2005
Annual Report on Subcontracted Research
to
The Institute for Biobased Products
by
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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 seven (7) different species and eighteen (18) 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 produce the best seed yield and oil production in different environments across the state while further determining the oilseed best suited for biobased fuel and lubricant applications.

2. Oilseed Management Evaluations

   This is the second year of a trial designed and conducted only at Northern Agricultural Research Center (NARC). The trial focuses 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 three seeding dates (April 21, April 26 and May 4), 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 the multi-specie and oilseed management evaluations.

1. Multi-Specie Evaluation of Alternative Oilseed Crops

The four camelina entries seeded on March 2 produced the highest yields of all entries. 'MT 1' , 'MT 3', 'MT 5' and 'Celina' produced 1789, 1681, 1590 and 1585 lb/ac, respectively. 'Meyer' crambe produced 1449 lb/ac which was statistically the same as MT 5 and Celina (Table 1). At an estimated market price of $0.09 per pound on January 13, 2006, the camelina would have produced a gross return of $142.61 to $161.04 per acre with no other crop related expenses taken into account. No other entry produced a gross return statistically equal to that of the camelina entries seeded in early March. A second seeding date for camelina was May 4. The late seeded 'Ligena' produced 954 lb/ac and the 'Celina' produced 732 lb/ac. Overall, the lowest yielding cultivars in the trial were the canola and mustard species. Soybean and rapeseed were dropped from the 2005 multi-specie trial because they are currently not crops that can be feasibly and economically produced under dryland conditions in north central Montana. For the second year, camelina, a crop new to Montana, demonstrated good agronomic potential for oilseed producers. The gross return for camelina in 2004 was lower than that of sunflower, safflower and flax, but higher than that of canola, crambe, mustard, rapeseed and soybean. In 2005 the four early seeded entries of camelina produced the highest gross return of all the oilseeds in the trial.

2. Oilseed Management Evaluations

The canola, mustard and safflower seeded on April 21 out yielded the same species seeded on April 26 and May 4 (Table 2). Safflower seeded on April 21 and April 26, with no top dressed N, out yielded all other entries in the trail at 1721 and 1591 lb/ac, respectively. When applying the January 13 market prices to the different commodities, the highest yielding entries also produced the highest gross returns. Overall, late seeded canola, mustard and safflower produced the lowest gross returns.

3. Safflower Cultivar Evaluations

Seed yield among the 36 common varieties and experimental lines ranged from 828 to 1510 lb/ac, and percent oil ranged from 33 to 48 (Table 3). All data parameters measured between entries were statistically significant for all variables except stand percentage. 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:

Lamb, Peggy F. and G. R. Carlson. 2005 Oilseed rotation crop performance evaluations. This is an annual report of preliminary data to the NARC Advisory Council and the general public. The report is made available in hard copy and via the internet (www.ag.montana.edu/narc). 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 2005.

Impact Statement

Cooperatives or Small Businesses Formed or Helped:

This information is of assistance to the "Peaks & Prairies Oilseed Cooperative", "Great Northern Growers" and other individuals or groups interested in producing or utilizing oilseeds. This research attempts to determine which oil producing plant species and/or variety is best suited to grow and produce quality oil under north central Montana environments. This research also helps interested producers determine the best management practices for crop establishment and growth. 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. NARC Public Field Day (approx. 80 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 13, 2005).

2. NARC Advisory Council (approx. 22 farmers, ranchers, and Extension personnel, Havre, February 14, 2006).

TABLE 1. Oilseed Multi-specie Evaluation Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2005.
(Exp# 05-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	22.2	88.8	35.2	0.0	1584.6*	5.0	52.5	pndg	$142.61	$9.00/cwt
Camelina	Celina (late seeded)	100.0	21.5	178.0	31.6	0.0	731.7	5.4	51.1	pndg	$65.86	$9.00/cwt
Camelina	Ligena (late seeded)	100.0	19.0	178.0	30.4	0.0	853.8	5.4	50.0	pndg	$85.84	$9.00/cwt
Camelina	MT 1	100.0	22.9	80.4	31.6	0.0	1789.4**	5.2	51.6	pndg	$161.04**	$9.00/cwt
Camelina	MT 3	100.0	32.6	82.0	32.3	0.0	1681.3*	5.1	53.3	pndg	$151.32*	$9.00/cwt
Camelina	MT 5	100.0	26.0	80.8	31.8	0.0	1590.4*	8.1	53.2	pndg	$143.14*	$9.00/cwt
Canola	CHS2061	79.0	10.1	175.3	36.1	0.0	514.9	5.2	51.7	pndg	$40.32	$7.83/cwt
Canola	Crosby	81.3	6.3	175.7	34.7	0.0	392.5	5.2	51.2	pndg	$30.73	$7.83/cwt
Crambe	Meyer	100.0	14.5	174.0	32.0	0.0	1448.9	4.6	50.9	pndg	$92.15	$6.36/cwt
Flax	Carter	100.0	100.4	174.5	23.2	0.0	1113.2	5.1	53.5	pndg	$106.42	$9.56/cwt
Flax	Neche	100.0	108.1	173.0	22.2	0.0	1120.8	5.2	53.3	pndg	$107.15	$9.56/cwt
Flax	Omega	100.0	105.2	174.3	22.6	0.0	1146.4	5.1	53.2	pndg	$109.60	$9.56/cwt
Flax	York	100.0	90.8	173.5	22.4	0.0	1166.2	5.2	53.5	pndg	$111.49	$9.56/cwt
Mustard	Amulet	93.1	11.2	174.8	39.4	0.0	442.8	5.7	54.5	pndg	$49.55	$11.19/cwt
Safflower	MT2004	84.3	10.8	203.0	27.2	0.0	1137.6	7.8	40.0	pndg	$106.25	$9.34/cwt
Safflower	Nutrasaf	74.8	10.6	204.0	32.3	0.0	835.4	7.2	37.1	pndg	$78.03	$9.34/cwt
Sunflower	308 NS	100.0	5.2	207.3	49.3	36.7	563.0	5.1	31.4	pndg	$42.96	$7.63/cwt
Sunflower	8442 NS	100.0	5.2	207.3	50.6	36.7	917.7	5.2	29.1	pndg	$70.02	$7.63/cwt
EXPERIMENTAL MEANS		95.1	34.6	161.4	32.5	4.1	884.6	5.6	48.4	-	69.1	-
LSD (0.05)		10.0	15.9	2.6	2.1	1.0	213.1	0.2	0.7	-	18.2	-
C.V.: (S / MEAN)*100		9.2	40.0	1.4	5.6	21.0	17.5	3.7	1.2	-	16.9	-

1/ No. of Days from January 1 (161 = June 10)
2/ Volumetric yields are based on plot weights adjusted to a uniform 8 percent grain moisture for camelina, canola, crambe, flax, mustard and safflower, and a uniform 10 percent grain moisture for 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 1/13/2006, USDA-FSA, Havre, MT. Camelina price estimate from Dr. Duane Johnson, Institute for Bio-Based Products ($0.08 to $0.10 per lb - used $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# 05-OC01-OC)							
Field	An-2-6		SaltHaz(MMHOS/cm)6-24"	0.37		2" Soil Temp (^{o}F) @ Plnt'g	61
Quarter	NW		Soil Texture 0-6"	CL		4" Soil Temp (^{o}F) @ Plnt'g	60
Section	33		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	N48 29.539'		Init Zn (ppm) 0-6"	0.4		Fert. Rate (lbs/ac) P2O5	40
Longitude	W48 47.798'		Init Mn (ppm) 0-6"	10.1		Fert. Rate (lbs/ac) K2O	25
Soil Series	unk		Init Cu (ppm) 0-6"	1.1		Herbicide App. Date	4/19
pH 0-6"	8		Init Fe (ppm) 0-6"	5		Herbicide Product	Treflan EC
Org.Matter (%) 0-6"	1.6		CEC 0-6"	21.8		Herbicide Rate (/ac)	24 oz
Init N (lbs/ac) 0-6"	22		Init PAW (in.) 0-6"	0.99		Precip (in.) Plnt'g-Harvest	*
Init N (lbs/ac) 6-24"	30		Init PAW (in.) 6-24"	3.36		Precip (>.1) Plnt'g-Harvest	*
Init N (lbs/ac) 24-36"	16		Init PAW (in.) 24-36"	2.22		Harvest Date	*
Init N (lbs/ac) 36-48"	16		Init PAW (in.) 36-48"	1.93		Rooting Depth (in.)	*
Init P (ppm) Olsen 0-6"	84		Cropping System	NT-ChmFlw		Post PAW (in.) 0-6"	*
Init K (ppm) 0-6"	14		Planting Date	3/2		Post PAW (in.) 6-24"	*
Init S (ppm) 0-24"	228		Planting Depth (in.)	0.125		Post PAW (in.) 24-36"	*
Init Na (MEQ/100g) 0-6"	23		Moist Soil Depth @Plnt'g	48+		Post PAW (in.) 36-48"	*
SaltHaz (MMHOS/cm) 0-6"	0.05		Dry Surf Soil (in.) @Plnt'g	0.1		Precip (>.1) Hvst-Post	*

* See individaul crop details.

Camelina			4" Soil Temp (°F) @ Plnt'g	42		Post PAW (in.) 0-6"	0.32
Planting Date	3/2		Precip (in.) Plnt'g-Harvest	7.96		Post PAW (in.) 6-24"	1.28
Planting Depth (in.)	0.125		Precip (>.1) Plnt'g-Harvest	6.90		Post PAW (in.) 24-36"	1.16
Dry Surf Soil (in.) @Plnt'g	0.125		Harvest Date	7/18		Post PAW (in.) 36-48"	1.81
2" Soil Temp (°F) @ Plnt'g	50		Rooting Depth (in.)	n/a		Precip (>.1) Hvst-Post	0.00

Canola			4" Soil Temp (°F) @ Plnt'g	60		Post PAW (in.) 0-6"	0.33
Planting Date	4/21		Precip (in.) Plnt'g-Harvest	6.79		Post PAW (in.) 6-24"	1.85
Planting Depth (in.)	0.25		Precip (>.1) Plnt'g-Harvest	6.24		Post PAW (in.) 24-36"	1.39
Dry Surf Soil (in.) @Plnt'g	0.25		Harvest Date	8/3		Post PAW (in.) 36-48"	1.86
2" Soil Temp (°F) @ Plnt'g	61		Rooting Depth (in.)	n/a		Precip (>.1) Hvst-Post	0.00

Crambe			4" Soil Temp (°F) @ Plnt'g	60		Post PAW (in.) 0-6"	na
Planting Date	4/21		Precip (in.) Plnt'g-Harvest	6.79		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.75		Precip (>.1) Plnt'g-Harvest	6.24		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	0.25		Harvest Date	8/3		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	61		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Flaxseed			4" Soil Temp (°F) @ Plnt'g	60		Post PAW (in.) 0-6"	0.33
Planting Date	4/21		Precip (in.) Plnt'g-Harvest	6.79		Post PAW (in.) 6-24"	1.47
Planting Depth (in.)	0.75		Precip (>.1) Plnt'g-Harvest	6.24		Post PAW (in.) 24-36"	1.40
Dry Surf Soil (in.) @Plnt'g	0.25		Harvest Date	8/3		Post PAW (in.) 36-48"	2.18
2" Soil Temp (°F) @ Plnt'g	61		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	0.00

Mustard			4" Soil Temp (°F) @ Plnt'g	60		Post PAW (in.) 0-6"	0.40
Planting Date	4/21		Precip (in.) Plnt'g-Harvest	6.79		Post PAW (in.) 6-24"	1.47
Planting Depth (in.)	0.75		Precip (>.1) Plnt'g-Harvest	6.24		Post PAW (in.) 24-36"	1.26
Dry Surf Soil (in.) @Plnt'g	0.25		Harvest Date	8/3		Post PAW (in.) 36-48"	2.06
2" Soil Temp (°F) @ Plnt'g	61		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	0.00

Safflower			4" Soil Temp (°F) @ Plnt'g	60		Post PAW (in.) 0-6"	na
Planting Date	4/21		Precip (in.) Plnt'g-Harvest	9.27		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1		Precip (>.1) Plnt'g-Harvest	7.85		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	0.25		Harvest Date	10/24		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	61		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Sunflower			4" Soil Temp (°F) @ Plnt'g	61		Post PAW (in.) 0-6"	na
Planting Date	5/9		Precip (in.) Plnt'g-Harvest	9.08		Post PAW (in.) 6-24"	na
Planting Depth (in.)	2		Precip (>.1) Plnt'g-Harvest	8.29		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	1.25		Harvest Date	10/25		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	64		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. 2005.
(Exp# 05-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	33.9	11.4	182.3	32.3	0.0	192.8	5.7	51.0	pndg	$15.09	$7.83
Canola	Early / 35 # N Topdress	48.3	7.3	183.5	25.9	0.0	245.1	5.7	51.0	pndg	$19.19	$7.83
Canola	Early / 70 # N Topdress	55.1	11.6	181.3	32.5	0.0	190.1	5.7	51.5	pndg	$14.89	$7.83
Canola	Mid / 0 # N Topdress	78.6	14.5	184.8	36.9	0.0	166.2	5.6	50.4	pndg	$13.02	$7.83
Canola	Mid / 35 # N Topdress	81.0	19.6	182.0	31.3	0.0	182.8	5.7	51.5	pndg	$14.31	$7.83
Canola	Mid / 70 # N Topdress	80.0	16.6	184.5	36.5	0.0	99.7	5.7	51.3	pndg	$7.80	$7.83
Canola	Late / 0 # N Topdress	86.7	27.6	184.3	35.4	0.0	87.0	5.7	51.5	pndg	$6.81	$7.83
Canola	Late / 35 # N Topdress	62.9	29.0	187.5	40.5	0.0	57.8	5.7	51.2	pndg	$4.53	$7.83
Canola	Late / 70 # N Topdress	59.0	26.0	187.3	28.5	0.0	62.6	5.6	50.7	pndg	$4.90	$7.83
Mustard	Early / 0 # N Topdress	74.7	16.6	169.0	43.1	0.0	959.7	5.8	54.7	pndg	$107.39	$11.19
Mustard	Early / 35 # N Topdress	68.9	11.9	170.8	39.2	0.0	892.4	5.8	54.4	pndg	$99.86	$11.19
Mustard	Early / 70 # N Topdress	86.9	14.3	178.3	30.9	0.0	942.3	5.8	55.0	pndg	$105.45	$11.19
Mustard	Mid / 0 # N Topdress	93.9	22.1	179.8	39.4	0.0	852.4	5.6	54.9	50.2	$95.39	$11.19
Mustard	Mid / 35 # N Topdress	81.4	22.0	170.3	38.7	0.0	737.9	5.6	54.2	50.4	$82.57	$11.19
Mustard	Mid / 70 # N Topdress	100.0	17.9	179.8	38.0	0.0	786.3	5.6	55.2	50.4	$87.99	$11.19
Mustard	Late / 0 # N Topdress	86.1	23.1	175.5	40.7	0.0	632.4	5.6	54.6	51.3	$70.77	$11.19
Mustard	Late / 35 # N Topdress	98.1	25.4	176.5	38.9	0.0	532.6	5.7	54.7	50.2	$59.59	$11.19
Mustard	Late / 70 # N Topdress	96.0	22.9	180.3	37.9	0.0	638.5	5.7	55.2	48.5	$71.45	$11.19
Safflower	Early / 0 # N Topdress	71.9	13.4	202.8	34.3	0.0	1721.4**	7.7	38.0	pndg	$160.78**	$9.34
Safflower	Early / 35 # N Topdress	75.7	16.0	203.0	32.7	0.0	1541.9	7.9	37.9	pndg	$144.02	$9.34
Safflower	Early / 70 # N Topdress	95.8	15.8	202.8	31.0	0.0	1275.1	8.6	37.4	pndg	$119.09	$9.34
Safflower	Mid / 0 # N Topdress	81.3	13.4	204.8	32.6	0.0	1590.7*	8.1	38.0	pndg	$148.57*	$9.34
Safflower	Mid / 35 # N Topdress	88.5	13.8	206.3	29.8	0.0	1485.1	8.4	37.9	pndg	$138.71	$9.34
Safflower	Mid / 70 # N Topdress	94.2	20.3	205.3	31.7	0.0	1422.3	8.2	38.0	pndg	$132.84	$9.34
Safflower	Late / 0 # N Topdress	95.8	10.1	210.5	28.5	0.0	1119.5	8.1	38.1	50.2	$104.57	$9.34
Safflower	Late / 35 # N Topdress	100.0	8.5	208.8	30.5	0.0	1122.9	7.7	38.5	50.4	$104.88	$9.34
Safflower	Late / 70 # N Topdress	93.2	10.5	208.5	32.7	0.0	1001.1	8.2	37.6	50.4	$93.50	$9.34
EXPERIMENTAL MEANS		80.3	17.1	188.5	34.5	0.0	689.1	6.5	47.9	-	89.8	-
LSD (0.05)		30.7	12.2	8.9	7.5	0.0	160.3	0.5	0.8	-	15.3	-
C.V.: (S / MEAN)*100		27.2	50.7	3.3	15.4	0.0	15.0	5.8	1.2	-	14.5	-

1/ No. of Days from January 1 (189 = July 8)
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 1/13/2006, 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# 05-OC02-OC)							
Field	An-2-6		SaltHaz(MMHOS/cm)6-24"	0.32		2" Soil Temp (^{o}F) @ Plnt'g	*
Quarter	NW		Soil Texture 0-6"	CL		4" Soil Temp (^{o}F) @ Plnt'g	*
Section	33		Soil Texture 6-24"	CL		Fertilizer Formulation	Gran.Blend
Township	32N		Soil Texture 24-36"	CL		Fertilizer Placement	Bnd at Plntg N Brdcst
Range	15E		Soil Texture 36-48"	CL		Fert. Rate (lbs/ac) N	0
Latitude	2N48 29.940'		Init Zn (ppm) 0-6"	0.4		Fert. Rate (lbs/ac) P2O5	40
Longitude	W109 47.800'		Init Mn (ppm) 0-6"	11.2		Fert. Rate (lbs/ac) K2O	0
Soil Series	unk		Init Cu (ppm) 0-6"	0.9		Herbicide App. Date	4/19
pH 0-6"	8.0		Init Fe (ppm) 0-6"	5.2		Herbicide Product	Treflan EC
Org.Matter (%) 0-6"	1.6		CEC 0-6"	21.8		Herbicide Rate (/ac)	24 oz
Init N (lbs/ac) 0-6"	26		Init PAW (in.) 0-6"	1.04		Precip (in.) Plnt'g-Harvest	*
Init N (lbs/ac) 6-24"	54		Init PAW (in.) 6-24"	3.79		Precip (>.1) Plnt'g-Harvest	*
Init N (lbs/ac) 24-36"	76		Init PAW (in.) 24-36"	2.31		Harvest Date	*
Init N (lbs/ac) 36-48"	92		Init PAW (in.) 36-48"	2.03		Rooting Depth (in.)	*
Init P (ppm) Olsen 0-6"	11		Cropping System	CT-MechFlw		Post PAW (in.) 0-6"	na
Init K (ppm) 0-6"	262		Planting Date	*		Post PAW (in.) 6-24"	na
Init S (ppm) 0-24"	18		Planting Depth (in.)	*		Post PAW (in.) 24-36"	na
Init Na (MEQ/100g) 0-6"	0.08		Moist Soil Depth @Plnt'g	48+		Post PAW (in.) 36-48"	na
SaltHaz (MMHOS/cm) 0-6"	0.35		Dry Surf Soil (in.) @Plnt'g	*		Precip (>.1) Hvst-Post	na

* See individaul crop details.

Early Canola			4" Soil Temp (°F) @ Plnt'g	59		Post PAW (in.) 0-6"	na
Planting Date	4/21		Precip (in.) Plnt'g-Harvest	6.79		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25c,.5m		Precip (>.1) Plnt'g-Harvest	6.24		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	0.25		Harvest Date	8/3		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	63		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Early Mustard			4" Soil Temp (°F) @ Plnt'g	59		Post PAW (in.) 0-6"	na
Planting Date	4/21		Precip (in.) Plnt'g-Harvest	6.79		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25c,.5m		Precip (>.1) Plnt'g-Harvest	6.24		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	0.3		Harvest Date	8/3		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	63		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Early Safflower			4" Soil Temp (°F) @ Plnt'g	59		Post PAW (in.) 0-6"	na
Planting Date	4/21		Precip (in.) Plnt'g-Harvest	9.27		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	8.24		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	0.3		Harvest Date	10/24		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	63		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Mid Canola			4" Soil Temp (°F) @ Plnt'g	57		Post PAW (in.) 0-6"	na
Planting Date	4/26		Precip (in.) Plnt'g-Harvest	6.79		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25c,.5m		Precip (>.1) Plnt'g-Harvest	6.24		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	0.3		Harvest Date	8/3		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	60		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Mid Mustard			4" Soil Temp (°F) @ Plnt'g	57		Post PAW (in.) 0-6"	na
Planting Date	4/26		Precip (in.) Plnt'g-Harvest	6.79		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25c,.5m		Precip (>.1) Plnt'g-Harvest	6.24		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	0.3		Harvest Date	8/3		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	60		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Mid Safflower			4" Soil Temp (°F) @ Plnt'g	57		Post PAW (in.) 0-6"	na
Planting Date	4/26		Precip (in.) Plnt'g-Harvest	9.27		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	8.24		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	0.3		Harvest Date	10/24		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	60		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Late Canola			4" Soil Temp (°F) @ Plnt'g	61		Post PAW (in.) 0-6"	na
Planting Date	5/4		Precip (in.) Plnt'g-Harvest	6.71		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25c,.5m		Precip (>.1) Plnt'g-Harvest	6.24		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	0.3		Harvest Date	7/20		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	64		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Late Mustard			4" Soil Temp (°F) @ Plnt'g	61		Post PAW (in.) 0-6"	na
Planting Date	5/4		Precip (in.) Plnt'g-Harvest	6.71		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25c,.5m		Precip (>.1) Plnt'g-Harvest	6.24		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	0.3		Harvest Date	7/20		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	64		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Late Safflower			4" Soil Temp (°F) @ Plnt'g	61		Post PAW (in.) 0-6"	na
Planting Date	5/4		Precip (in.) Plnt'g-Harvest	8.84		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	8.24		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @Plnt'g	0.3		Harvest Date	10/25		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	64		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. 2005. (Exp# 05-7702-SA)

ENTRY	CULTIVAR or SELECTION	STAND %	1/ FLWR DATE	PLNT HT Inches	YIELD Lbs/Ac	MOIST %	TEST WT Lbs/Bu	OIL % 0%Mois.	OIL % 8%Mois.	OIL Lbs/Ac 8%Mois.
11	01B 7113	75.9	209.7	20.3	1227.9	7.4	36.2	44.1	40.6	498.9
19	02B 8599	74.6	211.0	23.4	1453.4	8.2	43.5	37.2	34.2	496.4
33	MT 2004	78.9	208.7	19.7	1392.6	8.0	42.3	38.6	35.5	493.8
15	02B 6081	80.6	209.0	20.8	1344.9	8.0	42.6	39.8	36.6	492.5
18	02B 6674	75.9	210.0	17.8	1231.9	7.2	35.5	43.4	40.0	492.2
27	HYBRID 9049	72.9	211.3	23.2	1509.9	8.3	43.7	34.7	31.9	482.1
23	03B 6789	73.6	211.3	20.2	1207.2	7.9	34.6	43.0	39.5	477.3
24	03B 6956	70.1	212.3	21.3	1204.5	8.1	40.3	43.0	39.6	476.7
22	03B 4098	79.9	210.7	21.0	1312.8	8.1	41.8	39.4	36.3	476.3
29	CENTENNIAL	74.5	210.7	24.6	1181.1	7.7	42.1	42.9	39.5	466.3
17	02B 6655	78.9	211.7	18.4	1155.0	7.6	36.0	43.4	39.9	461.3
4	97B 1286	80.1	211.0	23.4	1261.8	7.9	40.1	39.6	36.5	460.3
31	NUTRA SAFF	84.9	208.3	22.1	1036.2	6.9	38.1	47.6	43.8	453.9
32	MT 2003	81.7	208.7	21.0	1226.1	8.0	41.9	39.3	36.2	443.0
20	02B 8628	77.1	211.0	23.2	1274.5	7.7	42.2	37.7	34.7	442.3
30	MT 2000	82.2	209.0	19.8	1160.5	8.0	39.7	41.2	37.9	440.2
34	MORLIN	75.2	211.0	20.5	1194.4	7.9	40.5	39.6	36.4	435.3
25	03B 8069	80.8	210.7	22.0	1216.0	8.1	42.1	38.9	35.8	435.2
7	00B 1413	78.0	211.7	21.2	1124.1	7.7	38.6	41.1	37.8	425.8
2	95B 7446	77.8	211.7	21.7	1222.9	8.0	42.1	37.8	34.8	425.3
35	FINCH	85.4	208.7	21.6	1214.2	8.2	42.2	38.1	35.0	424.2
28	S-541	90.8	210.0	25.2	1061.7	7.5	41.5	43.0	39.5	419.7
3	96B 6170	65.8	211.3	22.6	1138.6	7.8	44.3	39.5	36.4	413.9
1	95B 3538	73.1	213.0	22.5	1215.6	7.8	42.3	36.8	33.8	411.4
5	97B 1744	80.1	209.3	20.4	1150.4	8.0	43.5	36.8	33.8	389.2
14	01B 9104	80.1	210.3	19.3	1150.6	8.2	41.1	36.7	33.8	388.9
9	00B 7627	80.6	210.0	21.4	1089.5	7.8	39.8	38.3	35.2	383.5
12	01B 7353	83.3	211.3	21.3	1066.3	7.9	43.3	38.8	35.7	380.5
6	00B 1397	69.2	210.7	23.0	1117.4	7.8	41.3	37.0	34.1	380.5
8	00B 6878	82.9	211.0	22.2	1038.1	7.5	43.0	39.7	36.5	379.5
16	02B 6204	77.5	211.0	19.2	1094.3	8.1	43.7	37.5	34.5	377.9
21	03B 1118	75.9	211.0	23.0	993.3	7.8	40.0	40.5	37.3	370.2
10	00B 8208	80.8	213.0	20.3	1085.6	7.7	42.4	36.6	33.6	364.9
13	01B 8553	84.3	210.3	19.2	1076.7	7.9	43.5	36.4	33.5	360.9
26	HYBRID 9022	74.8	213.0	25.3	1046.2	8.0	42.5	33.3	30.7	321.3
36	ERLIN	84.0	208.7	20.7	828.3	7.2	39.8	40.5	37.3	308.6
EXPERIMENTAL MEANS		78.4	210.6	21.5	1175.1	7.8	41.1	39.5	36.3	426.4
LSD (0.05)		13.3	1.2	3.2	194.9	0.5	1.1	0.8	0.7	72.1
C.V.2: (S of MEAN / MEAN)*100		6.0	0.2	5.3	5.9	2.3	0.9	0.7	0.7	6.0

1/ No. of Days from January 1 (211 = July 30)

Site Resource & Management Data: (Exp# 05-7702-SA)							
Field	An-4-5		Soil Texture 0-6"	CL		2" Soil Temp (^{o}F) @ Plnt'g	55
Quarter	NW		Soil Texture 6-24"	CL		4" Soil Temp (^{o}F) @ Plnt'g	57
Section	33		Soil Texture 24-36"	CL		Fertilizer Formulation	Gran.Blend
Township	32N		Soil Texture 36-48"	CL		Fertilizer Placement	Bnd at Plntg
Range	15E		Init Zn (ppm) 0-6"	0.4		Fert. Rate (lbs/ac) N	50
Latitude	N48 29.443'		Init Mn (ppm) 0-6"	10.0		Fert. Rate (lbs/ac) P2O5	20
Longitude	W109 47.891'		Init Cu (ppm) 0-6"	1.2		Fert. Rate (lbs/ac) K2O	10
Soil Series	unk		Init Fe (ppm) 0-6"	5.4		Herbicide App. Date	4/19
pH 0-6"	8.1		CEC 0-6"	21.8		Herbicide Product	Treflan EC
Org.Matter (%) 0-6"	1.4		Init PAW (in.) 0-6"	0.96		Herbicide Rate (/ac)	24 oz
Init N (lbs/ac) 0-6"	32		Init PAW (in.) 6-24"	4.13		Precip (in.) Plnt'g-Harvest	9.19
Init N (lbs/ac) 6-24"	156		Init PAW (in.) 24-36"	1.75		Precip (>.1) Plnt'g-Harvest	8.14
Init N (lbs/ac) 24-36"	304		Init PAW (in.) 36-48"	1.81		Harvest Date	10/25
Init N (lbs/ac) 36-48"	216		Init PAW (in.) 0-48"	8.66		Rooting Depth (in.)	n/a
Init P (ppm) Olsen 0-6"	18		Cropping System	NT-ChmFlw		Post PAW (in.) 0-6"	pndg
Init K (ppm) 0-6"	255		Previous Crop	Wntr Wheat		Post PAW (in.) 6-24"	pndg
Init S (ppm) 0-24"	40		Planting Date	5/4		Post PAW (in.) 24-36"	pndg
Init Na (MEQ/100g) 0-6"	0.09		Planting Depth (in.)	1.5		Post PAW (in.) 36-48"	pndg
SaltHaz (MMHOS/cm) 0-6"	0.48		Moist Soil Depth @Plnt'g	48+		Post PAW (in.) 0-48"	pndg
SaltHaz(MMHOS/cm)6-24"	0.52		Dry Surf Soil (in.) @Plnt'g	1		Precip (>.1) Hvst-Post	pndg

TABLE 4. Ten-Year Yield Summary on Selected Entries from Dryland Safflower Nursery. Northern Agricultural Research Center. Havre, Montana. 1996-2005. (Exp# 05-7702-SA)

VARIETY or SELECTION		No. of YEARS TESTED	YIELD (Lbs Per Acre) 1996	1997	1998	1999	2000	2001 1/	2002	2003	2004	2005	AVE. for YEARS TESTED	% of CHECK YIELD 2/	**10-YR COMP. AVE. YIELD 3/**
95B7446	99MTDSVT 218/108	6				1366.8	1496.5		1950.3	692.8	1229.7	1222.9	1326.5	113.6	**1189.4**
S-518	Will 95FI	6		560.8	1044.3	1180.9	1569.6		1870.3	630.0			1142.6	111.0	**1162.5**
97B1744	99DLI2 319/107	5					1941.9		1785.7	451.7	1298.9	1150.4	1325.7	111.0	**1162.2**
95B7174	99MTDSVT 222/106	6		540.2	1066.3	1176.9	1666.0		1691.4	688.2			1138.2	110.6	**1158.0**
95B3538	99MTDSVT 104	7			835.1	1160.7	1588.2		1832.6	480.4	1113.7	1215.6	1175.2	105.3	**1102.5**
00B8208	01DOL4 4126	4							1754.2	595.8	1343.8	1085.6	1194.8	105.0	**1100.2**
MORLIN	011-2180	9	942.0	466.6	937.3	1342.4	1313.2		1839.9	495.0	1359.6	1194.4	1098.9	104.9	**1098.9**
95B7181	99MTDSVT 228/107	7		597.2	1079.6	1245.5	1902.9		1541.5	676.7	1046.5		1155.7	104.5	**1094.8**
FINCH	Will 95FI	9	1048.8	470.0	1033.4	1267.5	1516.3		1383.7	564.1	1276.5	1214.2	1086.1	103.7	**1086.1**
MONT2004	Will	4							1617.1	448.8	1257.3	1392.6	1179.0	103.6	**1085.5**
97B1286	99MTDSVT 311/120	6				1347.7	1036.8		1791.8	447.3	1326.0	1261.8	1201.9	102.9	**1077.7**
CENTENNIAL	Will	9	937.7	673.5	806.6	1034.6	1423.6		1744.7	493.5	1130.6	1181.1	1047.3	100.0	**1047.3**
96B6527	99MTDSVT 317/111	4				1345.4	1108.3		1701.4	519.7			1168.7	99.5	**1042.5**
S-541	Will	5	918.4						1848.6	413.9	1202.1	1061.7	1088.9	99.2	**1039.1**
MONT2000	Will	9	972.1	452.3	920.1	1152.1	1163.5		1787.3	479.2	1113.7	1160.5	1022.3	97.6	**1022.3**
00B7627	01DOL4 4115	4							1562.6	497.2	1265.8	1089.5	1103.8	97.0	**1016.3**
MONT2001	991-122-6503	8	922.7	315.9	854.2	1060.0	1571.6		1605.3	516.6	1074.0		990.0	96.1	**1006.1**
MONT2003	Will WOMA2003	8		574.7	917.5	1311.4	758.9		1715.2	468.2	1110.2	1226.1	1010.3	95.2	**997.2**
00B6878	01DOL3 3110	4							1666.2	413.4	1210.1	1038.1	1081.9	95.1	**996.2**
98B1475	99DLI2 316/130	3							1406.1	545.8	1206.0		1052.6	93.7	**981.8**
00B1027	01DLI2 7107	3							1545.2	307.3	1288.8		1047.1	93.3	**976.6**
91B2166	99DLI1 212/106	4		567.6	876.9				1552.8		1059.8		1014.3	93.2	**975.6**
96B6731	99DOL2 125	3					1415.5		1473.8	513.7			1134.4	92.9	**973.3**
96B6054	99MTDSVT 109	5				1027.1	1112.1		1503.9	468.2	993.1		1020.9	87.6	**917.5**
00B6144	01DOL2 2124	3							1293.2	452.4	1133.2		959.6	85.5	**895.0**
NUTRASAF	91B3842	8		484.2	740.8	879.4	833.1		1585.8	211.2	1048.9	1036.2	852.5	80.3	**841.4**
ERLIN	99MTDSVT 224/130	9	925.0	421.2	565.1	882.3	759.0		1262.5	360.4	1376.7	828.3	820.1	78.3	**820.1**
MEANS (For Entries Listed)			952.4	510.3	898.2	1173.8	1343.2		1641.2	493.5	1194.1	1147.4			1032.1
April-July Precip. (in.)			5.17	5.65	8.78	8.57	6.01		8.87	7.18	8.64	7.37	7.36		
Tot.Annual Precip. (in.)			10.20	12.06	12.17	14.30	10.27		13.29	12.05	14.43	11.90	12.30		
Soil N (lbs) to SD @ PLtg			88	248	n/a	n/a	n/a		n/a	78	214	708	267		
SD (Smplng Depth inches)			48	48	48	Pndg	Pndg		48	48	48	48	48		
Fertilizer Applied	(# N)		70	70	70	70	70		70	70	7	50	61		
	(# P2O5)		40	40	40	40	40		40	40	40	20	38		
	(# K2O)		25	25	25	25	25		25	25	25	10	23		

Long-term check variety is Centennial

1/ The 2001 nursery was destroyed in October due to extreme stand variablity caused by severe drough conditions prior to planting and throughout the growing season.

2/ 10-Yr Comparable Average = (x/y) * z where x = average yield or oil of a given entry for years tested, y = average yield or oil for Centennial for the same years, and z = 10-Yr average yield or oil for the check variety Centennial.

3/ Percent of Centennial yield or oil for the same data years as those in which a given entry was tested.

TABLE 5. Ten-Year Percent Oil Summary on Selected Entries from Dryland Safflower Nursery. Northern Agricultural Research Center. Havre, Montana. 1996-2005. (Exp# 05-7702-SA)

VARIETY or SELECTION		No. of YEARS TESTED	Oil (%) 1996	1997	1998	1999 1/	2000	2001 1/	2002	2003	2004	2005	AVE. for YEARS TESTED	% of CHECK OIL 2/	**10-YR COMP. AVE. OIL 3/**
00B1027	01DLI2 7107	3							41.0	43.5	43.8		42.8	109.3	**42.7**
NUTRASAF	91B3842	7		40.5	36.9		41.6		39.4	46.2	44.9	43.8	41.9	107.3	**41.9**
00B6144	01DOL2 2124	3							37.9	43.3	42.1		41.1	105.1	**41.0**
S-541	Will	5	40.6						37.0	41.2	40.5	39.5	39.8	101.5	**39.6**
CENTENNIAL	Will	8	39.0	38.7	36.5		41.3		37.2	40.1	40.1	39.5	39.0	100.0	**39.0**
96B6054	99MTDSVT 109	4					38.5		38.3	42.5	39.1		39.6	99.8	**39.0**
S-518	Will 95FI	5		39.3	37.5		42.5		33.2	38.9			38.3	98.8	**38.6**
MONT2000		8	40.2	36.6	36.2		37.5		32.7	38.7	37.3	37.9	37.1	95.1	**37.1**
ERLIN	99MTDSVT 224/130	8	35.9	34.5	34.6		39.7		34.7	36.4	37.7	37.3	36.3	93.1	**36.3**
97B1286	99MTDSVT 311/120	5					39.5		34.7	36.0	37.6	36.5	36.8	93.0	**36.3**
00B6878	01DOL3 3110	4							33.5	39.7	35.6	36.5	36.3	92.7	**36.2**
MONT2001		8	38.7	34.4	35.9		35.7		33.1	39.1	35.5		36.1	92.4	**36.1**
MONT2003		7		37.8	36.5		36.7		32.4	37.8	34.9	36.2	36.1	92.3	**36.0**
95B7174	99MTDSVT 222/106	5		37.9	34.2		35.3		32.3	38.9			35.7	92.2	**36.0**
MORLIN	011-2180	8	35.1	34.8	34.4		38.9		33.8	37.3	37.1	36.4	36.0	92.1	**36.0**
96B6731	99DOL2 125	3					35.9		33.3	39.4			36.2	91.6	**35.8**
00B7627	01DOL4 4115	4							33.6	39.3	35.5	35.2	35.9	91.5	**35.7**
91B2166	99DLI1 212/106	4		34.1	33.0				34.3		37.1		34.6	90.9	**35.5**
96B6527	99MTDSVT 317/111	3					37.1		32.2	37.4			35.6	89.9	**35.1**
98B1475	99DLI2 316/130	3							33.1	36.1	35.9		35.0	89.5	**34.9**
MONT2004		4							32.0	37.2	35.5	35.5	35.0	89.3	**34.9**
95B7181	99MTDSVT 228/107	7		35.6	34.4		34.7		32.4	37.9	34.2		34.9	89.3	**34.9**
95B3538	99MTDSVT 104	6			34.3		36.5		32.7	35.2	34.8	33.8	34.5	88.3	**34.5**
FINCH	Will 95FI	8	34.7	33.3	33.6		37.5		32.4	34.5	34.5	35.0	34.4	88.2	**34.4**
95B7446	99MTDSVT 218/108	5					35.5		31.7	37.8	34.8	34.8	34.9	88.1	**34.4**
97B1744	99DLI2 319/107	5					36.3		32.3	34.6	34.9	33.8	34.4	86.8	**33.9**
00B8208	01DOL4 4126	4							30.6	36.4	33.6	33.6	33.6	85.6	**33.4**
MEANS (For Entries Listed)			37.7	36.4	35.2		37.8		34.1	38.7	37.3	36.6			36.6
April-July Precip. (in.)			5.17	5.65	8.78	8.57	6.01		8.87	7.18	8.64	7.37	7.36		
Tot.Annual Precip. (in.)			10.20	12.06	12.17	14.30	10.27		13.29	12.05	14.43	11.90	12.30		
Soil N (lbs) to SD @ PLtg			88	248	n/a	n/a	n/a		n/a	78	214	708	267		
SD (Smplng Depth inches)			48	48	48	Pndg	Pndg		48	48	48	48	48		
Fertilizer Applied	(# N)		70	70	70	70	70		70	70	7	50	61		
	(# P2O5)		40	40	40	40	40		40	40	40	20	38		
	(# K2O)		25	25	25	25	25		25	25	25	10	23		

Long-term check variety is Centennial

1/ The 1999 oil results not reported. The 2001 nursery was destroyed in October due to extreme stand variablity caused by severe drough conditions prior to planting and throughout the growing season.

2/ 10-Yr Comparable Average = (x/y) * z where x = average yield or oil of a given entry for years tested, y = average yield or oil for Centennial for the same years, and z = 10-Yr average yield or oil for the check variety Centennial.

3/ Percent of Centennial yield or oil for the same data years as those in which a given entry was tested.