

RESEARCH PROJECT TITLE: Developing optimal agronomic management systems for direct seeding *Brassica* oilseed and mustard crops in the Pacific Northwest.

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INTERIM REPORT: Year two of three.

PROJECT OBJECTIVES:

1. Determine more optimal agronomic practices for direct seeding winter canola by examining the effects of straw management, row spacing, seeder opener type, and starter fertilizer rate.
2. Determine more optimal agronomic practices for direct seeding spring canola, oriental mustard and yellow mustard by examining the effects of straw management, and seeding rate.

KEY WORDS: canola, mustard, seeding rate, straw management

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

ABSTRACT OF RESEARCH FINDINGS:

Straw management is critical for successful crop establishment and high yield in both winter and spring canola. Winter canola offers a greater challenge in obtaining suitable crop stands compared to either spring canola or oriental or yellow mustard. As in the previous years study, better winter canola stands were obtained from planting into burned straw or after a light harrow. In this years winter trials, good fall rain resulted in timely planting and moderate to good fall establishment. However, a change from high to low temperatures caused almost 100% winter-kill, even on large established plants sown early into summer fallow. Spring canola, Oriental mustard and yellow mustard are less responsive to straw treatment prior to planting. However, results from this years trials were similar to those from 2003 in that direct seeding into standing straw produced significantly lower plant stands, a shorter crop height, later flowering and lower seed yield and oil content. In contrast to the 2003 trials, highest seed yield was obtained when straw was harrowed prior to planting. The mustard cultivars were less responsive to different seeding rates, but Sunrise responded to higher seed rates, particularly at the low yield potential sites.

RESULTS AND INTERPRETATION:

Winter canola trials

As a result of poor performance in the 2002/2003 growing season, it was decided not to include the Great Plains drill in the 2003/2004 trials. In fall of 2003 winter canola trials were planted at two seeding dates in Moscow, Idaho, and once at Pendleton, Oregon. A randomized strip-strip-plot design was used at each location and planting date. Moscow planting dates were September 16 and September 26, while the Pendleton trial was planted on October 7. Main-strips in the trials were assigned to straw management (Burn, harrow, mow, and no-treatment). Strip-plots, planted at right angles to the straw management, were winter canola cultivars 'Ericka' and 'Athena', which have both shown late-planting potential. Sub-strip-plots were row spacing (18-inch spacing and 9-inch spacing) and starter fertilizer rates (10lb – low and 20lb – high N, in 16:20:0 dry fertilizer mix). Each treatment combination was replicated four times at each site. Unit plot size was 10 feet x 25 feet at Pendleton and 5 feet by 25 ft at Moscow.

Markedly better seedling establishment was achieved in fall 2003 compared to the previous year. An average of 22.5 plants m⁻² emerged from the Moscow earlier planting date and 15 plants m⁻² from the later planting. Plant stand counts from the earlier planting were significantly higher in the straw burn and harrow treatments compared to the mowed straw and no-treatment control. There was no significant difference in fall plant stands over treatments in the later planting (Table 1).

Despite good seedling and emergence in all 2003 planted evaluation trials, 95 to 100% winter-kill occurred in the last week of October and first week of November. On October 22nd day-time temperature was 80° F while night-time temperature dropped to 8° F, one week later. This temperature differential was sufficient to cause crop failure throughout the trials. It was noted that 100% of our breeding plots at Genesee were winterer-killed during the same period while 30 to 45% winter kill was observed on breeding lines at Moscow. One should also note that these breeding plots lost to temperature change were well established plants seeded into good summer fallow ground in mid-August.

Fall planting conditions were ideal for re-crop winter canola in 2004. Similar straw management trials were planted in Moscow on September 15 into good moisture. Seedling emergence in all straw treatments was good, although seedling emergence where seeded into standing wheat stubble was delayed by two days compared to seeding into chemical fallow. Warm conditions after a wet period in September resulted in good seedling growth and all plants were at the rosette stage going into the winter.

Spring canola and mustard trials

The spring Brassica crop agronomic study includes the spring canola cultivar 'Sunrise', yellow mustard cultivar 'IdaGold' and oriental mustard cultivar 'Pacific Gold'. Field trials were planted at four locations in 2004 (Moscow, Genesee, and Craigmont in Idaho

and Pendleton in Oregon) in an attempt to counter loosing two locations in 2003. Good direct seeding conditions were found at all four test sites and sites were planted in a timely manner. Planting at Pendleton on March 23, at Genesee on April 9, at Craigmont April 13, and at Moscow on April 27,

The trials were planted using a Flexi-Coil shank drill and a randomized strip-strip-plot (split block) design was used. Main-strips were randomly assigned to straw management treatments (burn, harrow, mow/chip, and no-treatment). The crop species (Sunrise, IdaGold and Pacific Gold) were planted as strip-plots at right angles to the straw management treatments. Sub-strip plots were assigned to low and high seeding rate (4 and 8lb/acre for canola, 5 and 10lb/acre for yellow mustard, and 2.5 and 5lb/acre for oriental mustard, to accommodate for seed size differences). All fertilizer was dry and banded below and to the side of the seed. Each treatment combination was replicated four times at each site and the unit plot size was 15 feet x 25 feet at Moscow, Genesee, and Craigmont, and 10 feet x 20 feet at Pendleton.

Significantly ($P < 0.05$) higher plant stand counts were found when wheat straw was mowed compared to direct seeding into standing straw (Table 2). Sunrise had poorest stand counts while Pacific Gold had highest counts across all straw treatments. Stand counts of the two mustard cultivars was relatively constant over treatments. However, Sunrise showed marked reduction in stand count in the burn and standing straw treatments (Table 2).

As expected, higher plant stands were obtained by increasing seeding rates (Table 3). However, there was no seeding rate x cultivar interaction. Tallest plants were obtained after seeding into burned straw (Table 4), while shortest plants were obtained by direct seeding into standing straw. On average, plants direct seeding into standing straw flowered 54.2 days after planting which was significantly later than plants seeded into straw that had been harrowed or mowed.

Averaged over the three cultivars, seed yield of the direct seeded, burned and mowed treatments were not significantly different. However, significantly higher seed yield was obtained by harrowing the straw prior to planting (Table 5). Highest yield was obtained from Pacific Gold, followed by IdaGold, with Sunrise being significantly lower than either of the mustard cultivars. Yield of Pacific Gold was very similar irrespective of straw treatment and ranged from 3,249 lb/acre in burned straw to 3,172 lb/acre when direct seeded into standing straw, a range of 77 lb/acre from highest to lowest. Sunrise, in contrast was most affected over treatments, ranging from a high of 2,292 lb/acre seeded into harrowed ground, and lowest at 1,907 when seeded into burned straw, a difference of 385 lb/acre. IdaGold was intermediate in response with a difference of 178 lb/acre between highest and lowest yield over treatments.

Over all cultivars, significantly higher seed yield was obtained from the higher seeding rates (Table 6). Sunrise was most responsive to increased seeding rate and showed 20% increase in seed yield with a higher seeding rate. Both mustards were more tolerant to lower seeding rates higher seeding only increased seed yield by 4% in each

cultivar. The difference in seed yield with low and high seeding rate of Sunrise was related to the yield potential of each site. For example, at the two lowest yielding sites (Moscow and Craigmont, Idaho) higher seeding rates of Sunrise were 23% and 55%, respectively. At the two higher yielding locations, Genesee and Pendleton, Sunrise yield increase due to higher seeding rates were 15% and 3%, respectively. It is reasonable to suggest that the lower yielding sites were the result of less optimal growing conditions, suggesting that higher seeding rates of Sunrise would be justified under poor growth conditions. Seed yield of the mustard cultivars did not follow this trend.

As expected the cultivars produced significantly different oil content (Table 9). Significantly higher oil content was obtained from the mow treatment compared to burn or no straw treatment. Lowest oil content was obtained when direct seeding cultivars into standing straw.

Results from this years trials were similar to those from 2003 in that direct seeding into standing straw produced lower plant stands, a shorter crop, with lower seed yield and oil content. In contract to the 2003 trials, highest seed yield was obtained when straw was harrowed prior to planting. The mustard cultivars were less responsive to different seeding rates and Sunrise required higher seed rates, particularly at the low yield potential sites.

PUBLICATIONS AND PRESENTATIONS:

- Wittman, N, J. Brown and J.B. Davis. 2004. Straw management in direct seeding winter and spring Brassica crops. Poster presented at the 2004 Direct Seed Conference, Pendleton, Oregon, January 7-9 2004.
- Wittman, N, J. Brown and J.B. Davis. 2003. Straw management in direct seeding winter and spring Brassica crops. Poster presented at the Idaho and Washington Canola & Mustard Commission Meeting, Moscow, ID, March 4, 2004.
- Wittman, N., 2003. Straw management in direct seeded spring Brassica crops. Presented at the University of Idaho, Canola, Rapeseed & Mustard Field Day, July 7, 2004.

Table 1. Plant emergence counts averaged of early planted winter straw management trials planted fall 2003 with 9 and 18-inch row spacing, low and high starter fertilizer and two cultivars (Ericka and Athena).

Row Spacing	Starter fertilizer	No-treatment		Burn		Harrow		Mow	
		Ericka	Athena	Ericka	Athena	Ericka	Athena	Ericka	Athena
9-inch	Low	15	9	16	15	10	7	9	5
	High	16	11	23	6	22	11	7	4
18-inch	Low	22	19	24	18	19	14	15	11
	High	24	18	21	20	19	23	15	13

No significant differences within the table

Table 2. Treatment and species mean of plant stand counts from spring straw management trials.

Species/ Cultivar	Treatment				Mean
	No-treatment	Burn	Harrow	Mow	
	----- plants m ⁻² -----				
Pacific Gold	19.1	19.1	19.1	18.3	18.9 ^a
Sunrise	12.6	13.4	15.1	16.7	14.5 ^c
IdaGold	16.3	18.1	17.5	17.4	17.3 ^b
Mean	16.0 ^b	16.9 ^{ab}	17.3 ^{ab}	17.4 ^a	

Means with different superscript letters are significantly different (P<0.05)

Table 3. Treatment and seeding rate of plant stand counts from spring straw management trials.

Seeding rate ¹	Treatment				Mean
	No-treatment	Burn	Harrow	Mow	
	----- plants m ⁻² -----				
Low	12.8	13.0	12.9	12.9	12.9 ^b
High	21.0	20.6	21.5	22.0	21.3 ^a
Mean	16.0 ^b	16.9 ^{ab}	17.3 ^{ab}	17.4 ^a	

Means with different superscript letters are significantly different (P<0.05)

¹ Low seed rate was 2.5lb, 4lb and 5lb/acre for Pacific Gold, Sunrise and IdaGold, respectively. High seed rate was 5lb, 8lb, and 10lb, for Pacific Gold, Sunrise and IdaGold, respectively.

Table 4. Treatment and species mean of plant height from spring straw management trials.

Species/ Cultivar	Treatment				Mean
	No-treatment	Burn	Harrow	Mow	
	----- inches -----				
Pacific Gold	59	65	62	63	62 ^a
Sunrise	46	50	49	48	48 ^c
IdaGold	48	55	52	51	52 ^b
Mean	51 ^c	56 ^a	54 ^b	54 ^b	

Means with different superscript letters are significantly different (P<0.05)

Table 5. Treatment and species mean of seed yield from spring straw management trials.

Species/ Cultivar	Treatment				Mean
	No-treatment	Burn	Harrow	Mow	
----- lb acre ⁻¹ -----					
Pacific Gold	3172	3249	3213	3227	3215 ^a
Sunrise	2143	1907	2292	2039	2095 ^c
IdaGold	2733	2789	2819	2641	2746 ^b
Mean	2683 ^b	2649 ^b	2779 ^a	2631 ^b	

Means with different superscript letters are significantly different (P<0.05)

Table 6. Treatment and seeding rate of seed yield from spring straw management trials.

Seeding rate ¹	Treatment				Mean
	No-treatment	Burn	Harrow	Mow	
----- lb acre ⁻¹ -----					
Low	2604	2563	2515	2659	2585 ^b
High	2764	2733	2900	2746	2786 ^a
Mean	2683 ^b	2649 ^b	2779 ^a	2631 ^b	

Means with different superscript letters are significantly different (P<0.05)

¹ Low seed rate was 2.5lb, 4lb and 5lb/acre for Pacific Gold, Sunrise and IdaGold, respectively. High seed rate was 5lb, 8lb, and 10lb, for Pacific Gold, Sunrise and IdaGold, respectively.

Table 7. Species and seeding rate of seed yield from spring straw management trials.

Seeding rate ¹	Species/Cultivar			Mean
	Pacific Gold	Sunrise	IdaGold	
	----- lb acre ⁻¹ -----			
Low	3157	1906	2692	2585 ^b
High	3274	2285	2799	2786 ^a
Mean	3215 ^a	2095 ^c	2746 ^b	

Means with different superscript letters are significantly different (P<0.05)

¹ Low seed rate was 2.5lb, 4lb and 5lb/acre for Pacific Gold, Sunrise and IdaGold, respectively. High seed rate was 5lb, 8lb, and 10lb, for Pacific Gold, Sunrise and IdaGold, respectively.

Table 8. Site by species by seeding rate of seed yield from straw management trials.

Species/ Cultivar	Seed Rate ¹	Moscow	Craigmont	Genesee	Pendleton
		----- lb acre ⁻¹ -----			
Pacific Gold	Low	1223	2506	4133	4763
	High	1318	3043	4112	4624
Sunrise	Low	843	1355	2439	2986
	High	1140	2100	2815	3084
IdaGold	Low	1910	2096	3132	3629
	High	2091	2062	3128	3915

¹ Low seed rate was 2.5lb, 4lb and 5lb/acre for Pacific Gold, Sunrise and IdaGold, respectively. High seed rate was 5lb, 8lb, and 10lb, for Pacific Gold, Sunrise and IdaGold, respectively.

Table 9. Treatment and species mean of seed oil content from spring straw management trials.

Species	Treatment				Mean
	No-treatment	Burn	Harrow	Mow	
	----- % -----				
Pacific Gold	33.5	33.5	33.9	33.7	33.6 ^b
Sunrise	35.2	35.7	36.1	36.4	35.9 ^a
IdaGold	26.1	26.1	26.2	26.0	26.1 ^c
Mean	31.6 ^c	31.8 ^{bc}	32.0 ^{ab}	32.1 ^a	

Means with different superscript letters are significantly different (P<0.05)