across all year 1 spring crops. The year 2 winter wheat planted within each of the previous spring crop areas is divided into sub-plots receiving fertilizer rates of 32, 64, 96, 128, 160 lbs N/acre applied in a split-plot, factorial design.
Results from five years of spring crop comparisons are in Table 1. Preliminary conclusions are:

- ⇒ Performance variability among spring crop is high and varies over years.
- ⇒ Some crops, barley and camelina, are more consistent across years.
- ⇒ Market prices and yields will guide spring crop selection for growers.
- ⇒ Winter wheat performance following spring crops is best after pea and lentil, followed by brassicas, and both are better than after wheat or barley.
- ⇒ Wheat fertilizer response is best after legumes followed closely by brassica crops.
- ⇒ With results showing wheat performance after spring crops, growers can give rotational benefits to biofuel crops from better winter wheat performance and low N fertilizer inputs.

Table 1. Spring Crop Seed Yields, 2008 Moscow, 2009 – 2012 Pullman.

Spring Crop	2008	2009	2010	2011	2012	2008-2012 Ave.	Avg. % Variation
	---------------------- lbs/acre --------------------						
Spring Wheat	3750	3915	1700	2770	3020	3030	21.2
Spring Barley	4625	5485	3520	4145	4610	4480	11.5
Dry Pea	1830	245	840	2565	1020	1300	55.2
Lentil	1075	740	480	1850	860	1000	36.9
Camelina	1895	2585	1715	1530	1820	1910	14.2
Yellow Mustard	1390	1635	695	1415	1430	1310	19.0
Oriental Mustard	915	2290	700	1750	1570	1445	35.3
Canola	700	1610	670	1395	860	1050	34.8
Average	2025	2315	1290	2175	1900	1940	28.5
LSD (0.05)	515	765	750	455	523		

Safflower Oilseed Production under Deficit Irrigation and Variable N Fertilization

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The production of oilseed crops represents a unique opportunity for PNW producers to provide a biodiesel feedstock for an emerging renewable energy industry. The inclusion of oilseeds in rotation offers producers an alternative strategy to improve farm economies and gain additional benefits that improve soil and water conservation, reduce pest cycles, and diversify cropping systems. Safflower is considered a low input and drought tolerant crop, but responds well with irrigation and fertilizers. Three safflower varieties S334, S345 and CW99OL were planted in April 2008-2011 under center pivot irrigation at the USDA-ARS field site near Paterson WA (Fig. 1). Standard irrigation and deficit irrigation were 28 and 22 inches, respectively. The difference in water applied between the deficit irrigated and the standard water treatment was 6 inches resulting in a treatment of 80% of ET in 2009 and 8 inches, 70% of ET in 2010 and 2011. Safflower oilseed

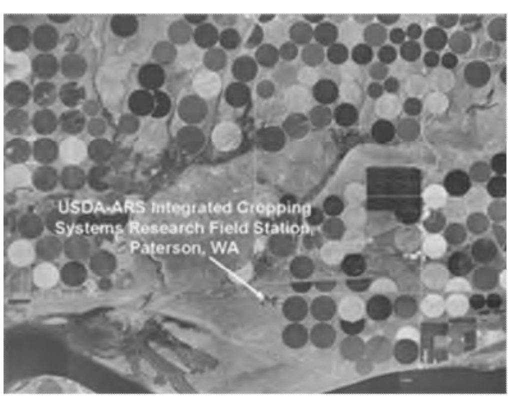

Fig. 1. USDA-ARS Paterson Field Site.

Fig. 2. Safflower ready to harvest 2011.

yields averaged 3100 lbs ac^{-1} among years in all treatments (Table 1). Safflower oilseed yields were significantly higher under the 100 than 145 lb N acre^{-1} fertilizer rate in 2008. Safflower oilseed yields were not significantly different between the full and 70% ET treatments, indicating a potential 5 to 7 inch water savings using a deficit irrigation strategy depending on year. Deficit irrigation (70% of ET) had a positive effect on WUE with an average increase of 23 lb seed yield acre^{-1} inch^{-1} of water applied. Oil contents of the seed were 1.5 – 2.2% higher under deficit irrigation than under full irrigation following the higher yields and greater water use efficiencies.

Table 1. Yield of safflower and water use at the USDA-ARS Field Station near Paterson, Benton County, WA.

		Full Irrigation				Deficit Irrigation			
N rate (lb/acre)		100		145		100		145	
Yield	Yr	lb/acre	lb/ac/inch Water	lb/acre	lb/ac/inch Water	lb/acre	lb/ac/inch Water	lb/acre	lb/ac/inch Water
Cw99 OL	08'	3103	107	3084	106	3250	135	3026	126
	09'	2547	88	2419	84	2819	118	2212	93
	10'	3040	103	2877	98	2934	129	3105	137
	11'	3197	118	3839	141	3170	161	2860	145
	Average	2972	104	3055	107	3043	136	2801	125
S345	08'	3370	116	3017	104	3557	148	3326	139
	09'	2326	81	2982	103	2793	117	2383	100
	10'	3028	103	3068	104	2871	127	3361	148
	11'	2826	104	3292	121	2595	132	2398	122
	Average	2888	101	3090	108	2954	131	2867	127
S 334	08'	----	----	----	----	----	----	----	----
	09'	----	----	----	----	----	----	----	----
	10'	2936	100	2390	81	2978	131	2822	124
	11'	1547	57	2121	80	1207	61	1444	73
	Average	2242	31	2256	81	2093	39	2133	99

Wind Erosion Potential from Oilseed Cropping Systems

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The United States Energy Independence and Security Act of 2007 mandates the use of 36 billion gallons of biofuel by 2022 with 21 billion gallons being derived from advanced biofuel feedstocks. To meet this goal, the United States Department of Agriculture developed a strategy entitled "A USDA regional roadmap to meeting the biofuels goals of the Renewable Fuels Standard by 2022" in which it is anticipated that 4.6% of the advanced biofuels would be produced in the northwestern United States. Although progress ish being made in growing oilseeds for advanced biofuels, little is known concerning the impact of growing oilseed crops on environmental resources.

Fig. 1. Wind erosion assessed using a wind tunnel after sowing winter wheat at Lind, WA in August 2011.

We examined the impact of growing oilseeds in a winter wheat-summer fallow rotation on wind erosion and PM10 (particles ≤10μm in diameter) emissions in eastern Washington state where atmospheric PM10 is an acute environmental concern. Wind erosion and PM10 emissions were measured at the end of the fallow phase of a winter wheat-summer fallow versus a winter wheat-camelina-summer fallow rotation or a winter wheat-safflower-summer fallow rotation in 2011 and 2012. In addition, camelina and safflower were direct seeded into standing stubble of the preceding winter wheat crop. The undercutter implement, a conservation tillage tool, was used for primary tillage during fallow in all rotations. A portable wind tunnel was used to assess horizontal sediment and PM10 flux after sowing wheat (Fig. 1).

Our results indicate that total sediment and PM10 flux were as much as 200% higher from the wheat-oilseed-fallow rotation