2004
Annual Report on Subcontracted Research
to
The Institute for Biobased Products
by
Peggy F. Lamb and Gregg R. Carlson
Department of Research Centers – Northern Agricultural Research Center, Havre

Activities Summary

Research Conducted:

1. Multi-Specie Evaluation of Alternative Oilseed Crops for Adaptation and Production in Northern Montana for Use as Biobased Fuels and Lubricants

   This trial was conducted in conjunction with four other Research Centers (CARC, NWARC, SARC, and WTARC). Entries consisted of nine (9) different species and twenty (20) cultivars or lines. Specie and varietal adaptation of oilseed crops was evaluated in different parts of the state focusing on seed yield, oil quality and oil quantity, while also measuring an array of plant characteristics including percent stand, plant count, flower date, plant height, percent shatter, seed moisture and test weight. The objective of the trial is to determine which oilseed species or varieties will have the best seed yield and oil production while further determining the oilseed that will be best suited for biobased fuel and lubricant applications.

2. Oilseed Management Evaluations

   This trial was designed and conducted only at Northern Agricultural Research Center (NARC), and focused on the effect of seeding date and nitrogen fertilizer application rate on canola, mustard and safflower seed yield, oil quality and oil quantity, while also measuring an array of plant characteristics including percent stand, plant count, flower date, plant height, percent shatter, seed moisture and test weight. Each crop was planted at two seeding dates (April 20 and May 3), and with three rates of top dressed N (0, 35 and 70 lbs/ac) actual nutrient using granular Urea. The objective of this trial was to determine the best combination of seeding date and top dressed nitrogen fertilizer rate for seed and oil production under dryland, minimum input, no-till cropping conditions for biobased fuel and lubricant end-use applications.

3. Safflower Cultivar Evaluations

   This 36-entry trial was conducted at NARC and selected other Research Centers in Montana and North Dakota, and focused on evaluating existing and experimental cultivars under traditional management methods to determine seed yield and oil quantity and quality, while also measuring an array of plant characteristics including percent stand, flower date, plant height, percent shatter, seed moisture and test weight

Summary of Results (field and laboratory):

Agronomic and economic performance data for 1) multi-specie evaluation of alternative oilseed crops, 2) oilseed management evaluations, and 3) safflower cultivar evaluations are summarized in Tables 1, 2 and 3, respectively. Associated site resource and management data specific to each investigation and/or individual entries within an investigation follow the performance data table for each overall investigation grouping. At this reporting, laboratory analyses for percent seed oil are still pending for crop entries other than safflower.

1. Multi-Specie Evaluation of Alternative Oilseed Crops

'Montola 2004' safflower produced the highest yield at 2046.7 lb/ac, with no other entry yielding the same, statistically (Table 1). The two sunflower varieties, 'CL340' and '8442NS' yielded 1857.1 and 1849.9 lbs/ac, respectively. At a market price of $10.94 per hundred weight on February 11, 2005, the sunflower would have produced a gross return of $202.38 to $203.17 per acre with no other crop related expenses taken into account. There was no other entry to produce a gross return statistically equal to that of the sunflower varieties. The lowest yielding cultivar was soybean, with 'Jim' and 'Surge' producing 2.7 and 3.5 bu/ac, respectively. As previously thought, soybeans are currently not a crop that can be feasibly and economically produced under dryland conditions in north central Montana, mainly due to low nighttime temperatures and lack of sufficient moisture during the summer months. Camelina, a crop new to Montana, may have good agronomic potential for oilseed producers. The gross return for camelina was lower than that of sunflower, safflower and flax, but higher than that of canola, crambe, mustard, rapeseed and soybean in 2004.

2. Oilseed Management Evaluations

The canola, mustard and safflower seeded on April 20 out yielded the same species seeded on May 3 (Table 2). Safflower seeded early with 0 or 35 lb/ac of top dressed N out yielded all other entries in the trail at 1928 and 1779.3 lb/ac, respectively. However, when applying the February 11 market prices to the different commodities, early seeded mustard with 70 or 35 lb/ac of top dressed N produced $173.27 and $165.95, respectively. The only other entry to yield statistically equal to the two mustards was the early seeded safflower with no top dressed N application at $165.62 per acre. Again there was no production costs associated with the different crops addressed in this dollar per acre assessment.

3. Safflower Cultivar Evaluations

Seed yield among the 36 common varieties and experimental lines ranged from 962 to 1395 lb/ac, and percent oil ranged from 32 to 48 (Table 3). Seed yield between entries was not statistically significant. Ten-year comparable averages for seed yield and oil quantity is presented in Tables 4 and 5. This trial is utilized mainly by Eastern Agricultural Research Center to determine lines adapted to north central Montana and across the state. New lines that are determined to be of benefit to the oilseed industry are eventually released for production.

Publications Generated:

2004 annual report of preliminary data to the NARC Advisory Council and the general public. Formal scientific publications will not be prepared until at least three years of data have been collected.

Graduate Students/Post Doctoral Fellows:

None directly associated with Northern Agricultural Research Center in 2004.

Impact Statement

Cooperatives or Small Businesses Formed or Helped:

This information is of assistance to the "Peaks & Prairies Oilseed Cooperative" and other individuals or groups interested in producing oilseeds by attempting to determine which oil producing plant species and/or variety is best suited to grow and produce quality oil under north central Montana environments. The economics of the individual crops may be further evaluated after a sufficient amount of data has been collected.

Public Meetings Related to BPI:

1. County Agent Updating (approx. 30 Extension personnel, NARC, May 12-13, 2004).

2. Certified Crop Advisor Training (approx. 30 chemical dealers, agricultural consultants, seed dealers, fertilizer dealers, and other CCA certification holders, NARC, June 29, 2004).

3. NARC Public Field Day (approx. 90 farmers, ranchers, media representatives, Extension personnel, scientists, and other interested individuals from the Hi-Line area attended the Oilseeds tour portion of the overall Field Day program, NARC, July 15, 2004).

4. NARC Advisory Council (approx. 22 farmers, ranchers, and Extension personnel, Havre, February 22, 2005).

TABLE 1. Oilseed Multi-specie Evaluation Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2004.
(Exp# 04-OC01-OC)

Species	CULTIVAR or SELECTION	STAND %	PLANT COUNT	1/ FLOWER DATE	PLNT HT Inches	SHATTER %	2/ YIELD Lb/Ac	MOISTURE %	TEST WT Lbs/Bu	3/ OIL %	4/ RETURN $/ac	5/ MARKET $
Camelina	Celina	100.0	17.5	188.0	34.6	9.2	792.3	3.8	52.3	pndg	$71.31	$0.09/lb
Canola	Cheetah	98.3	5.9	186.3	33.3	0.8	140.6	3.4	51.9	pndg	$10.40	$7.40/cwt
Canola	CHS2061	98.6	5.9	185.7	35.5	1.7	292.0	3.4	51.1	pndg	$21.61	$7.40/cwt
Canola	CHS905	97.4	5.5	182.0	38.8	0.8	295.5	3.4	50.5	pndg	$21.87	$7.40/cwt
Canola	Crosby	96.9	6.5	186.7	35.2	1.7	187.7	3.3	50.4	pndg	$13.89	$7.40/cwt
Canola	Minot	99.6	9.6	185.0	33.1	0.8	282.8	3.5	52.1	pndg	$20.93	$7.40/cwt
Canola	Oscar	99.4	7.8	186.8	33.4	0.0	290.2	3.5	53.2	pndg	$21.47	$7.40/cwt
Crambe	Meyer	99.6	9.8	190.0	31.4	10.0	646.5	5.3	20.7	pndg	$38.40	$5.94/cwt
Flax	Omega	100.0	33.6	191.3	21.1	0.0	767.5	4.0	53.4	pndg	$150.05	$19.55/cwt
Flax	Pembina	100.0	29.9	191.3	20.9	0.0	701.1	4.1	53.3	pndg	$137.07	$19.55/cwt
Mustard	Amulet	97.8	9.0	185.2	37.0	0.0	268.1	3.8	52.7	pndg	$31.34	$11.69/cwt
Rapeseed	Garnet	100.0	7.5	184.2	31.7	3.3	252.4	3.4	51.3	pndg	$30.77	$12.19/cwt
Rapeseed	Gem	99.2	7.4	184.0	34.6	3.3	289.8	3.4	50.7	pndg	$35.33	$12.19/cwt
Rapeseed	Sterling	99.4	8.2	185.5	31.2	2.5	154.5	3.4	51.3	pndg	$18.83	$12.19/cwt
Safflower	MT2004	90.4	2.9	214.0	25.9	0.0	2046.7**	5.5	42.3	41.3	$175.81	$8.59/cwt
Safflower	Nutrasaf	97.5	3.8	215.7	30.2	0.0	1710.9	4.6	38.2	55.6	$146.97	$8.59/cwt
Soybean	Jim	98.7	3.7	194.0	9.4	90.0	161.7	8.6	58.6	pndg	$12.83	$4.67/bu
Soybean	Surge	98.6	2.8	196.3	8.1	0.0	211.2	8.6	57.9	pndg	$16.76	$4.67/bu
Sunflower	8442 NS	100.0	0.4	196.8	46.4	0.0	1849.9	6.8	32.5	pndg	$202.38*	$10.94/cwt
Sunflower	CL340	100.0	0.4	216.3	46.0	0.0	1857.1	6.8	33.2	pndg	$203.17**	$10.94/cwt
EXPERIMENTAL MEANS		98.6	8.9	192.3	30.9	6.2	659.9	-	-	-	69.1	-
LSD (0.05)		1.5	8.5	10.2	5.7	1.9	121.9	-	-	-	11.4	-
C.V.: (S / MEAN)*100		1.3	27.4	4.6	6.3	26.1	16.1	-	-	-	14.4	-

1/ No. of Days from January 1 (192 = July 10)
2/ Volumetric yields are based on plot weights adjusted to a uniform 8 percent grain moisture for camelina, canola crambe, flax, mustard, rapeseed and safflower and a uniform 10 percent grain moisture for soybeans and sunflower.
3/ Oil percentage values are reported on a 92% dry matter basis.
4/ Gross Return does not take into account any input costs associated with the crop.
5/ Price quotes as of 2/11/2005, USDA-FSA, Havre, MT. Camelina price estimate from Dr. Duane Johnson, Institute for Bio-Based Products ($0.08 to $0.09 per lb - used the $0.09 per lb figure).
** Indicates highest ranking entry within a column.
* Indicates entries ranking equal to the highest ranking enty within a column based on Fisher's protected LSD (p=0.05).

Site Resource & Management Data: (Exp# 04-OC01-OC)							
Field	An-1-6		SaltHaz(MMHOS/cm)6-24"	0.68		2" Soil Temp (^{o}F) @ Plnt'g	*
Quarter	NW		Soil Texture 0-6"	CL		4" Soil Temp (^{o}F) @ Plnt'g	*
Section	32		Soil Texture 6-24"	CL		Fertilizer Formulation	Gran.Blend
Township	32N		Soil Texture 24-36"	CL		Fertilizer Placement	Bnd at Plntg
Range	15E		Soil Texture 36-48"	CL		Fert. Rate (lbs/ac) N	0
Latitude			Init Zn (ppm) 0-6"	0.4		Fert. Rate (lbs/ac) P2O5	40
Longitude			Init Mn (ppm) 0-6"	0.8		Fert. Rate (lbs/ac) K2O	25
Soil Series			Init Cu (ppm) 0-6"	0.6		Herbicide App. Date	na
pH 0-6"	8.1		Init Fe (ppm) 0-6"	3.1		Herbicide Product	none
Org.Matter (%) 0-6"	1.2		CEC 0-6"	21.8		Herbicide Rate (/ac)	na
Init N (lbs/ac) 0-6"	40		Init PAW (in.) 0-6"	0.87		Precip (in.) Plnt'g-Harvest	*
Init N (lbs/ac) 6-24"	72		Init PAW (in.) 6-24"	2.56		Precip (>.1) Plnt'g-Harvest	*
Init N (lbs/ac) 24-36"	84		Init PAW (in.) 24-36"	1.70		Harvest Date	*
Init N (lbs/ac) 36-48"	96		Init PAW (in.) 36-48"	1.79		Rooting Depth (in.)	*
Init P (ppm) Olsen 0-6"	11		Cropping System	NT-ChmFlw		Post PAW (in.) 0-6"	*
Init K (ppm) 0-6"	254		Planting Date	*		Post PAW (in.) 6-24"	*
Init S (ppm) 0-24"	31		Planting Depth (in.)	*		Post PAW (in.) 24-36"	*
Init Na (MEQ/100g) 0-6"	0.09		Moist Soil Depth @Plnt'g	48+		Post PAW (in.) 36-48"	*
SaltHaz (MMHOS/cm) 0-6"	0.84		Dry Surf Soil (in.) @Plnt'g	*		Precip (>.1) Hvst-Post	*

* See individaul crop details.

Camelina			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	0.45
Planting Date	4/30		Precip (in.) Plnt'g-Harvest	7.92		Post PAW (in.) 6-24"	1.37
Planting Depth (in.)	0.125		Precip (>.1) Plnt'g-Harvest	6.79		Post PAW (in.) 24-36"	1.15
Dry Surf Soil (in.) @Plnt'g	0.125		Harvest Date	8/11		Post PAW (in.) 36-48"	1.81
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	38"		Precip (>.1) Hvst-Post	0.00

Canola			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	0.45
Planting Date	4/30		Precip (in.) Plnt'g-Harvest	7.92		Post PAW (in.) 6-24"	1.95
Planting Depth (in.)	0.25		Precip (>.1) Plnt'g-Harvest	6.79		Post PAW (in.) 24-36"	1.42
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	8/11		Post PAW (in.) 36-48"	1.96
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	34"		Precip (>.1) Hvst-Post	0.00

Crambe			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	na
Planting Date	5/6		Precip (in.) Plnt'g-Harvest	9.48		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	8.16		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	9/7		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Flaxseed			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	0.46
Planting Date	4/30		Precip (in.) Plnt'g-Harvest	7.92		Post PAW (in.) 6-24"	1.57
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	6.79		Post PAW (in.) 24-36"	1.43
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	8/15		Post PAW (in.) 36-48"	2.16
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	37"		Precip (>.1) Hvst-Post	0.00

Mustard			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	0.45
Planting Date	4/30		Precip (in.) Plnt'g-Harvest	7.92		Post PAW (in.) 6-24"	1.59
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	6.79		Post PAW (in.) 24-36"	1.28
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	8/11		Post PAW (in.) 36-48"	2.04
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	32"		Precip (>.1) Hvst-Post	0.00

Rapeseed			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	0.50
Planting Date	4/30		Precip (in.) Plnt'g-Harvest	7.92		Post PAW (in.) 6-24"	1.40
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	6.79		Post PAW (in.) 24-36"	1.54
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	8/11		Post PAW (in.) 36-48"	2.38
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	30"		Precip (>.1) Hvst-Post	0.00

Safflower			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	na
Planting Date	5/6		Precip (in.) Plnt'g-Harvest	10.76		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25		Precip (>.1) Plnt'g-Harvest	9.28		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	10/6		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Soybean			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	na
Planting Date	5/6		Precip (in.) Plnt'g-Harvest	10.87		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.5		Precip (>.1) Plnt'g-Harvest	9.28		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	10/8		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Sunflower			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	na
Planting Date	4/30		Precip (in.) Plnt'g-Harvest	10.87		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.5		Precip (>.1) Plnt'g-Harvest	9.28		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	10/8		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

TABLE 2. Oilseed Management Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2004.
(Exp# 04-OC02-OC)

SPECIES	PLANTING DATE / N	STAND %	PLANT COUNT	1/ FLOWER DATE	PLNT HT Inches	SHATTER %	2/ YIELD Lb/Ac	MOISTURE %	TEST WT Lbs/Bu	3/ OIL %	4/ RETURN $/ac	5/ MARKET $
Canola	Early / 0 # N Topdress	95.6	3.9	179.0	109.7	0.0	714.3	3.5	52.7	pndg	$52.85	$7.40
Canola	Early / 35 # N Topdress	97.5	5.0	179.0	105.4	0.0	781.9	3.5	52.7	pndg	$57.86	$7.40
Canola	Early / 70 # N Topdress	94.4	3.4	179.0	109.6	0.0	620.6	3.5	52.7	pndg	$45.92	$7.40
Canola	Late / 0 # N Topdress	100.0	9.2	190.3	87.3	0.0	80.2	3.5	52.2	pndg	$5.93	$7.40
Canola	Late / 35 # N Topdress	100.0	10.8	190.3	83.6	0.0	40.4	3.6	52.2	pndg	$2.99	$7.40
Canola	Late / 70 # N Topdress	99.4	10.4	190.0	85.2	0.0	44.8	3.6	51.8	pndg	$3.31	$7.40
Mustard	Early / 0 # N Topdress	96.8	7.0	172.3	125.1	1.8	1313.0	3.9	54.2	pndg	$153.49	$11.69
Mustard	Early / 35 # N Topdress	96.9	5.4	172.5	130.2	2.0	1419.6	3.7	55.1	pndg	$165.95*	$11.69
Mustard	Early / 70 # N Topdress	97.6	5.8	170.8	134.8	2.0	1482.2	3.7	55.1	pndg	$173.27**	$11.69
Mustard	Late / 0 # N Topdress	98.5	13.5	183.5	91.1	0.0	412.5	3.8	54.1	pndg	$48.22	$11.69
Mustard	Late / 35 # N Topdress	99.7	12.7	183.3	105.9	0.0	448.0	3.7	54.5	pndg	$52.38	$11.69
Mustard	Late / 70 # N Topdress	98.6	16.4	183.0	103.0	0.0	382.2	3.7	54.6	pndg	$44.68	$11.69
Safflower	Early / 0 # N Topdress	92.5	3.0	212.0	91.3	0.0	1928.0**	6.6	42.4	50.2	$165.62*	$8.59
Safflower	Early / 35 # N Topdress	94.3	5.0	212.0	77.4	0.0	1779.3*	6.3	42.5	50.4	$152.84	$8.59
Safflower	Early / 70 # N Topdress	98.3	4.2	212.0	89.7	0.0	1543.9	6.4	42.4	50.4	$132.62	$8.59
Safflower	Late / 0 # N Topdress	87.4	4.2	218.0	73.4	0.0	1473.2	7.4	41.3	51.3	$126.54	$8.59
Safflower	Late / 35 # N Topdress	90.3	4.7	218.0	74.1	0.0	1414.0	7.2	42.1	50.2	$121.46	$8.59
Safflower	Late / 70 # N Topdress	88.6	3.5	218.0	66.5	0.0	1289.8	6.7	42.3	48.5	$110.80	$8.59
EXPERIMENTAL MEANS		95.9	7.1	192.4	96.8	0.3	953.8	4.7	-	-	89.8	-
LSD (0.05)		3.5	2.2	1.5	14.8	0.2	174.6	0.3	-	-	17.7	-
C.V.: (S / MEAN)*100		2.6	21.6	0.6	10.8	18.1	12.9	4.6	-	-	13.9	-

1/ No. of Days from January 1 (192 = July 10)
2/ Volumetric yields are based on plot weights adjusted to a uniform 8 percent grain moisture.
3/ Oil percentage values are reported on a 92% dry matter basis.
4/ Gross Return does not take into account any input costs associated with the crop.
5/ Price quotes as of 2/11/2005, USDA-FSA, Havre, MT.
** Indicates highest ranking entry within a column.
* Indicates entries ranking equal to the highest ranking enty within a column based on Fisher's protected LSD (p=0.05).

Site Resource & Management Data: (Exp# 04-OC02-OC)							
Field	An-1-5		SaltHaz(MMHOS/cm)6-24"	0.76		2" Soil Temp (^{o}F) @ Plnt'g	*
Quarter	NW		Soil Texture 0-6"	CL+		4" Soil Temp (^{o}F) @ Plnt'g	*
Section	32		Soil Texture 6-24"	CL+		Fertilizer Formulation	Gran.Blend
Township	32N		Soil Texture 24-36"	CL+		Fertilizer Placement	Bnd at Plntg
Range	15E		Soil Texture 36-48"	CL+		Fert. Rate (lbs/ac) N	0
Latitude			Init Zn (ppm) 0-6"	0.5		Fert. Rate (lbs/ac) P2O5	40
Longitude			Init Mn (ppm) 0-6"	1.1		Fert. Rate (lbs/ac) K2O	25
Soil Series			Init Cu (ppm) 0-6"	0.7		Herbicide App. Date	4/20
pH 0-6"	8.0		Init Fe (ppm) 0-6"	4.2		Herbicide Product	Treflan EC
Org.Matter (%) 0-6"	0.8		CEC 0-6"	21.8		Herbicide Rate (/ac)	24 oz
Init N (lbs/ac) 0-6"	38		Init PAW (in.) 0-6"	0.85		Precip (in.) Plnt'g-Harvest	*
Init N (lbs/ac) 6-24"	60		Init PAW (in.) 6-24"	3.11		Precip (>.1) Plnt'g-Harvest	*
Init N (lbs/ac) 24-36"	88		Init PAW (in.) 24-36"	1.68		Harvest Date	*
Init N (lbs/ac) 36-48"	76		Init PAW (in.) 36-48"	1.62		Rooting Depth (in.)	*
Init P (ppm) Olsen 0-6"	19		Cropping System	NT-ChmFlw		Post PAW (in.) 0-6"	*
Init K (ppm) 0-6"	188		Planting Date	*		Post PAW (in.) 6-24"	*
Init S (ppm) 0-24"	20		Planting Depth (in.)	*		Post PAW (in.) 24-36"	*
Init Na (MEQ/100g) 0-6"	0.13		Moist Soil Depth @Plnt'g	48+		Post PAW (in.) 36-48"	*
SaltHaz (MMHOS/cm) 0-6"	0.76		Dry Surf Soil (in.) @Plnt'g	*		Precip (>.1) Hvst-Post	*

* See individaul crop details.

Early Canola			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	na
Planting Date	4/20		Precip (in.) Plnt'g-Harvest	11.02		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	7.05		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	8/11		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Early Mustard			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	na
Planting Date	4/20		Precip (in.) Plnt'g-Harvest	11.02		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	7.05		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	8/11		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Early Safflower			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	na
Planting Date	4/20		Precip (in.) Plnt'g-Harvest	11.02		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25		Precip (>.1) Plnt'g-Harvest	9.22		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	10/6		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Late Canola			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	na
Planting Date	5/3		Precip (in.) Plnt'g-Harvest	7.92		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	6.79		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	8/11		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Late Mustard			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	na
Planting Date	5/3		Precip (in.) Plnt'g-Harvest	7.92		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	6.79		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	8/11		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Late Safflower			4" Soil Temp (°F) @ Plnt'g	pndg		Post PAW (in.) 0-6"	na
Planting Date	5/3		Precip (in.) Plnt'g-Harvest	10.76		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25		Precip (>.1) Plnt'g-Harvest	8.05		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	pndg		Harvest Date	10/6		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	pndg		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

TABLE 3. Montana Safflower Cultivar Evaluation Nursery Grown On-Station Under No-Till Dryland Fallow Conditions at Northern Agricultural Research Center. Havre, Montana. 2004. (Exp# 04-7702-SA)

ENTRY	SOURCE	STAND %	1/ FLWR DATE	PLNT HT Inches	YIELD Lbs/Ac	MOIST %	TEST WT Lbs/Bu	OIL % 0%Mois.	OIL % 8%Mois.	Lbs OIL 8%Mois.
13	00B 1397	92.4	212.3	27.2	1210.3	4.5	40.9	38.0	35.0	423.3
12	00B1027	93.2	211.0	26.4	1288.8	4.4	41.3	47.6	43.8	564.1
14	00B6144	93.8	212.0	25.1	1133.2	4.5	41.2	45.8	42.1	477.3
15	00B6878	96.4	211.3	27.6	1210.1	4.5	42.1	38.7	35.6	431.0
16	00B7583	90.6	212.7	26.1	1395.3	4.7	41.3	39.5	36.4	507.2
17	00B7627	94.8	214.7	28.6	1265.8	4.7	42.2	38.6	35.5	449.4
18	00B8208	95.3	213.0	27.9	1343.8	4.4	42.3	36.6	33.6	452.8
19	01B 7114	94.5	214.3	25.8	977.8	4.4	39.0	42.5	39.1	382.2
20	02B 1638	94.3	212.7	26.9	1036.1	4.6	40.5	41.0	37.8	391.1
21	02B 6081	94.5	212.7	27.0	1175.4	4.5	41.0	38.8	35.7	419.9
22	02B 6381	95.3	213.7	25.8	1088.9	4.4	39.7	45.8	42.2	459.0
23	02B 6674	96.4	213.0	24.4	1084.7	4.5	39.3	43.2	39.7	430.4
24	02B 8599	95.9	212.3	26.3	1040.4	4.8	42.4	36.5	33.6	348.9
25	02B 8624	97.9	214.7	25.2	1025.5	4.7	40.7	35.5	32.7	334.5
1	91B2166	88.8	215.7	24.8	1059.8	4.6	40.3	40.4	37.1	393.9
3	95B3538	95.3	214.0	25.8	1113.7	4.8	43.5	37.8	34.8	388.3
4	95B7181	91.4	212.7	25.7	1046.5	4.9	43.2	37.1	34.2	357.8
5	95B7446	94.8	212.3	25.4	1229.7	4.9	44.3	37.8	34.8	427.6
7	96B 6170	97.4	212.7	26.7	1011.9	4.8	44.3	39.5	36.4	368.1
6	96B6054	95.3	212.0	24.7	993.1	4.4	40.8	42.5	39.1	388.6
8	97B1214	94.5	212.7	26.1	962.8	4.5	38.2	37.2	34.2	329.5
9	97B1286	94.3	211.3	24.9	1326.0	4.6	42.3	40.9	37.6	498.5
10	97B1744	92.7	211.3	26.2	1298.9	4.6	42.8	37.9	34.9	452.9
11	98B 1475	93.5	211.0	28.3	1206.0	4.3	41.1	39.1	35.9	433.5
29	CENTENNIAL	95.8	213.7	27.0	1130.6	4.4	41.3	43.6	40.1	453.4
36	ERLIN	92.2	212.0	24.7	1376.7	4.4	39.8	41.0	37.7	520.6
35	FINCH	92.7	212.3	29.0	1276.5	4.8	43.0	37.5	34.5	440.6
26	HYBRID 9022	94.0	213.3	25.9	1237.3	4.7	43.6	32.7	30.1	372.7
27	HYBRID 9048	93.8	214.3	26.7	1246.8	4.7	41.1	34.2	31.4	391.6
30	MONTOLA 2000	94.8	211.7	24.8	1113.7	4.3	39.5	40.5	37.3	415.2
31	MONTOLA 2001	94.0	212.3	25.3	1074.0	4.7	41.5	38.6	35.5	380.7
32	MONTOLA 2003	95.8	210.3	26.3	1110.2	4.5	40.8	38.0	34.9	387.8
33	MONTOLA 2004	95.1	210.7	26.5	1257.3	4.7	42.0	38.6	35.5	445.9
34	MORLIN	95.3	210.7	27.8	1359.6	4.8	43.7	40.3	37.1	504.0
2	NUTRASAFF (91B3842)	94.8	212.3	26.3	1048.9	4.3	40.0	48.8	44.9	470.8
28	S-541	95.3	214.0	28.2	1202.1	4.5	41.1	44.1	40.5	487.2
EXPERIMENTAL MEANS		94.4	212.6	26.3	1165.5	4.6	41.5	39.9	36.7	427.2
LSD (0.05)		5.1	3.4	3.4	284.5	0.5	3.7	0.7	0.7	103.6
C.V.2: (S of MEAN / MEAN)*100		1.9	0.6	4.6	8.7	4.0	3.2	0.7	0.7	8.6

1/ No. of Days from January 1 (212 = July 30)

Site Resource & Management Data: (Exp# 04-7702-SA)							
Field	An-3-5		SaltHaz(MMHOS/cm)6-24"	0.92		2" Soil Temp (^{o}F) @ Plnt'g	pndg
Quarter	NW		Soil Texture 0-6"	CL		4" Soil Temp (^{o}F) @ Plnt'g	pndg
Section	32		Soil Texture 6-24"	CL		Fertilizer Formulation	Gran.Blend
Township	32N		Soil Texture 24-36"	CL		Fertilizer Placement	Bnd at Plntg
Range	15E		Soil Texture 36-48"	CL		Fert. Rate (lbs/ac) N	70
Latitude			Init Zn (ppm) 0-6"	0.5		Fert. Rate (lbs/ac) P2O5	40
Longitude			Init Mn (ppm) 0-6"	9.6		Fert. Rate (lbs/ac) K2O	25
Soil Series			Init Cu (ppm) 0-6"	1.1		Herbicide App. Date	4/20
pH 0-6"	7.2		Init Fe (ppm) 0-6"	12.2		Herbicide Product	Treflan EC
Org.Matter (%) 0-6"	0.8		CEC 0-6"	21.8		Herbicide Rate (/ac)	24 oz
Init N (lbs/ac) 0-6"	26		Init PAW (in.) 0-6"	1.00		Precip (in.) Plnt'g-Harvest	0.81
Init N (lbs/ac) 6-24"	48		Init PAW (in.) 6-24"	3.58		Precip (>.1) Plnt'g-Harvest	0.81
Init N (lbs/ac) 24-36"	80		Init PAW (in.) 24-36"	2.64		Harvest Date	10/6
Init N (lbs/ac) 36-48"	60		Init PAW (in.) 36-48"	2.98		Rooting Depth (in.)	n/a
Init P (ppm) Olsen 0-6"	24		Cropping System	CT-MechFlw		Post PAW (in.) 0-6"	n/a
Init K (ppm) 0-6"	305		Planting Date	4/23		Post PAW (in.) 6-24"	n/a
Init S (ppm) 0-24"	39		Planting Depth (in.)	1.25		Post PAW (in.) 24-36"	n/a
Init Na (MEQ/100g) 0-6"	0.08		Moist Soil Depth @Plnt'g	48+		Post PAW (in.) 36-48"	n/a
SaltHaz (MMHOS/cm) 0-6"	0.64		Dry Surf Soil (in.) @Plnt'g	pndg		Precip (>.1) Hvst-Post	n/a