RESEARCH PROJECT TITLE: Identifying superior winter canola (*Brassica napus* L. and *B. rapa* L.) cultivars that are suitable for direct seeding in the Pacific Northwest region.

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INTERM REPORT: Year 2 of 3.

PROJECT OBJECTIVE:

1. Determine the potential of increasing adaptability, reliability and repeatability of winter canola cultivars to direct seeding systems.
2. Identify superior winter canola cultivars that are specifically designed for planting into standing cereal straw in direct seed systems.

KEY WORDS: winter canola, cultivar development, direct seed, fallow

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

ABSTRACT OF RESEARCH FINDINGS:

The second stage of a three year study was conducted successfully and 157 F_5 genotypes were selected from 2,162 segregating progeny grown at Moscow and Pendleton planted into traditional summer fallow and direct seeded into cereal stubble. Unlike the previous selection stage where there was a relationship between the numbers of selections made from each cross at the different environments. From the 32 cross combination examined, no selections were taken from the progeny of six crosses. Seven of the eight parents used in this study produced progeny equally well when examined as a total count. However, different parents produced progeny which was more suited to some sites than others. Most adapted parent line at Moscow fallow was Kronos, while 'Athena' produced most selection from at Moscow direct seeded and Pendleton fallow.

RESULTS AND INTERPRETATION:

The University of Idaho and Oregon State University have been working over the past 10 years to identify cultivars that have potential to be planted later in the fall in direct seeded systems. Over this period of time a number of cultivars have been identified that have shown higher direct seed adaptability over others. These cultivars and advanced breeding lines tend to have quicker emergence and crop establishment and better winter hardiness, particularly in the juvenile stage. In 2003, twelve *B. napus* cultivars/advanced breeding lines were identified with superior direct seed adaptation. These lines were: Ericka, Athena, Baldur, Kronos, Decathlon, along with four advanced breeding lines from the University of Idaho winter canola breeding program and 4 advanced winter rapeseed (industrial oil) selection. These lines were crossed in all possible combination in the spring of that year, and in 4-way ([Baldur x Rasmus] x [Ericka x Kronos])

parent combinations in the fall of that year. In addition, the five other cross combinations were included that involved the breeding selection 95WC340.7, which was selected to have very high oleic acid content and low polyunsaturated fats so that the oil can be used in frying without hydrogenation (hence no *trans*-fats).

The first generation (F_1) seed was obtained from 30 segregating cross combinations. Second generation seed (F_2) seed was obtained by self pollinating 10 F_1 plants from each cross combination (i.e. a total of 500 plants) in the glasshouse in the fall of 2004 and spring of 2005.

In the fall of 2005, seed from these 32 cross combinations were planted at Moscow, ID, and Pendleton, OR. At each location, each population was planted into conventional summer fallow ground and by direct seeding into standing cereal stubble. All the parents used in the initial crosses along with other cultivars with know 'poor' adaptability to direct seeding situations will be included at each site. Each population was represented by 8 replicate plots in each environment, in a randomized complete block design, with two-row plots 20 feet in length. Moscow traditional fallow plots were planted on September 13 and direct seed planting was October 2. The very late direct seed planting was due to low soil moisture. Plantings at Pendleton were September 4 on traditional fallow and September 27 direct seeded.

The late planting of the direct seeded plots at Moscow resulted in small plants with 1-3 leaves going into the winter. A severe frost in early spring caused severe winterkill of these small seedlings. Some plots, however, showed significantly less cold damage. 424 plots were identified with least cold damage and transplanted into pots and grown to maturity in a glasshouse. The Moscow traditional fallow, and both trials at Pendleton did not suffer as badly and plots were grown to maturity. Based on observations and preference evaluations 'desirable' plots were identified and 15 single plant selections were taken from each. Selected plants were hand cut, and the seed from each individual plant was trashed by hand and bagged. Overall, 2,162 plants were selected for further evaluation from the 2005-2006 crop (600, from Moscow traditional fallow, 424 from Moscow direct seeded, 705 from Pendleton traditional fallow and 465 from Pendleton direct seeded).

In the fall on 2006, the selection made from each 2005-2006 environment (Moscow fallow; Moscow direct seeded; Pendleton fall; and Pendleton direct seeded), were planted at the same environment that they had been selected the previous season. A range of characters were recorded on each of the four environment trials including: fall stand, spring stand, days to flower, plant height and lodge resistance. At maturity each plot was visually assessed for breeders' preference (a visual assessment combining multiple traits of importance including yield potential, pod length, maturity, lodging, height, and plant stature). Based on this preference score the 'best' 40 F_5 genotypes were identified from each environment.

Selection made from the Moscow fallow trial were from the progeny of 17 cross combinations (Table 1). Selected lines from Moscow direct seed and Pendleton fall were from progeny of 12 and 13 cross combination, respectively. Pendleton direct seeded selections were from only 9 of the 32 possible cross combinations. Indeed 30% of the selection from Pendleton direct seeded were from the four-way cross Ericka/Rasmus//Decathlon/Kronos and another 27% from the cross Baldur/94WC 340.7.73. Selections made from Moscow fall were spread, somewhat

evenly, over progeny from each of the eight parents (Table 2). Progeny from 'Athena' were most adapted to Moscow direct seeded, although 'Baldur' and 'Decathlon' were parents in 16% and 17% of the selection made at this site. Progeny resulting from 'Athena' and '94WC304.7' were most adapted at Pendleton fall accounting for 24% and 29% of the selection, respectively. Progeny resulting from 'Kronos', 'Rasmas', and 'Decathlon' accounted for 20%, 17% and 17%, respectively, from Pendleton direct seeded.

Fifteen single plant selections from each selected line were harvested by hand trashing while the remainder of the plants in the selected plots were bulk thrashed. Seed from the single plant selections will be used to plant increase plots at Moscow in the fall of 2007, while the bulk samples will be used to plant replicate yield trials in the fall of 2007. All selection (i.e. 157 lines) will be included in the yield trials which will be planted in all four environments.

Residual seed from each single plant selection will be used to determine seed oil content using a Newport MKIIIA Nuclear Magnetic Resonance (Howard and Daun, 1991), glucosinolate content using glucose sensitive test strips (McGregor and Downey, 1975), and fatty acid profile using a gas chromatograph (Christie, 1992; Hammond, 1991), over the winter months.

A suitable crop rotation is essential in a profitable direct seeding cropping system. The availability of winter canola cultivars which are adapted to being direct seeded into cereal straw stubble will offer Pacific Northwest growers profitability with a non-cereal crop. Direct seeded winter canola will have significantly higher yield potential compared to spring *Brassica* crops with potentially fewer inputs, particularly insecticides. Availability of direct seed winter canola will offer growers greater diversity and sustainability. Availability of such cultivars will increase the area of land seeded to winter canola which will help reduce soil erosion and reduce ground water contamination. In addition greater acreage of canola in the region will help drive the development of oil crush facilities in the region which will reduce transportation costs currently incurred. Overall, direct seeded winter canola will offer Pacific Northwest growers increased flexibility in crop rotation, greater profitability and competitiveness in international markets, while offering increase environmental stewardship.

References

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Table 1. Number of selected F_5 lines taken from each cross combination grown at Moscow and Pendleton and planted on traditional fallow (S/F) or direct seeded into cereal stubble (D/S).

		Moscow		Pendleton		
Code	Parentage	S/F	D/S	S/F	D/S	TOTAL
03.WL4.6	Ericka x Athena x Rasmus x Decathlon	.	.	.	1	1
03.WL4.2	Ericka x Rasmus x Decathlon x Kronos	3	2	.	11	16
03.WL4.3	Ericka x Decathlon x Kronos x Baldur	4	.	2	.	6
03.WL4.4	Athena x Rasmus x Decathlon x Kronos	1	.	.	2	3
03.WL4.5	Athena x Decathlon x Kronos x Baldur	.	.	.	.	0
03.WL4.1	Rasmus x Decathlon x Kronos x Baldur	4	.	2	4	10
03.WC.1	Ericka x Athena	1	4	.	.	5
03.WC.2	Ericka x Rasmus	3	6	.	.	9
03.WC.3	Ericka x Decathlon	.	.	.	.	0
03.WC.4	Ericka x Kronos	.	.	.	.	0
03.WC.6	Athena x Rasmus	2	2	.	.	4
03.WC.7	Athena x Decathlon	.	8	1	.	9
03.WC.8	Athena x Kronos	6	.	3	.	9
03.WC.9	Athena x Baldur	1	4	2	.	7
03.WC.10	Rasmus x Decathlon	2	.	2	.	4
03.WC.11	Rasmus x Kronos	.	.	.	.	0
03.WC.12	Rasmus x Baldur	2	.	.	.	2
03.WC.13	Decathlon x Kronos	.	2	.	.	2
03.WC.14	Decathlon x Baldur	2	1	.	.	3
03.WC.15	Kronos x Baldur	1	.	3	3	9
03.WDB.23	Athena x 94WC340.7.29	.	6	.	.	6
03.WDB.29	Athena x 94WC340.7.95	.	2	11	.	13
03.WDB.41	Baldur x 94WC340.7.4	.	.	.	.	0
03.WDB.46	Baldur x 94WC340.7.73	.	2	.	10	12
03.WDB.47	Baldur x 94WC340.7.75	.	.	1	.	1
03.WDB.58	Kronos x 94WC340.7.82	3	.	1	1	5
03.WDB.62	INT.E x .0127 x 94WC340.7.26	3	.	6	1	10
03.WDB.63	INT.E x .0127 x 94WC340.7.29	.	1	.	.	1
03.WDB.64	INT.E x .0127 x 94WC340.7.45	.	.	2	.	2
03.WDB.67	INT.E x .0127 x 94WC340.7.75	1	.	.	4	5
03.WDB.80	Ericka x 94WC340.7.97	1	.	4	.	5
03.WDB.87	Athena x 95WC340.7.97	.	.	.	.	0
Total		**40**	**40**	**40**	**37**	**157**

Table 2. Number of selections and % of total, in which each cultivar contributed as a parent in progeny planted at Moscow and Pendleton into traditional fallow (S/F) and direct seeded into cereal stubble (D/S).

	Moscow				Pendleton					
	S/F		D/S		S/F		D/S			
Parent	Number	%	Number	%	Number	%	Number	%	Total	%
Athena	11	11	26	29	17	24	2	2	56	15
Baldur	14	13	14	16	7	10	14	14	49	13
Decathlon	16	15	15	17	5	7	17	17	53	14
Ericka	12	12	12	13	5	7	11	11	40	11
Kronos	22	21	4	4	6	8	20	12	52	14
Rasmus	17	16	4	4	3	4	17	17	41	11
Int.Ex	4	4	2	2	8	11	5	5	19	5
94.WC340.7	8	8	12	13	21	29	16	16	57	16
Total	104		89		72		102		367	