RESEARCH PROJECT TITLE: Identifying superior *Brassica* species and cultivars within species that are suitable for direct seeding throughout the Pacific Northwest region.

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INTERIM REPORT: Third and final year report of project started in 1999.

PROJECT OBJECTIVES

- Examine interactions between four *Brassica* crop species (*B. napus, B. rapa, B. juncea* and *S. alba*) to determine which species has greatest adaptability to different regions throughout the Pacific Northwest.
- Examine genotype x tillage system interactions within canola (*B. napus*), yellow mustard (*S. alba*), and oriental mustard (*B. juncea*) and identify specific cultivars with superior adaptability to direct seeding systems in different rainfall regions of the Pacific Northwest.

KEY WORDS: canola, mustard, genotype x tillage interactions

STATEMENT OF PROBLEMS TO BE ADDRESSED

Rainfall in the Pacific Northwest can vary from high (> 20 inches annually) to low (<8 inches annually), and the traditional cropping systems have been winter wheat/summer fallow and wheat/barley/legume rotations. Predominance of monoculture cereal production in these regions over the past 100 years has resulted in a buildup of soil-borne diseases. As a result, farmers have shown increased interest in annual cropping systems and advantages of *Brassica* crops have induced growers to include them in their crop rotation. At present, growers in the Pacific Northwest region have the option of planting one, or more, of four different spring-planted *Brassica* species: canola, or rapeseed (from either *Brassica napus* or *B. rapa*), yellow mustard (*Sinapis alba*) or oriental mustard (*B. juncea*). From the four species available, *B. napus* is least heat and drought tolerant, followed by *B. rapa*, and *B. juncea*, with *S. alba* showing greatest adaptability to driest regions. Genotype by environment interaction is in some way involved in most problems associated with quantitative genetics and all problems in plant breeding. It is difficult to believe that a change from conventional tillage to direct seeding systems will not be associated with some degree of cultivar by seeding system interaction. To identify the most appropriate spring *Brassica* species from different regions throughout the Pacific Northwest and to select the most productive cultivars from within each species will require a more detailed description of cultivar response to direct seeding.

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

ABSTRACT OF RESEARCH FINDINGS

Yield potential of canola, oriental mustard and yellow mustard cultivars (and advanced breeding lines) was evaluated for yield potential under direct seeding and conventional seeding management systems. Both mustard species showed a significant yield reduction when direct seeded compared to conventional seeding. On average canola cultivars performed the same under the two tillage management schemes. However, there were large differences between individual canola cultivars, whereby performance under the two schemes was not related. Similar results were found in the mustards where the most adapted cultivars for direct seeding were not the most adapted for more conventional seeding. Overall, the results from this year conclude that it will be necessary to test canola, oriental and yellow mustard breeding lines for adaptability to direct seeding situations early in the selection scheme to ensure that the 'better' adapted lines suitable for direct seeding systems are not lost from the program due to somewhat inferior adaptation to conventionally tilled systems.

RESULTS AND INTERPRETATION

In spring 2002 all canola (*B. napus*), oriental mustard (*B. juncea*), and yellow mustard entries in the Pacific northwest variety trials were, in addition to the standard sites, grown at four locations (Moscow ID, Genesee ID, Grangeville ID, and Davenport WA), under direct seeding and conventional tillage management. The two tillage management areas were adjacent at each location. At each location and tillage treatment cultivar was grown in four replicate randomized block designs. Plot size was 20 feet x 5 feet. All plots (irrespective of tillage treatment) were planted using a 5 row flexi-coil shank opener plot-drill.

An analysis of variance was carried out for seed yield within each of the three species (*B. napus*, *B.* juncea, and *S. alba*) (Table 1). The largest proportion of variation in seed yield in all three species was due to differences between sites, accounting for 90%, 64%, and 71% of the total variation in yield within *B. napus, B. juncea,* and *S. alba,* respectively. Seed yield was not significantly different in direct seeded compared to conventional tillage in canola. However, average seed yield of oriental mustard was significantly reduced, by 7%, when direct seeded compared to conventional seeding. Similarly significant yield reduction was observed in direct seeded yellow mustard compared to conventional seeding (a 12% yield reduction). Site x tillage interaction was significant in all species tested. The primary cause of the interaction was the difference between Moscow and Genesee sites compared to Davenport and Grangeville. Seed yield from conventionally seeded plots was markedly higher at Moscow and Genesee compared to the direct seed plots. In converse, seed yield from Davenport and Grangeville tended to be higher in the direct seed plots. The later two site suffered severe drought in the later part of crop development, and this might explain the difference observed where the direct seeded plots conserved moisture better, under drought conditions.

Despite non-significant interactions between tillage treatment and cultivar, heritability estimates were only moderate for oriental mustard and very low for canola (Table 1). This would suggest that

performance under conventional tillage was not strongly related to yield performance under direct seeding situations. Examining first the canola cultivars and their relative performance (Figure 1), highest yielding cultivar under conventional tillage was Hylite 289 CF which averaged 1876 lb/acre. Hylite, however, was only ranked as 15th overall yield (1526 lb/acre) under direct seeding. Similarly, Clearwater (a new Raptor resistant spring canola release from the University of Idaho) was ranked as second highest yield under conventional tillage (1799 lb/acre), but produced significantly lower yield (1450 lb/acre) and ranked as 20th under direct seeding. Converse examples were found when the 'better' cultivars under direct seeding were examined. Highest yielding cultivar when direct seeded was the breeding line UISH00.3.13, which produced an average of 1849 lb/acre direct seeded but only 1633 lb/acre (ranking 9th) when conventionally seeded. KAB 36 CF ranked second under direct seeding (1840 lb/acre) but 12th (1596 lb/acre) when conventionally seeded. The result shown here for canola differed from the previous year where the 'best' lines under direct seeding were indeed also the 'better' ones when conventionally seeded. This might again be explained by the more severe drought condition of 2002 compared to 2001.

Highest heritability between tillage treatment yields was found in oriental mustard cultivars. Indeed inspection of yield in oriental mustard under the different tillage treatments (Figure 2) does suggest a good relationship. However, it should be pointed out the 'Pacific Gold' was significantly highest yielding under both direct seed and conventional seed than any other cultivars in trial. This does indicate that an oriental cultivar can be selected that has high yield potential in both systems. Also, the lowest yielding cultivar, 'Common Brown' has previously shown to be highly unadapted to the Pacific Northwest region. These two cultivars therefore have perhaps bias the heritability estimate, and as is shown from Figure 2, the other cultivars did not express the same repeatability under the different treatments.

Yellow mustard heritabilities for yield under different tillage management, also were moderately low. Often there were large differences between yield potential under the two treatments (Figure 3). 'UI3277', an advanced University of Idaho breeding line was highest yielding entry in both direct and conventional seeding. 'IdaGold' also showed adaptability to both tillage management schemes. However, line '92XH.83.8' ranked second with average yield of 1572 lb/acre when conventionally seeded but ranked as lowest yield (1201 lb/acre) when direct seeded.

Overall, the results from this year conclude that it will be necessary to test canola, oriental and yellow mustard breeding lines for adaptability to direct seeding situations early in the selection scheme to ensure that the 'better' adapted lines suitable for direct seeding systems are not lost from the program due to somewhat inferior adaptation to conventionally tilled systems.

Table 1. Degrees of freedom, mean squares and significance levels from analyses of variance of seed yield of cultivars, sites and tillage for *B. napus*, *B. juncea* and *S. alba*. Also shown is the heritability of yield between conventional tillage and direct seeding, calculated by regression.

Source	*B. napus*			*B. juncea*			*S. alba*		
	df	M.Sq.		df	M.Sq.		df	M.Sq	
Sites	3	2821.1	***	3	485.1	***	3	316.6	***
Tillage treatment	1	0.0	ns	1	214.9	***	1	88.7	***
Cultivar	21	10.6	**	8	10.3	***	14	2.2	ns
Site x Tillage	3	29.8	***	3	140.7	***	3	46.9	***
Site x Cultivar	63	3.9	ns	24	1.9	ns	42	1.3	ns
Tillage x Cultivar	21	5.4	ns	8	1.6	ns	14	1.0	ns
Error	592	2.9		241	2.0		592	1.3	
Heritability (h^2)		0.1090			0.6818			0.1565	

* = 0.05 >*P*> 0.01; *** = *P* <0.001

Table 2. Average seed yield of three *Brassica* species at five sites direct seeded and conventionally seeded.

Species	Treat	Site				
		Moscow	Genesee	Davenport	Nez Perce	Mean
		---------- lb/acre ----------				
B. napus	Convent	1373[1]	2645	580	1725	1581
	Direct	1280	2465	723	1865	1583 ns
B. juncea	Convent	1842[2]	2088	521	1563	1504
	Direct	1490	954	593	1575	1158***
S. alba	Convent	1750[3]	1857	920	1347	1468
	Direct	1272	1635	1046	1232	1296***
Mean		1501	1941	731	1551	

[1] $LSD_{5\%}$ within treatments and sites for *B. napus* = 714.2; [2] $LSD_{5\%}$ within treatments and sites for *B. juncea* = 106.7; [3] $LSD_{5\%}$ within treatments and sites for *S. alba* = 200.7. *** = Conventional tillage significantly higher yield than direct seeding (*P*<0.001); ns = Conventional tillage yield not significantly different from direct seeding.

Figure 1. Seed yield (lb/acre) of 22 canola (*B. napus*) cultivars grown under direct seed and conventional seed situations.

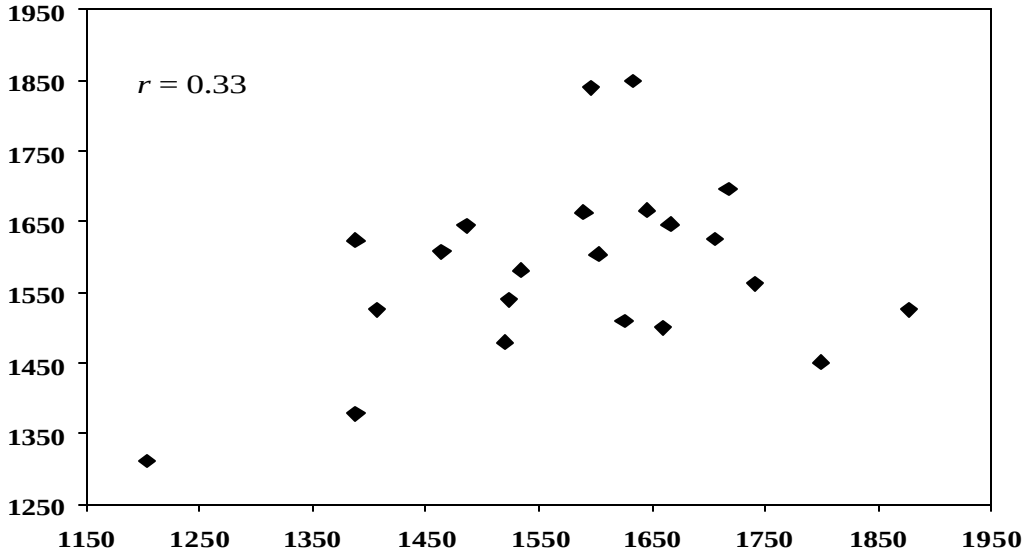

Figure 2. Seed yield (lb/acre) of 9 oriental mustard (*B. juncea*) cultivars grown under direct seed and conventional seed situations.

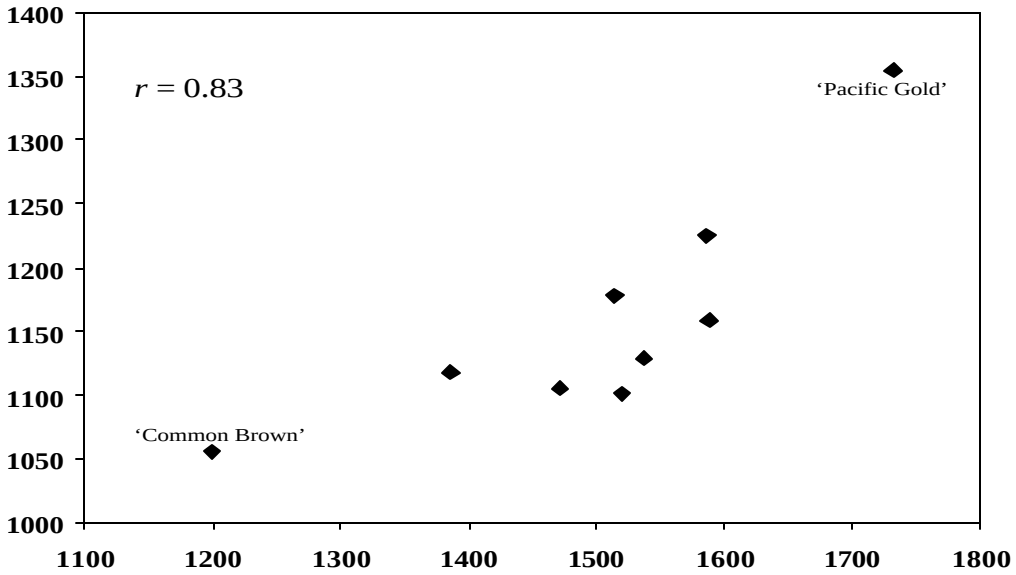

Figure 3. Seed yield (lb/acre) of 15 yellow mustard (*S. alba*) cultivars grown under direct seed and conventional seed situations.