RESEARCH PROJECT TITLE: Examine the effect of cropping systems that include canola (*Brassica* napus L.), yellow mustard (*Sinapis alba* L.) or Oriental mustard (*B.* juncea L.) on yield of subsequent winter wheat in the Pacific Northwest.

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FINAL REPORT: Year 1 & 2 combined.

PROJECT OBJECTIVE:
- To determine yield potential of Oriental mustard compared to canola and yellow mustard under different rainfall regions under direct seed systems.
- Compare water use of Oriental mustard with water use of spring wheat, canola and yellow mustard under direct seed systems

KEY WORDS: yellow mustard, oriental mustard, canola, water use, rotation.

ZONE OF INTEREST: annual cropping; low, intermediate and high rainfall; non-irrigated.

ABSTRACT OF RESEARCH FINDINGS:
Results from this research suggest that in dry years Oriental mustard and yellow mustard deplete deep profile soil moisture more than spring wheat. Both mustard crops have very aggressive root systems and one might speculate that this deep soil depletion could have a negative impact on subsequent crops. A better understanding of the effect of Oriental and yellow mustard in crop rotation with small grain cereals will help increase mustard acreage in the Pacific Northwest, which will offer Pacific Northwest growers increased flexibility in crop rotation, greater profitability and competitiveness in international markets.

RESULTS AND INTERPRETATION:
An experiment to determine yield potential of Oriental mustard, canola and yellow mustard under different rainfall regions under direct seed systems and to compare water use of these crops with water use of spring wheat under direct seeding was planted at three locations in spring of 2005 and 2006. The three locations chosen were Pendleton, OR, and Genesee and Moscow, ID. These three sites were chosen to cover a range of rainfall regions which exist throughout the Pacific Northwest wheat growing regions. Twenty-year average annual rainfall respectively at these sites is 16.5 19.8 and 26.4 inches.

The four crops examined included 'Zak' spring wheat (at Pendleton), 'Hank' spring wheat (at the other two locations), 'Hyola.401' spring canola, 'IdaGold' yellow mustard and 'Pacific Gold' Oriental mustard. In the spring of 2005 and 2006, these spring crops were planted in plots (20 x 60 feet) at each location. Seeding rates used were 25 seeds/ft^2 for spring wheat, 7 lb/acre for spring canola, 8 lb/acre for yellow mustard and 5 lb/acre for Oriental mustard. Fertility management was adjusted at each site according to soil tests, local practice and rainfall. The complete trial design was a randomized complete block with four replicates.

All trials were direct seeded into cereal stubble. The trials were planted using a Flexi coil shank drill planting pair rows 2 inches apart, and with 12 inch spacing between paired rows. Fertilizer placement will be 1 inch below the seed and between the pair rows.

Soil moisture was determined at one foot depths up to five feet immediately after planting, mid-season and after harvest. Soil cores were extracted and weighed after which samples were oven dried for 4 weeks at 70^{o}C, and weighed again to determine soil moisture. Soil moisture depletion was estimated as the percentage difference between soil moisture from the initial soil samples compared to the final soil test. Throughout the growing season the following characters were evaluated on all plots: plant stand establishment counts, seed yield and quality. At the time of writing this report crop quality has not been determined from the 2006 trials and will be omitted from this progress report. Similarly, at this time yield data from the 2006 Pendleton site was not available and yield will only be reported from Moscow and Genesee in 2006.

Spring wheat yields were significantly higher than any of the Brassicaceae crops in 2005 (Table 1). Canola and Oriental mustard produced similar yields (2,794 and 2,437, respectively), while lowest yield was obtained from yellow mustard. There was, however, a significant site x crop interaction where by canola yields were markedly reduced at the drier site (Pendleton). This was expected as spring canola is not as tolerant to heat as the mustard species. All of the Brassicaceae crops showed visible wilting symptoms at and after flowering, although canola was most affected and yellow mustard showed least wilting symptoms.

In 2005, soil moisture significantly increased by depth with lowest soil moisture in the 0-1 foot of soil (Table 2). Averaged over all sample depths there was no significant difference in soil moisture between the four crops. There was however an interaction between crops and soil moisture at the different soil depths. This was caused by lower moisture at the shallow soil depths in wheat and canola (1.0% and 1.6%, respectively) compared to the two mustard crops (3.6% and 3.2%). Similarly, the mustard crops depleted greater moisture at the deepest depths (11.3% and 10.4% for Oriental mustard and yellow mustard, respectively) compared to canola and wheat (13.6% and 12.2%, respectively).

Spring wheat yield in 2006 was higher than 2005, but yield of canola, Oriental and yellow mustard were markedly reduced (Table 3). Canola yields were reduced by 24%, while Oriental mustard and yellow yields were reduced by 48% and 61%, respectively. As in 2005, wheat yield in 2006 was significantly higher than from the other crops. Canola yields were significantly higher in 2006 compared to Oriental mustard and yellow mustard yields were lowest.

Despite higher air temperatures, soil moisture was higher in 2006 compared to 2005. Soil moisture was significantly linear with depth. Averaged over all soil depth, soil moisture in spring canola was significantly higher than in wheat. There was no crop by soil moisture by depth interaction in 2006.

Initial results from this research suggest that in dry years Oriental mustard and yellow mustard deplete deep profile soil moisture more than spring wheat. Both mustard crops have very aggressive root systems and one might speculate that this deep soil depletion could have a negative impact on subsequent crops.

Table 1. Seed yield of four spring crops planted at three locations in 2005.

Crop	Genesee	Moscow	Pendleton	Mean
	lb/acre			
Wheat	6503	2944	5711	5052 [a]
Canola	2047	2308	586	2794 [b]
Oriental mustard	1556	5199	1237	2437 [b]
Yellow mustard	1417	3898	1998	1647 [c]

Table 2. Soil moisture by soil depth after harvesting wheat, canola, Oriental mustard and yellow mustard in 2005.

Crop	Soil depth					Average
	0-1'	1-2'	2-3'	3-4'	4-5'	
	%					
Wheat	1.0	3.8	5.4	9.3	13.6	6.61
Canola	1.6	3.6	5.7	9.3	12.2	6.47
Oriental Mustard	3.6	3.7	4.0	8.7	11.3	6.26
Yellow mustard	3.2	4.0	5.0	7.9	10.5	6.49
Average	2.35 [e]	3.77 [d]	5.02 [c]	8.81 [b]	12.35 [a]	

Table 3. Seed yield of four spring crops planted at two locations in 2006.

Crop	Genesee	Moscow	Mean
	lb/acre		
Wheat	5521	7124	6323 [a]
Canola	1892	2381	2136 [b]
Oriental mustard	1354	1184	1270 [c]
Yellow mustard	770	516	643 [d]

Table 4. Soil moisture by soil depth after harvesting wheat, canola, Oriental mustard and yellow mustard in 2006.

Crop	Soil depth					Average
	0-1'	1-2'	2-3'	3-4'	4-5'	
	%					
Wheat	8.3	10.1	11.8	13.5	17.2	11.78 [b]
Canola	8.1	12.5	13.6	14.1	17.2	12.83 [a]
Oriental Mustard	8.7	9.5	12.1	14.5	17.1	11.99 [ab]
Yellow mustard	9.1	10.1	11.8	13.8	17.0	12.08 [ab]
Average	8.58 [e]	10.56 [d]	12.35 [c]	14.01 [b]	17.10 [a]	