallow rotations. In the next several years the national farm program will transition from a subsidy based program to one that is market oriented. This transition is a major change in program philosophy from that of the past 60 years. Subsidy payments will be incrementally reduced to zero in the transition. At program conclusion, producers will receive no deficiency payment; they will receive the market price. In the past, deficiency payments have kept the price received by the producer at about $4/bushel. To operate in this system, growers must become more flexible so they can react to market trends. Flexibility means planting different crops (those with better profit margins), growing different market classes of wheat or annual cropping in favorable years.

A second challenge facing wheat producers is the continued decline of soil resources. At the farm and field level, erosion and loss of soil organic matter in winter wheat-summer fallow (WF) fields threaten crop productivity and long-term farm sustainability. At the watershed level, they affect ecosystem health and surface water quality. Fortunately, FC may assist producers in addressing this challenge. Intensifying crop rotations and/or using rotation crops in FC systems improves protection from erosion and increases the amount of carbon cycled to the soil. Farmers, fields, and the environment are all better off when FC replaces WF cropping systems. Higher risk, greater workload, and the learning curve involved with changing systems are factors that deter producers from FC.

AGRONOMIC ZONE OF INTEREST: This project focused on FC systems that have direct application in agronomic zones 3, 4, and 5 (Douglas et al. 1990). Soils in these zones are primarily, Condon, Valby, Morrow, Ritzville, Shano, or Walla Walla silt loams with a few very fine sandy loam analogs. Annual precipitation ranges from 8 to about 16 inches. Information obtained during this project will also have application to agronomic zones 1 and 2. This project will be conducted in areas that traditional have been in winter wheat-summer fallow rotation. The purpose of the project is to assist growers in developing flex-cropping option that can replace summer fallow in these systems.

ABSTRACT OF RESEARCH FINDINGS: This project was initiated in the summer of 1997. Experiments have been conducted to address grower questions and needs. Trials were discussed with cooperators and established in the spring of 1998. Research results were discussed with participating producers and presented at grower meetings. Rotations that include cereal grain and limited tillage offer the greatest economic return. Spring wheat and yellow mustard are responsive to applied sulfur. Sulfur applied with the seed at 10 lb/acre showed yield increases of up to 30 percent. Response to phosphorus was much lower (about 3-5 percent). No response was observed with applied chloride.

RESULTS AND INTERPRETATIONS: Experiments that addressed cropping systems questions were conducted during this project. These trials were designed in consultation with growers and project investigator. When producers convert from fallow rotations to more intensive cropping, fertilizer and tillage management decisions must be made with little previous experience. Growers must decide when to till and fertilize and at what rate to fertilize.

<u>Rotation, tillage and fertilizer timing</u>

Fertilizer timing, crop rotation, and tillage practices in a spring wheat cropping system were compared in an experiment on the Pendleton station. The study compared the performance of spring wheat following spring Canola or spring wheat, with and without fall disking, using fall or spring fertilizer application. Adjacent areas that had grown spring Canola (1200 lb/ac yield) and spring wheat (50-bu/ac yield) were prepared in the fall of 1997. Specific tillage or fertilizer operations were applied to achieve the experimental variables (Table 1.). Six replications of each treatment were established in the trial. Each tillage plot was 28 X 48 feet. Half of each tillage plot received N fertilizer in the fall, with the remaining half fertilized in the spring. Consequently, individual plots of each treatment after sowing were 24 X 28 feet. Fall disking was done with a Sunflower offset disk (26" dia. disks, 3" concavity) pulled 4-inches deep at 4 mph. Nitrogen fertilizer was applied using a spike wheel injector. Plots were seeded using a direct seed Flexicoil 5000 drill equipped with stealth openers. Starter fertilizer was placed below the seed row with the stealth openers. Timing of these various operations is shown in Table 2. All plots were supplied with phosphorus, sulfur and starter nitrogen through the addition of 100 lb/acre 16-20-0-14 with the drill at planting. Yields from the various treatments are shown in Table 3. Rotation had the greatest influence on yield of spring wheat. Wheat following Canola yields about 10 percent higher than spring wheat following spring wheat. Timing of fertilizer and tillage had no effect when wheat followed Canola, but it did have an effect on wheat following wheat. Spring wheat did better when plots were fall disked and fertilized in the spring. The specific reason for this response is not known, it could be a direct soil temperature response or an indirect response to soil borne diseases. The results of this study suggest that rotations with non-cereals can reduce tillage operations and yet get equivalent yields. Direct seeding into non-cereal residue is the least cost system and yields were same whether fertilizer was fall or spring applied. Under this system, a single direct seed operation would be the best option. When wheat follows wheat, some type of residue management may be needed to maintain optimum yields.

Table 1. Agronomic treatments in annual cropping spring wheat trials, Pendleton, Oregon 1997-98.

Treatment Abbreviation	Previous Crop	Fall Tillage	Amount & Timing of Nitrogen Application	
			Fall	Spring
C-O-S	S. Canola	None	None	80 lb/ac
C-D-S	S. Canola	1X Disk	None	80 lb/ac
C-O-F	S. Canola	None	80 lb/ac	None
C-D-F	S. Canola	1X Disk	80 lb/ac	None
W-O-S	S. Wheat	None	None	80 lb/ac
W-D-S	S. Wheat	1X Disk	None	80 lb/ac
W-O-F	S. Wheat	None	80 lb/ac	None
W-D-F	S. Wheat	1X Disk	80 lb/ac	None

Table 2. Field operations for annual crop spring wheat trials, Pendleton, Oregon 1997-1998.

Operation	Implement	Date	Amount/acre	Speed (mph)	Soil Condition
Fall N Fertilize	Spike Wheel Injector	23 Oct	80 lb N Solution 32	3	Dry
Disk	Offset Disk	24 Oct		4	Dry
Herbicide	Sprayer	19 March	20 oz Glyphosate	5	
Spring N Fertilize	Spike Wheel Injector	25 March	80 lb N Solution 32	3	Moist
Seed & Starter Fertilize	Flexicoil 5000 air drill 7.5-inch spacing	7 April	100 lb Alpowa Spring wheat 80 lb 16-20-0-14	3	Moist
Herbicide	Sprayer	19 May	1 pt Bronate	5	
Harvest	Hege plot combine	29 July			

Table 3. Yield and test weights from annual spring wheat cropping trials, Pendleton, Oregon, 1997-98.

Treatment	Test Weight lb/bu	Yield Bu/ac	Gross Return $/acre
C-O-S	58.1	38.7	116.1
C-D-S	57.4	38.5	115.5
C-O-F	58.3	38.7	116.1
C-D-F	57.5	38.7	116.1
W-O-S	57.9	32.7	98.1
W-D-S	58.5	37.1	111.3
W-O-F	59.0	33.4	100.2
W-D-F	58.8	34.8	104.4

Sulfur, Phosphorus and Chloride Fertilization

Growers in Sherman and Wasco counties have reported greater response to sulfur than to phosphorus on spring annual-cropped wheat and barley. Since sulfur and phosphorus are usually recommended on spring crops, we investigated the interaction of sulfur, phosphorus, and chloride on spring wheat at Moro, Oregon. All plots received a uniform N application of 65 lb/acre. The previous crop was spring barley. The soil was prepared by spring chisel plowing, fertilizing, harrowing and planting. We applied

20, 10 and 10 lb/ac P2O5, S, and Cl respectively in different treatments (Table 4). We observed no response to chloride, a 9-10 bushel response to sulfur, a 6-8 bushel response to P2O5, and a 13-bushel response to sulfur and phosphorus together (Table 5.). Application of ten pounds of sulfur returned over $25/acre compared to the check (no sulfur). Application of phosphorus returned just under $8/acre and chloride returned under $2/acre).

Table 4. Nutrient treatments in the seed row on Alpowa spring wheat, Moro, Oregon, 1998

Treatment	Nutrient #/acre		
	P	S	Cl
1	15	10	10
2	15	10	0
3	15	0	10
4	0	10	10
5	15	0	0
6	0	10	0
7	0	0	10
8 Check	0	0	0

Table 5. Chloride, sulfur, and phosphorus response to spring wheat at Moro, Oregon, 1998.

Treatment	Yield bu/acre	Yield above the Check bu/acre	Income above the Check $	Cost of Product $/acre	Net Profit $/acre
P, S, Cl	45.8	13	38.26	12.20	26.06
P,S	45.7	13	37.98	10.20	27.78
P, Cl	40.7	8	22.77	12.20	10.57
S, Cl	42.8	10	29.13	4.16	24.97
P	39.1	6	18.15	10.20	7.95
S	42.1	9	27.21	2.16	25.05
Cl	34.4	1	3.93	2.00	1.93
CHECK	33.1	0	0	0	0.00

Results from the 1998 crop year caused us to further investigate the sulfur and phosphorus response. We have planted a sulfur X phosphorus trial, with several check treatments at both Moro and Pendleton. Treatments consisted of increasing rates of both sulfur and phosphorus, along with the checks (Table 6). Most P and S fertilizers contain nitrogen. We used 0-45-0 (TSP) and calcium sulfate (gypsum) as P and S sources respectively. Neither of these materials contains fertilizer N. This allowed us to vary both P and S without varying nitrogen. Check treatments included common sources of P and S used by growers. This provides a control with the commonly used sources. At the Sherman, station the experiment again should a response to sulfur and a minor response to phosphorus. The experiment at the Pendleton station did not show a response to either phosphorus or sulfur. Yields at the Sherman station respectively for 0, 10, 20, 30 lb/acre added sulfur were 18.4, 22.3, 21.2, 23.3 bushels/acre (Table 7). The addition of 10-lb/acre sulfur increases yields by about 4 bushel/acre or about 21 percent. Higher rates of sulfur did not result in increased yields.

Table 6. Phosphorus and sulfur treatments on Alpowa Spring Wheat, Moro and Pendleton, 1999

<table>
<tr><td rowspan="2">Lb/ac S as gypsum</td><td colspan="4">Lb/acre P2O5 as 0-45- 0 (TSP)</td><td colspan="2">Paired Controls</td></tr>
<tr><td>0</td><td>10</td><td>20</td><td>40</td><td rowspan="2">Treatment 17
21-0-0-24 (87)</td><td rowspan="2">Treatment 18
Gypsum + N</td></tr>
<tr><td>0</td><td>Treatment 1</td><td>Treatment 5</td><td>Treatment 9</td><td>Treatment 13</td></tr>
<tr><td>10</td><td>Treatment 2</td><td>Treatment 6</td><td>Treatment 10</td><td>Treatment 14</td><td rowspan="2">Treatment 19
16-20-0-14 (75)</td><td rowspan="2">Treatment 20
Gyp + TSP + N</td></tr>
<tr><td>20</td><td>Treatment 3</td><td>Treatment 7</td><td>Treatment 11</td><td>Treatment 15</td></tr>
<tr><td>30</td><td>Treatment 4</td><td>Treatment 8</td><td>Treatment 12</td><td>Treatment 16</td><td rowspan="2">Treatment 21
11-52-0 (40)</td><td rowspan="2">Treatment 22
TSP + N</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Table 7. Phosphorus and sulfur response to spring wheat at Moro, Oregon, 1999

P205 lb/acre	Yield Bu/acre	S lb/acre	Yield Bu/acre
0	19.9	0	18.4
10	20.7	10	22.3
20	22.3	20	21.2
40	22.2	30	23.3

INTERACTION WITH OTHER SCIENTISTS CONDUCTION RELATED ACTIVITY

This project is complimentary to other cropping system projects currently funded STEEP III projects. Investigators in this project communicate with investigators on these projects. This includes Steven Guy, Frank Young, Dan Ball, and Bill Schillinger.

PRESENTATIONS: Results were presented at six field days, five industry meetings and to the Oregon wheat Commission