2006
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 only at Northern Agricultural Research Center (NARC) in 2006. In previous years four other Research Centers (CARC, NWARC, SARC, and WTARC) also participated. Entries consisted of five (5) different species and eighteen (18) cultivars or lines. Specie and varietal adaptation of oilseed crops was evaluated, 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 was to determine which oilseed species or lines would produce the best seed yield and oil production in north central Montana while further determining the oilseed best suited for biobased fuel and lubricant applications.

2. Oilseed Management Evaluations

   This is the third year of a trial designed and conducted only at NARC. The trial 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 three seeding dates (April 21, April 28 and May 4), with three rates of topdressed nitrogen (0, 35 or 70 lbs/ac) actual nutrient using granular Urea. The objective of this trial was to determine the best combination of seeding date and topdressed 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 other selected Research Centers in Montana and North Dakota, focusing on the evaluation of existing and experimental safflower 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.

4. Statewide Camelina Seed Glucosinolate Evaluations

   As camelina becomes an increasingly important crop to the oilseed industry in the state of Montana, it is important to examine all aspects of the crop's end-use products. Following oil extraction, approximately 60 to 65 percent of the initial input comes out as co-product in the form of oilseed meal. This oilseed meal may become an economically important product when used as an ingredient for balancing animal rations and potentially increasing Omega-3 fatty acid content in the foodstuffs produced from animals fed these rations. An example of enhanced animal end products would include, but not be limited to, milk, eggs and meat. Increased glucosinolate levels in the camelina seed and the resulting oilseed meal may be a detriment in feed rations. It is believed that high sulfur content in the soil may result in the formation of increased glucosinolate levels in camelina seed. Research Centers across the state (CARC, EARC, NWARC, NARC, SARC, WARC and WTARC) participated in this statewide camelina seed glucosinolate evaluation. Samples from each of the centers were compiled at NARC and sent to USDA, ARS, NCAUR in Peoria, IL for glucosinolate analysis. This information should provide researchers and producers a

statewide baseline of the effects that soil type, fertility and/or environment may have on the glucosinolate level in camelina oil and the resulting camelina oilseed meal.

5. Camelina fertility evaluations.

A nitrogen and sulfur fertility trial was planted at NARC to determine the effects of the fertility on seed yield, oil content and glucosinolate levels within camelina oil. Fourteen (14) camelina entries were superimposed with three levels of sulfur (0, 10 or 20 lb/ac) and two levels of nitrogen (0 or 10 lb/ac) fertilization resulting in an 84 entry trial. Four of those camelina entries were dropped from the trial due to either poor or no germination. Because it is believed that high sulfur content in the soil may result in the formation of increased glucosinolate levels in camelina seed, it is very important to determine the impacts that varying fertility may have on the glucosinolate levels of multiple camelina lines. Oilseed meal, a by-product of oil extraction, may have the potential to become an important co-product to enhance animal feeds. However, increased glucosinolate levels in the oilseed meal may be a disadvantage when it comes to application as a feedstuff. Seed samples from three replications of the 84 entry trial were sent to USDA, ARS, NCAUR in Peoria, IL for glucosinolate analysis and to NWARC for a complete oil analysis. Typical plant response characteristics including percent stand, population density, flower date, plant height, maturity date, percent shatter, seed yield, seed moisture and test weight were also measured. Providing GRAS status is achieved for camelina meal to be developed as an animal feedstuff, this research is essential for the proper utilization of those bio industry co-products.

Summary of Results (field and laboratory):

Agronomic and economic performance data for:

1) Multi-specie evaluation of alternative oilseed crops is summarized in Tables 1, 2, 3, 4, 5 and 6.
2) Oilseed management evaluations are summarized in Tables 7, 8 and 9.
3) Safflower cultivar evaluations are summarized in Tables 10, 11 and 12.
4) Statewide camelina seed glucosinolate evaluation results are currently not back from the lab.
5) Camelina fertility evaluations are summarized in Tables 13, 14 and 15.

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 the time of this reporting, laboratory analyses for seed glucosinolate levels were still pending for the statewide camelina glucosinolate evaluation and the camelina fertility evaluation.

1. Multi-Specie Evaluation of Alternative Oilseed Crops

Camelina (14), crambe (1), flax (4), safflower (2) and sunflower (2) were evaluated in the 2006 multi-species trial. Seven camelina entries planted on March 31 produced the highest seed yields of all entries and species. Experimental lines ‘MT 1’ , ‘MT 3’, ‘MT 5’, ‘MT 12, ‘MT 15, ‘MT 32’ and ‘MT 38’ produced between 1674 and 1766 lb/ac, out yielding the named camelina varieties. No other specie or entry produced seed yields equal to that of the experimental camelina lines (Table 1). At an estimated market price of $0.10 per pound on December 13, 2006, the highest yielding camelina lines would have produced a gross return of $167.36 to $176.59 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 late March. For the third 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. Low seed yield and gross return of the camelina in 2004 is attributed to a later than optimum seeding date. In 2005 the four early seeded entries of camelina produced the highest gross return of all the oilseeds in the trial. In 2006, camelina produced the highest seed yields and gross returns of all oil seeds tested. We have found that seeding camelina prior to April 1 is critical to maximizing seed yield potential.

2. Oilseed Management Evaluations

The canola and mustard seeded on April 21 out yielded the same species seeded on April 28 and May 4 (Tables 7 and 8). Seeding date of safflower in 2007 did not significantly influence seed yield (Table 9).

Topdress nitrogen application did not influence seed yield of any of the species tested. This was due primarily to the high amount of nitrogen available in the soil profile. When applying the December 13 market prices to the different commodities, early seeded mustard produced the highest gross return at $131.80 per acre, not taking into account any inputs. Seeding canola or mustard past the third week in April is not recommended due to significantly reduced seed yields. Although there was not a statistical difference in seed yield between seeding dates of safflower, there was a linear decrease in yield as it was seeded later in the spring.

3. Safflower Cultivar Evaluations

Seed yield among the 36 common varieties and experimental lines ranged from 755 to 1464 lb/ac, and percent oil ranged from 33 to 47 (Table 10). All data parameters measured between entries were statistically significant for all variables. Ten-year comparable averages for seed yield and oil quantity is presented in Tables 11 and 12. 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.

4. Statewide camelina seed glucosinolate evaluations.

Camelina seed was collected from Research Centers across the state including CARC (Moccasin), EARC (Sidney), NWARC (Creston), NARC (Havre), SARC (Huntley), WARC (Corvallis) and WTARC (Conrad). Samples from each of the centers were compiled at NARC and sent to USDA, ARS, NCAUR in Peoria, IL for glucosinolate analysis. It is believed that high sulfur content in the soil, soil type, fertility and/or environment may have an influence on the glucosinolate level in camelina seed and the resulting camelina oilseed meal. This information should provide researchers and producers a statewide baseline of information on which to base future trials and analysis. As of the date of this report, glucosinolate analysis results were not yet available from the lab in Peoria, IL.

5. Camelina fertility evaluations.

A nitrogen and sulfur fertility trial was planted at NARC to determine the effects of the fertility on seed yield and oil content, plant characteristics and seed glucosinolate levels. Four out of the fourteen camelina entries were dropped from the trial due to either poor or no seed germination. There were no two-way or three-way interactions between camelina line, nitrogen and/or sulfur. As seen in Tables 13 and 14, neither the additional nitrogen nor the sulfur had an affect on overall camelina seed yield or percent oil. Glucosinolate analyses are still pending. The 'MT' experimental lines out yielded the named varieties of camelina. However, as stated earlier, glucosinolate analyses, the most important part, and the focus of this trial, are still pending. A complete report will be submitted as soon as those results are available.

Publications Generated:

Lamb, Peggy F. and G. R. Carlson. 2006 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 have not yet been prepared.

Graduate Students/Post Doctoral Fellows:

None directly associated with Northern Agricultural Research Center in 2006.

Impact Statement

Cooperatives or Small Businesses Formed or Helped:

This information is of assistance to the "Peaks & Prairies Oilseed Cooperative", "Great Northern Growers", "Greater Montana Bio Energies" and other individuals or groups interested in producing or utilizing oilseeds. This research attempts to determine which oil producing plant species and/or varieties

are 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 – July 14, 2006, Havre, MT
    a. Oilseed Crop Adaptation and Biobased Product Research (two tours, 20 minutes each – **44** farmers, ranchers, media representatives, Extension personnel, scientists, industry and other interested individuals from the Hi-Line area).
    b. Special Oilseed Tour (one tour, two hours – **80** farmers, ranchers, media representatives, Extension personnel, scientists, bio-fuel industry and other interested individuals from the Hi-Line area and out of state).
2. NARC Agri-Business Tour – July 14, 2006, Havre, MT
    a. Oilseed Update (20 minutes – **52** agri-business men and women, Extension personnel and bio-fuel industry individuals from the Hi-Line area.)
3. Great Northern Growers Annual Meeting – October 26, 2006, Lewistown, MT
    a. Camelina Production (1 hour – **38** farmers, media representatives and cooperative members).
4. Cabin Fever – December 19, 2006, Havre, MT
    a. Camelina Production Practices and Trial Results (1.5 hours – **40** farmers, ranchers and other interested individuals from the Hi-Line area).
5. Triangle Cropping Seminar Series – January 15, 16, 17 and 18, 2007 (1.5 hours per talk)
    a. Oilseed Trial Results & Camelina Production Practices. Conrad – **42** farmers and ranchers.
    b. Oilseed Trial Results & Camelina Production Practices. Chouteau – **11** farmers and ranchers.
    c. Oilseed Trial Results & Camelina Production Practices. Cutbank – **14** farmers and ranchers.
    d. Oilseed Trial Results & Camelina Production Practices. Shelby – **7** farmers and ranchers.
    e. Oilseed Trial Results & Camelina Production Practices. Chester – **47** farmers and ranchers.
    f. Oilseed Trial Results & Camelina Production Practices. Fort Benton – **50** farmers and ranchers.
    g. Oilseed Trial Results & Camelina Production Practices. Great Falls – **46** farmers and ranchers.
6. NARC Advisory Council – February 6, 2006, Havre, MT
    a. Three-year Oilseed Summary (approx. **22** farmers, ranchers, and Extension personnel).

TABLE 1. ALL SPECIES. Oilseed Multi-specie Evaluation Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-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/ OIL Lbs/Ac	5/ RETURN $/ac
Camelina	CELINE	97.6	25.9	148.7	29.8	9.3	1482.4	4.9	52.8	37.6	557.3	$148.24
Camelina	LIGENA	98.4	28.2	147.1	28.9	1.4	1540.7	4.9	52.1	38.4	590.5	$154.07
Camelina	ROBBY	86.6	9.8	152.6	26.4	10.8	1552.2	5.1	53.1	35.7	555.2	$155.22
Camelina	MT 1	97.2	22.8	144.3	27.6	4.9	1733.0*	4.9	52.1	39.1	677.6	$173.30
Camelina	MT 3	97.6	27.2	144.0	27.0	8.7	1694.9*	4.9	53.2	39.3	665.4	$169.49
Camelina	MT 5	96.9	24.8	143.7	26.7	10.6	1765.9**	4.9	52.7	38.1	673.9	$176.59
Camelina	MT 12	98.1	28.8	144.9	28.5	11.8	1727.0*	4.9	52.5	39.0	673.8	$172.70
Camelina	MT 15	98.0	25.8	146.4	27.9	5.2	1673.6*	5.0	52.2	37.8	632.4	$167.36
Camelina	MT 32	98.2	32.0	147.9	27.7	13.9	1700.1*	4.9	53.0	37.7	640.5	$170.01
Camelina	MT 38	98.5	31.3	143.7	26.0	13.1	1674.8*	4.9	53.4	40.4	676.4	$167.48
Crambe	MEYER	93.8	28.1	163.0	23.5	6.7	1310.6	3.7	23.1	30.9	404.9	$109.45
Flax	CARTER	94.6	57.3	163.5	19.6	5.0	591.7	4.8	52.5	38.7	230.7	$57.45
Flax	NECHE	96.5	58.3	163.7	18.3	3.3	570.1	4.8	52.2	41.5	236.7	$55.35
Flax	OMEGA	97.6	40.8	163.8	19.0	2.5	565.9	4.8	52.0	41.0	232.1	$54.95
Flax	YORK	93.3	58.7	164.5	18.3	2.5	673.0	4.7	52.0	40.2	270.8	$65.35
Safflower	MONTOLA 2004	83.0	11.5	192.7	21.5	0.0	1114.4	4.7	43.1	40.8	464.1	$126.37
Safflower	NUTRASAF	74.5	9.9	196.2	24.5	0.0	505.0	3.5	39.6	49.7	251.0	$57.26
Sunflower	8442NS	100.0	4.1	197.0	44.8	66.7	390.3	4.5	32.2	48.1	83.0	$34.39
Sunflower	CL308NS	100.0	4.4	197.0	42.9	65.8	159.6	5.0	34.6	52.0	187.7	$14.06
EXPERIMENTAL MEANS		94.8	27.9	161.3	26.8	12.7	1186.2	4.7	47.8	40.3	458.1	117.9
LSD (0.05)		7.6	7.2	1.2	2.4	4.5	171.9	0.3	1.3	1.1	70.3	17.0
C.V.: (S / MEAN)*100		7.4	22.6	0.7	7.8	29.6	12.6	6.3	2.3	2.4	13.3	12.6

1/ No. of Days from January 1 (161 = May 26).
2/ 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 12/13/2006, USDA-FSA, Havre, MT. Camelina price estimate from Gary Iverson, Great Northern Growers Cooperative ($0.10 per lb).
** 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).

TABLE 2. CAMELINA. Oilseed Multi-specie Evaluation Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-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/ OIL Lbs/Ac	5/ RETURN $/ac
Camelina	CELINE	97.6	25.9	148.7	29.8	9.3	1482.4	4.9	52.8	37.6	557.3	$148.24
Camelina	LIGENA	98.4	28.2	147.1	28.9	1.4	1540.7	4.9	52.1	38.4	590.5	$154.07
Camelina	ROBBY	86.6	9.8	152.6	26.4	10.8	1552.2	5.1	53.1	35.7	555.2	$155.22
Camelina	MT 1	97.2	22.8	144.3	27.6	4.9	1733.0*	4.9	52.1	39.1	677.6**	$173.30*
Camelina	MT 3	97.6	27.2	144.0	27.0	8.7	1694.9*	4.9	53.2	39.3	665.4*	$169.49*
Camelina	MT 5	96.9	24.8	143.7	26.7	10.6	1765.9**	4.9	52.7	38.1	673.9*	$176.59**
Camelina	MT 12	98.1	28.8	144.9	28.5	11.8	1727.0*	4.9	52.5	39.0	673.8*	$172.70*
Camelina	MT 15	98.0	25.8	146.4	27.9	5.2	1673.6*	5.0	52.2	37.8	632.4*	$167.36*
Camelina	MT 32	98.2	32.0	147.9	27.7	13.9	1700.1*	4.9	53.0	37.7	640.5*	$170.01*
Camelina	MT 38	98.5	31.3	143.7	26.0	13.1	1674.8*	4.9	53.4	40.4**	676.4*	$167.48*
EXPERIMENTAL MEANS		96.7	25.7	146.3	27.7	8.9	1654.5	4.9	52.7	38.3	634.3	165.4
LSD (0.05)		1.9	3.2	0.9	1.1	2.9	166.6	3.3	ns	1.0	68.8	16.0
C.V.: (S / MEAN)*100		3.0	19.3	1.0	6.2	49.4	15.3	3.3	2.9	3.9	16.5	15.3

1/ No. of Days from January 1 (146 = May 26).
2/ Yields are based on plot weights adjusted to a uniform 8 percent grain moisture for camelina.
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 12/13/2006, USDA-FSA, Havre, MT. Camelina price estimate from Gary Iverson, Great Northern Growers Cooperative ($0.10 per lb).
** 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).

TABLE 3. CRAMBE. Oilseed Multi-specie Evaluation Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-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/ OIL Lbs/Ac	5/ RETURN $/ac
Crambe	MEYER	93.8	28.1	163.0	23.5	6.7	1310.6	3.7	23.1	30.9	404.9	$109.45
EXPERIMENTAL MEANS		93.8	28.1	163.0	23.5	6.7	1310.6	3.7	23.1	30.9	404.9	109.5
LSD (0.05)		-	-	-	-	-	-	-	-	-	-	-
C.V.: (S / MEAN)*100		-	-	-	-	-	-	-	-	-	-	-

1/ No. of Days from January 1 (163 = June 12).
2/ Volumetric yields are based on plot weights adjusted to a uniform 8 percent grain moisture for crambe.
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 12/13/2006, USDA-FSA, Havre, MT.

TABLE 4. FLAX. Oilseed Multi-specie Evaluation Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-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/ OIL Lbs/Ac	5/ RETURN $/ac
Flax	CARTER	94.6	57.3	163.5	19.6	5.0	591.7	4.8	52.5	38.7	230.7	$57.45
Flax	NECHE	96.5	58.3	163.7	18.3	3.3	570.1	4.8	52.2	41.5	236.7	$55.35
Flax	OMEGA	97.6	40.8	163.8	19.0	2.5	565.9	4.8	52.0	41.0	232.1	$54.95
Flax	YORK	93.3	58.7	164.5	18.3	2.5	673.0**	4.7	52.0	40.2	270.8	$65.35**
EXPERIMENTAL MEANS		95.5	53.8	163.9	18.8	3.3	600.2	4.7	52.2	40.4	242.6	55.9
LSD (0.05)		ns	ns	0.7	2.0	ns	74.8	ns	ns	ns	ns	7.3
C.V.: (S / MEAN)*100		5.7	24.4	0.3	8.6	61.2	10.1	6.2	ns1.4	4.7	11.5	10.1

1/ No. of Days from January 1 (164 = June 13).
2/ Yields are based on plot weights adjusted to a uniform 8 percent grain moisture for flax.
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 12/13/2006, 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).

TABLE 5. SAFFLOWER. Oilseed Multi-specie Evaluation Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-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/ OIL Lbs/Ac	5/ RETURN $/ac
Safflower	MONTOLA 2004	83.0	11.5	192.7	21.5	0.0	1114.4**	4.7	43.1	40.8	464.1**	$126.37**
Safflower	NUTRASAF	74.5	9.9	196.2	24.5	0.0	505.0	3.5	39.6	49.7	251.0	$57.26
EXPERIMENTAL MEANS		78.8	10.7	194.4	23.0	0.0	809.7	4.1	41.3	45.2	352.5	57.3
LSD (0.05)		ns	ns	2.3	2.3	-	97.6	0.8	2.9	-	36.0	11.1
C.V.: (S / MEAN)*100		12.0	23.7	0.8	6.8	-	8.1	13.6	4.8	-	6.9	8.1

1/ No. of Days from January 1 (194 = July 13).
2/ Yields are based on plot weights adjusted to a uniform 8 percent grain moisture for safflower.
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 12/13/2006, 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).

TABLE 6. SUNFLOWER. Oilseed Multi-specie Evaluation Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-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/ OIL Lbs/Ac	5/ RETURN $/ac
Sunflower	CL308NS	100.0	4.4	197.0	42.9	65.8	159.6	5.0	34.6	52.0	83.0	$14.06
Sunflower	8442NS	100.0	4.1	197.0	44.8	66.7	390.3	4.5	32.2	48.1	187.7	$34.39
EXPERIMENTAL MEANS		-	4.3	197.0	43.9	66.3	275.0	4.7	33.4	50.0	135.4	62.3
LSD (0.05)		-	ns	ns	ns	ns	ns	ns	1.3	-	ns	ns
C.V.: (S / MEAN)*100		-	19.5	0.6	10.6	7.9	61.5	7.5	2.6	-	61.2	61.5

1/ No. of Days from January 1 (197 = July 16).
2/ Yields are based on plot weights adjusted to 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 12/13/2006, USDA-FSA, Havre, MT.

Site Resource & Management Data: (Exp# 06-OC01-OC)							
Field	A-7-4		SaltHaz (MMHOS/cm) 6-24"	n/a		Dry Surf Soil (in.) @ Plnt'g	0.3
Quarter	NW		Soil Texture 0-6"	CL		2" Soil Temp (°F) @ Plnt'g	*
Section	33		Soil Texture 6-24"	CL		4" Soil Temp (°F) @ Plnt'g	*
Township	33N		Soil Texture 24-36"	CL		Fertilizer Formulation	Gran.Blend
Range	15E		Soil Texture 36-48"	CL		Fertilizer Placement	Bnd at Plntg
Latitude	N48 29.568'		Ca (ppm)	4763		Fert. Rate (lbs/ac) N	0
Longitude	W109 47.987'		Init Zn (ppm) 0-6"	0.38		Fert. Rate (lbs/ac) P2O5	44
Soil Series	Hillon CL		Init Mn (ppm) 0-6"	3.24		Fert. Rate (lbs/ac) K2O	0
pH 0-6"	8.2		Init Mg (ppm) 0-6"	465		Herbicide App. Date	4/21
Org.Matter (%) 0-6"	1.5		Init Cu (ppm) 0-6"	1.35		Herbicide (not on camelina & flax)	Treflan EC
Init N (lbs/ac) 0-6"	37		Init Fe (ppm) 0-6"	9.6		Herbicide Rate (/ac)	32 oz
Init N (lbs/ac) 6-24"	150		CEC 0-6"	28.5		Precip (in.) Plnt'g-Harvest	4.90
Init N (lbs/ac) 24-36"	116		Init PAW (in.) 0-6"	1.20		Precip (>.1) Plnt'g-Harvest	4.40
Init N (lbs/ac) 36-48"	54		Init PAW (in.) 6-24"	3.87		Harvest Date	*
Init N (lbs/ac) 0-48"	357		Init PAW (in.) 24-36"	2.29		Rooting Depth (in.)	*
Init P (ppm) Olsen 0-6"	13		Init PAW (in.) 36-48"	2.35		Post PAW (in.) 0-6"	*
Init K (ppm) 0-6"	254		Cropping System	NT-ChmFlw		Post PAW (in.) 6-24"	*
Init S (ppm) 0-24"	142		Planting Date	*		Post PAW (in.) 24-36"	*
Init Na (MEQ/100g) 0-6"	27		Planting Depth (in.)	0.125		Post PAW (in.) 36-48"	*
SaltHaz (MMHOS/cm) 0-6"	0.12		Moist Soil Depth @ Plnt'g	48+		Precip (>.1) Hvst-Post	*

* See individaul crop details.

Camelina			4" Soil Temp (°F) @ Plnt'g	n/a		Post PAW (in.) 0-6"	0.47
Planting Date	3/31		Precip (in.) Plnt'g-Harvest	5.63		Post PAW (in.) 6-24"	1.79
Planting Depth (in.)	0.125		Precip (>.1) Plnt'g-Harvest	5.13		Post PAW (in.) 24-36"	1.16
Dry Surf Soil (in.) @ Plnt'g	0.3		Harvest Date	7/18		Post PAW (in.) 36-48"	1.79
2" Soil Temp (°F) @ Plnt'g	n/a		Rooting Depth (in.)	30		Precip (>.1) Hvst-Post	5.21

Crambe			4" Soil Temp (°F) @ Plnt'g	64		Post PAW (in.) 0-6"	na
Planting Date	4/21		Precip (in.) Plnt'g-Harvest	4.90		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.75		Precip (>.1) Plnt'g-Harvest	4.40		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	66		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Flaxseed			4" Soil Temp (°F) @ Plnt'g	64		Post PAW (in.) 0-6"	na
Planting Date	4/22		Precip (in.) Plnt'g-Harvest	4.90		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.75		Precip (>.1) Plnt'g-Harvest	4.40		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	66		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Safflower			4" Soil Temp (°F) @ Plnt'g	67		Post PAW (in.) 0-6"	na
Planting Date	4/28		Precip (in.) Plnt'g-Harvest	6.89		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1		Precip (>.1) Plnt'g-Harvest	5.76		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @ Plnt'g	0.25		Harvest Date	10/9		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	70		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

Sunflower			4" Soil Temp (°F) @ Plnt'g	45		Post PAW (in.) 0-6"	na
Planting Date	5/3		Precip (in.) Plnt'g-Harvest	7.36		Post PAW (in.) 6-24"	na
Planting Depth (in.)	2		Precip (>.1) Plnt'g-Harvest	6.15		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	44		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

TABLE 7. CANOLA. Oilseed Management Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-OC02-OC)

SPECIES	PLANTING DATE	STAND %	PLANT COUNT	1/ FLOWER DATE	PLNT HT Inches	2/ YIELD Lb/Ac	MOISTURE %	TEST WT Lbs/Bu	3/ OIL %	4/ OIL Lbs/Ac	5/ RETURN $/ac
Canola	April 21	68.5	13.3	174.8	91.3**	604.3**	4.4	52.3**	43.5	262.9	$59.50**
Canola	April 28	79.9	15**	178.3	89.9	398.9	4.3	50.8	40.7	162.2	$39.30
Canola	May 4	68.3	10.8	184.5**	75.9	89.3	4.7**	49.4	35.2	31.4	$8.80
EXPERIMENTAL MEANS		72.3	13.0	179.2	85.7	364.2	4.5	50.8	39.8	152.2	35.8
LSD (0.05)		ns	3.1	0.9	6.5	100.9	0.1	1.7	-	-	9.9
C.V.: (S / MEAN)*100		22.2	28.6	0.6	9.1	33.2	2.6	3.9	-	-	33.2

1/ No. of Days from January 1 (179 = June 28).
2/ 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 12/13/2006, 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).

TABLE 8. MUSTARD. Oilseed Management Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-OC02-OC)

SPECIES	PLANTING DATE	STAND %	PLANT COUNT	1/ FLOWER DATE	PLNT HT Inches	2/ YIELD Lb/Ac	MOISTURE %	TEST WT Lbs/Bu	3/ OIL %	4/ OIL Lbs/Ac	5/ RETURN $/ac
Mustard	April 21	86.4	17.4	161.0	79.9	1178.1**	3.8	53.1	36.0	424.2	$131.80**
Mustard	April 28	76.5	24.8**	164.0	83.5	814.2	3.8	53.0	36.1	293.6	$91.10
Mustard	May 4	77.7	22.5	171.8**	89.1**	620.7	3.8	53.5	35.3	218.9	$69.40
EXPERIMENTAL MEANS		80.2	21.6	165.6	84.2	871.0	3.8	53.2	35.8	312.3	97.5
LSD (0.05)		ns	4.7	0.4	5.3	120.8	ns	ns	-	-	13.5
C.V.: (S / MEAN)*100		14.5	26.4	0.3	7.5	16.6	1.5	1.2	-	-	16.6

1/ No. of Days from January 1 (165 = June 14).
2/ 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 12/13/2006, 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).

TABLE 9. SAFFLOWER. Oilseed Management Nursery Grown Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-OC02-OC)

SPECIES	PLANTING DATE	STAND %	PLANT COUNT	1/ FLOWER DATE	PLNT HT Inches	2/ YIELD Lb/Ac	MOISTURE %	TEST WT Lbs/Bu	3/ OIL %	4/ OIL Lbs/Ac	5/ RETURN $/ac
Safflower	April 21	88.7**	10.6	194.2	67.6	562.5	3.8	38.7**	51.7	290.6	$63.78
Safflower	April 28	81.8	11.0	196.3	65.8	500.1	3.8	37.4	52.3	261.4	$56.71
Safflower	May 4	78.5	10.9	195.4	65.2	413.4	3.8	37.9	51.8	213.9	$46.88
EXPERIMENTAL MEANS		83.0	10.8	195.3	66.2	492.0	3.8	38.0	51.9	255.3	55.8
LSD (0.05)		5.1	ns	ns	ns	ns	ns	0.5	-	-	ns
C.V.: (S / MEAN)*100		7.4	24.8	1.9	7.8	30.7	2.4	1.6	-	-	55.8

1/ No. of Days from January 1 (195 = July 14).
2/ 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 12/13/2006, 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# 06-OC02-OC)							
Field	A-7-3		SaltHaz (MMHOS/cm) 6-24"	n/a		Dry Surf Soil (in.) @ Plnt'g	*
Quarter	NW		Soil Texture 0-6"	CL		2" Soil Temp (^{o}F) @ Plnt'g	*
Section	33		Soil Texture 6-24"	CL		4" Soil Temp (^{o}F) @ Plnt'g	*
Township	33N		Soil Texture 24-36"	CL		Fertilizer Formulation	Gran.Blend
Range	15E		Soil Texture 36-48"	SCL		Fertilizer Placement	Bnd at Plntg N Brdcst
Latitude	N48 29.568'		Ca (ppm)	2005		Fert. Rate (lbs/ac) N	0, 35 or 70
Longitude	W109 47.987'		Init Zn (ppm) 0-6"	0.7		Fert. Rate (lbs/ac) P2O5	40
Soil Series	unk		Init Mn (ppm) 0-6"	9.7		Fert. Rate (lbs/ac) K2O	0
pH 0-6"	7.5		Init Mg (ppm) 0-6"	614.0		Herbicide App. Date	3/29
Org.Matter (%) 0-6"	1.5		Init Cu (ppm) 0-6"	1.3		Herbicide Product	Treflan EC
Init N (lbs/ac) 0-6"	31		Init Fe (ppm) 0-6"	19.2		Herbicide Rate (/ac)	24 oz
Init N (lbs/ac) 6-24"	120		CEC 0-6"	16.1		Precip (in.) Plnt'g-Harvest	*
Init N (lbs/ac) 24-36"	194		Init PAW (in.) 0-6"	1.20		Precip (>.1) Plnt'g-Harvest	*
Init N (lbs/ac) 36-48"	164		Init PAW (in.) 6-24"	3.87		Harvest Date	*
Init N (lbs/ac) 0-48"	509		Init PAW (in.) 24-36"	2.29		Rooting Depth (in.)	*
Init P (ppm) Olsen 0-6"	35		Init PAW (in.) 36-48"	2.35		Post PAW (in.) 0-6"	na
Init K (ppm) 0-6"	355		Cropping System	NT-MechFlw		Post PAW (in.) 6-24"	na
Init S (ppm) 0-24"	122		Planting Date	*		Post PAW (in.) 24-36"	na
Init Na (MEQ/100g) 0-6"	18.00		Planting Depth (in.)	*		Post PAW (in.) 36-48"	na
SaltHaz (MMHOS/cm) 0-6"	0.08		Moist Soil Depth @ Plnt'g	48+		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	4.90		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25		Precip (>.1) Plnt'g-Harvest	4.40		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	4.90		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	4.40		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 Safflower			4" Soil Temp (°F) @ Plnt'g	59		Post PAW (in.) 0-6"	na
Planting Date	4/21		Precip (in.) Plnt'g-Harvest	6.84		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	6.02		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @ Plnt'g	0.3		Harvest Date	10/9		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	4/28		Precip (in.) Plnt'g-Harvest	4.64		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25		Precip (>.1) Plnt'g-Harvest	4.14		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	4/28		Precip (in.) Plnt'g-Harvest	4.64		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	4.14		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	4/28		Precip (in.) Plnt'g-Harvest	6.58		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	5.76		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @ Plnt'g	0.3		Harvest Date	10/8		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	4.59		Post PAW (in.) 6-24"	na
Planting Depth (in.)	1.25		Precip (>.1) Plnt'g-Harvest	4.14		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	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	4.59		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	4.14		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	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	5.68		Post PAW (in.) 6-24"	na
Planting Depth (in.)	0.5		Precip (>.1) Plnt'g-Harvest	5.76		Post PAW (in.) 24-36"	na
Dry Surf Soil (in.) @ Plnt'g	0.3		Harvest Date	10/9		Post PAW (in.) 36-48"	na
2" Soil Temp (°F) @ Plnt'g	64		Rooting Depth (in.)	na		Precip (>.1) Hvst-Post	na

TABLE 16. Montana Safflower Cultivar Evaluation Nursery Grown On-Station Under No-Till Dryland Fallow Conditions at Northern Agricultural Research Center. Havre, Montana. 2006. (Exp# 06-7702-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.
26	HYBRID 9049 20#/ac	91.2	195.0	25.5	1463.5	5.1	44.1	33.4	30.7	448.6
27	HYBRID 9049 15#/ac	90.3	195.0	26.8	1433.7	5.1	44.1	33.7	31.0	443.7
32	CENTENNIAL	94.9	195.3	27.2	1257.3	4.7	42.4	43.4	39.9	501.6
19	03B 4024	95.3	194.3	24.8	1246.9	4.9	43.4	37.3	34.3	427.8
21	03B 4765	95.6	194.3	21.9	1213.9	4.5	41.2	39.2	36.1	438.1
30	MT 2004	99.1	192.7	22.5	1158.3	4.7	42.5	36.8	33.9	392.5
24	03B 6748	94.9	196.7	22.4	1140.2	4.3	37.7	41.3	38.0	434.5
23	03B 6673	84.2	200.3	23.1	1123.1	4.8	42.3	38.4	35.3	396.5
20	03B 4098	92.8	194.7	23.5	1104.7	4.8	42.5	38.7	35.6	393.4
6	01B 2159	96.5	200.0	25.6	1096.9	4.9	43.3	37.5	34.5	377.3
34	FINCH	91.7	196.7	25.7	1082.4	4.9	44.8	38.6	35.5	384.4
36	S-541	97.2	195.3	25.4	1068.3	4.6	42.1	43.1	39.7	422.7
10	01B 9104	97.9	197.0	24.7	1027.0	5.1	42.0	36.1	33.3	342.1
18	03B 1118	98.1	194.7	22.1	1018.7	4.1	37.4	43.3	39.8	405.9
28	MT 2000	99.5	194.3	22.8	1018.2	4.6	40.0	38.8	35.7	363.5
33	MORLIN	99.3	197.3	23.5	1013.9	4.6	41.8	40.1	36.9	373.8
17	02B 8628	93.7	196.0	24.0	1013.3	4.8	43.5	37.5	34.5	351.1
2	95B 7446	94.2	197.7	23.8	1000.4	4.8	42.4	36.9	33.9	343.3
16	02B 8599	96.8	196.7	24.5	997.8	5.0	42.4	35.5	32.6	327.0
7	01B 7113	96.3	197.0	22.5	982.3	4.3	37.0	41.7	38.4	377.7
9	01B 8553	96.5	198.7	24.2	973.2	5.0	44.5	36.6	33.7	328.4
11	02B 6081	100.0	195.0	24.4	968.1	4.7	42.1	38.1	35.0	339.6
8	01B 7353	98.1	197.0	25.9	963.9	4.9	43.5	37.5	34.5	333.6
3	97B 1286	96.1	196.7	24.2	962.8	4.6	40.7	40.2	37.0	357.4
14	02B 7619	99.1	197.3	24.2	942.3	4.9	42.6	36.3	33.4	315.7
12	02B 6381	95.8	189.7	22.7	891.8	4.0	38.4	38.1	35.1	318.8
1	95B 3538	97.4	197.3	26.4	886.4	4.9	42.8	35.1	32.2	295.0
29	MT 2003	98.1	195.3	24.4	882.8	4.7	41.8	37.9	34.8	308.6
25	04B 6184	98.8	197.3	24.6	866.4	4.9	41.9	36.9	33.9	295.5
4	97B 1744	97.9	197.0	26.6	833.9	4.8	43.8	34.5	31.8	282.6
13	02B 6655	97.7	186.7	22.7	826.6	4.4	38.9	41.1	37.8	312.9
35	NUTRA SAFF	91.6	195.3	26.4	823.9	3.9	38.7	47.0	43.2	356.1
31	ERLIN	96.3	193.3	22.2	817.4	4.9	40.6	39.3	36.2	296.0
22	03B 5085	96.5	194.7	23.8	798.6	4.1	38.3	42.5	39.1	312.4
15	02B 8350	97.2	199.3	23.8	767.2	4.8	41.9	33.9	31.2	240.0
5	00B 8206	96.3	197.3	24.4	755.2	5.0	41.5	35.4	32.5	245.9
EXPERIMENTAL MEANS		95.9	195.8	24.3	1011.7	4.7	41.6	38.4	35.3	357.9
LSD (0.05)		4.2	4.8	3.0	294.1	0.3	1.5	4.1	3.8	118.4
C.V.2: (S of MEAN / MEAN)*100		1.6	0.9	4.3	10.3	2.0	1.3	3.8	3.8	11.7

1/ No. of Days from January 1 (196 = July 15).

Site Resource & Management Data: (Exp# 06-7702-SA)							
Field	An-3-5		Soil Texture 0-6"	CL-		Dry Surf Soil (in.) @ Plnt'g	1
Quarter	NW		Soil Texture 6-24"	CL		2" Soil Temp (^{o}F) @ Plnt'g	71
Section	33		Soil Texture 24-36"	CL		4" Soil Temp (^{o}F) @ Plnt'g	67
Township	33N		Soil Texture 36-48"	CL		Fertilizer Formulation	Gran.Blend
Range	15E		Ca (ppm)	2529		Fertilizer Placement	Bnd at Plntg
Latitude	N48 29.437'		Init Zn (ppm) 0-6"	0.4		Fert. Rate (lbs/ac) N	0
Longitude	W109 47.834'		Init Mn (ppm) 0-6"	4.3		Fert. Rate (lbs/ac) P2O5	40
Soil Series	unk		Init Mg (ppm) 0-6"	333.0		Fert. Rate (lbs/ac) K2O	0
pH 0-6"	8.2		Init Cu (ppm) 0-6"	1.0		Herbicide App. Date	4/10
Org.Matter (%) 0-6"	1.3		Init Fe (ppm) 0-6"	9.7		Herbicide Product	Treflan EC
Init N (lbs/ac) 0-6"	28		CEC 0-6"	16.3		Herbicide Rate (/ac)	24 oz
Init N (lbs/ac) 6-24"	45		Init PAW (in.) 0-6"	n/a		Precip (in.) Plnt'g-Harvest	5.73
Init N (lbs/ac) 24-36"	24		Init PAW (in.) 6-24"	n/a		Precip (>.1) Plnt'g-Harvest	5.66
Init N (lbs/ac) 36-48"	60		Init PAW (in.) 24-36"	n/a		Harvest Date	10/9
Init N (lbs/ac) 0-48"	157		Init PAW (in.) 36-48"	n/a		Rooting Depth (in.)	n/a
Init P (ppm) Olsen 0-6"	20		Init PAW (in.) 0-48"	n/a		Post PAW (in.) 0-6"	n/a
Init K (ppm) 0-6"	299		Cropping System	CT-ChmFlw		Post PAW (in.) 6-24"	n/a
Init S (ppm) 0-24"	70		Previous Crop	Wntr Wheat		Post PAW (in.) 24-36"	n/a
Init Na (MEQ/100g) 0-6"	22.00		Planting Date	4/29		Post PAW (in.) 36-48"	n/a
SaltHaz (MMHOS/cm) 0-6"	0.10		Planting Depth (in.)	1		Post PAW (in.) 0-48"	n/a
SaltHaz (MMHOS/cm) 6-24"	n/a		Moist Soil Depth @ Plnt'g	48+		Precip (>.1) Hvst-Post	n/a

TABLE 11. Nine-Year Yield Summary on Selected Entries from Dryland Safflower Nursery. Northern Agricultural Research Center. Havre, Montana. 1997-2006. (Exp# 7702-SA)

VARIETY or SELECTION		No. of YEARS TESTED	YIELD (Lbs Per Acre) 1997	1998	1999	2000	2001 1/	2002	2003	2004	2005	2006	AVE. for YEARS TESTED	% of CHECK YIELD 2/	**9-YR COMP. AVE. YIELD 3/**
S-518	WILL 95FI	6	560.8	1044.3	1180.9	1569.6		1870.3	630.0				1142.6	111.0	**1201.9**
95B7181	99MTDSVT 228/107	7	597.2	1079.6	1245.5	1902.9		1541.5	676.7	1046.5			1155.7	110.7	**1198.9**
95B7174	99MTDSVT 222/106	6	540.2	1066.3	1176.9	1666.0		1691.4	688.2				1138.2	110.6	**1197.2**
91B2166	99DLI1 212/106	4	567.6	876.9				1552.8		1059.8			1014.3	109.1	**1181.5**
95B7446	99MTDSVT 218/108	7			1366.8	1496.5		1950.3	692.8	1229.7	1222.9	1000.4	1279.9	108.4	**1173.8**
00B8208	01DOL4 4126	4						1754.2	595.8	1343.8	1085.6		1194.8	105.0	**1137.5**
97B1744	99DLI2 319/107	6				1941.9		1785.7	451.7	1298.9	1150.4	833.9	1243.8	103.2	**1117.5**
MORLIN	011-2180	9	466.6	937.3	1342.4	1313.2		1839.9	495.0	1359.6	1194.4	1013.9	1106.9	102.2	**1106.9**
MONT2004	WILL	5						1617.1	448.8	1257.3	1392.6	1158.3	1174.8	101.2	**1095.3**
FINCH	WILL 95FI	9	470.0	1033.4	1267.5	1516.3		1383.7	564.1	1276.5	1214.2	1082.4	1089.8	100.6	**1089.8**
95B3538	99MTDSVT 104	8		835.1	1160.7	1588.2		1832.6	480.4	1113.7	1215.6	886.4	1139.1	100.4	**1087.7**
CENTENNIAL	WILL	9	673.5	806.6	1034.6	1423.6		1744.7	493.5	1130.6	1181.1	1257.3	1082.8	100.0	**1082.8**
97B1286	99MTDSVT 311/120	7			1347.7	1036.8		1791.8	447.3	1326.0	1261.8	962.8	1167.7	98.9	**1070.9**
02B 8599	02B 8599	3								1040.4	1453.4	997.8	1163.8	97.8	**1059.3**
02B 6081	02B 6081	3								1175.4	1344.9	968.1	1162.8	97.7	**1058.4**
00B7627	01DOL4 4115	4						1562.6	497.2	1265.8	1089.5		1103.8	97.0	**1050.8**
S-541	WILL	5						1848.6	413.9	1202.1	1061.7	1068.3	1118.9	96.3	**1043.2**
MONT2001	991-122-6503	7	315.9	854.2	1060.0	1571.6		1605.3	516.6	1074.0			999.7	95.8	**1037.0**
00B6878	01DOL3 3110	4						1666.2	413.4	1210.1	1038.1		1081.9	95.1	**1030.0**
MONT2000	WILL	9	452.3	920.1	1152.1	1163.5		1787.3	479.2	1113.7	1160.5	1018.2	1027.4	94.9	**1027.4**
98B1475	99DLI2 316/130	3						1406.1	545.8	1206.0			1052.6	93.7	**1015.1**
00B1027	01DLI2 7107	3						1545.2	307.3	1288.8			1047.1	93.3	**1009.7**
MONT2003	WILL WOMA2003	9	574.7	917.5	1311.4	758.9		1715.2	468.2	1110.2	1226.1	882.8	996.1	92.0	**996.1**
96B6054	99MTDSVT 109	5			1027.1	1112.1		1503.9	468.2	993.1			1020.9	87.6	**948.6**
00B6144	01DOL2 2124	3						1293.2	452.4	1133.2			959.6	85.5	**925.4**
NUTRASAF	91B3842	9	484.2	740.8	879.4	833.1		1585.8	211.2	1048.9	1036.2	823.9	849.3	78.4	**849.3**
ERLIN	99MTDSVT 224/130	9	421.2	565.1	882.3	759.0		1262.5	360.4	1376.7	828.3	817.4	808.1	74.6	**808.1**
MEANS (For Entries Listed)			510.3	898.2	1162.4	1353.3		1645.5	491.6	1187.2	1175.4	984.8			1059.3
April-July Precip. (in.)			6.18	8.78	8.57	6.01	4.81	8.87	7.07	8.64	7.37	5.71	7.20		
Total Annual Precip. (in.)			9.43	14.29	13.45	10.34	6.85	15.15	11.76	14.14	12.23	10.29	11.79		
Soil NO3 (lbs.) to SD at Planting			248	n/a	n/a	n/a	n/a	n/a	78	214	708	157	281		
SD (Sampling Depth in Inches)			48	48	Pndg	Pndg	n/a	48	48	48	48	48	48		
Fertilizer Applied		(# N)	70	70	70	70	n/a	70	70	70	50	0	60		
		(# P2O5)	40	40	40	40	n/a	40	40	40	20	40	38		
		(# K2O)	25	25	25	25	n/a	25	25	25	10	0	21		

Long-term check variety is Centennial.

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

2/ 9-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 =9-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 12. Eight-Year Percent Oil Summary on Selected Entries from Dryland Safflower Nursery. Northern Agricultural Research Center. Havre, Montana. 1997-2006. (Exp# 06-7702-SA)

VARIETY or SELECTION		No. of YEARS TESTED	Oil (%) 1997	1998	1999 1/	2000	2001 1/	2002	2003	2004	2005	2006	AVE. for YEARS TESTED	% of CHECK OIL 2/	**8-YR COMP. AVE. OIL 3/**
00B1027	01DLI2 7107	3						41.0	43.5	43.8			42.8	109.3	**42.8**
NUTRASAF	91B3842	8	40.5	36.9		41.6		39.4	46.2	44.9	43.8	43.2	42.0	107.4	**42.0**
00B6144	01DOL2 2124	3						37.9	43.3	42.1			41.1	105.1	**41.1**
S-541	WILL	5						37.0	41.2	40.5	39.5	39.7	39.6	100.6	**39.4**
CENTENNIAL	WILL	8	38.7	36.5		41.3		37.2	40.1	40.1	39.5	39.9	39.1	100.0	**39.1**
96B6054	99MTDSVT 109	4				38.5		38.3	42.5	39.1			39.6	99.8	**39.1**
S-518	WILL95FI	5	39.3	37.5		42.5		33.2	38.9				38.3	98.8	**38.7**
MONT2000	WILL	8	36.6	36.2		37.5		32.7	38.7	37.3	37.9	35.7	36.6	93.4	**36.6**
97B1286	99MTDSVT 311/120	6				39.5		34.7	36.0	37.6	36.5	37.0	36.9	92.9	**36.4**
ERLIN	99MTDSVT 224/130	8	34.5	34.6		39.7		34.7	36.4	37.7	37.3	36.2	36.4	92.9	**36.4**
00B6878	01DOL3 3110	4						33.5	39.7	35.6	36.5		36.3	92.7	**36.3**
MORLIN	011-2180	8	34.8	34.4		38.9		33.8	37.3	37.1	36.4	36.9	36.2	92.4	**36.2**
MONT2003	WILL WOMA2003	7	37.8	36.5		36.7		32.4	37.8	34.9	36.2		36.1	92.3	**36.1**
95B7174	99MTDSVT 222/106	5	37.9	34.2		35.3		32.3	38.9				35.7	92.2	**36.1**
00B7627	01DOL4 4115	4						33.6	39.3	35.5	35.2		35.9	91.5	**35.8**
MONT2001	991-122-6503	6	34.4	35.9		35.7		33.1	39.1	35.5			35.6	91.4	**35.8**
91B2166	99DLI1 212/106	4	34.1	33.0				34.3		37.1			34.6	90.9	**35.6**
02B 6081	02B 608	3								35.7	36.6	35.0	35.8	89.9	**35.2**
98B1475	99DLI2 316/130	3						33.1	36.1	35.9			35.0	89.5	**35.0**
95B7181	99MTDSVT 228/107	6	35.6	34.4		34.7		32.4	37.9	34.2			34.9	89.5	**35.0**
MONT2004	WILL	5						32.0	37.2	35.5	35.5	33.9	34.8	88.5	**34.6**
FINCH	WILL 95FI	8	33.3	33.6		37.5		32.4	34.5	34.5	35.0	35.5	34.5	88.2	**34.5**
95B7446	99MTDSVT 218/108	6				35.5		31.7	37.8	34.8	34.8	33.9	34.7	87.6	**34.3**
95B3538	99MTDSVT 104	7		34.3		36.5		32.7	35.2	34.8	33.8	32.2	34.2	87.3	**34.2**
00B8208	01DOL4 4126	4						30.6	36.4	33.6	33.6		33.6	85.6	**33.5**
97B1744	99DLI2 319/107	6				36.3		32.3	34.6	34.9	33.8	31.8	33.9	85.6	**33.5**
02B 8599	02B 8599	3								33.6	34.2	32.6	33.5	84.0	**32.9**
MEANS (For Entries Listed)			36.4	35.2		38.0		34.3	38.7	37.1	36.4	36.0			36.5
April-July Precip. (in.)			6.18	8.78	8.57	6.01	4.81	8.87	7.07	8.64	7.37	5.71	7.20		
Total Annual Precip. (in.)			9.43	14.29	13.45	10.34	6.85	15.15	11.76	14.14	12.23	10.29	11.79		
Soil NO3 (lbs.) to SD at Planting			248	n/a	n/a	n/a	n/a	n/a	78	214	708	157	281		
SD (Sampling Depth in Inches)			48	48	Pndg	Pndg	n/a	48	48	48	48	48	48		
Fertilizer Applied		(# N)	70	70	70	70	n/a	70	70	70	50	0	60		
		(# P2O5)	40	40	40	40	n/a	40	40	40	20	40	38		
		(# K2O)	25	25	25	25	n/a	25	25	25	10	0	21		

Long-term check variety is Centennial.

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

2/ 8-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 = 8-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 13. Camelina Nitrogen and Sulfur Fertility Evaluations Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-OC03-OC)

ENTRY	N RATE With Seed Lb/Ac	STAND %	PLANT COUNT	1/ FLOWER DATE	PLNT HT Inches	SHATTER %	2/ YIELD Lb/Ac	MOISTURE %	TEST WT Lbs/Bu	3/ OIL %	4/ OIL Lbs/Ac	5/ GLUCOSIN %	6/ RETURN $/ac
1	0	97.3	27.7**	146.9**	27.7	9.0	1653.5	4.9	52.9	38.3	632.9	pndg	$165.35
2	15	96.1	23.6	145.8	27.6	8.9	1655.5	4.9	52.5	38.3	635.7	pndg	$165.55
EXPERIMENTAL MEANS		96.7	25.7	146.3	27.7	8.9	1654.5	4.9	52.7	38.3	634.3	-	165.4
LSD (0.05)		0.9	1.5	0.4	ns	ns	ns	ns	ns	ns	ns	-	ns
C.V.: (S / MEAN)*100		3.0	19.3	1.0	6.2	49.4	15.3	3.3	2.9	4.0	15.9	-	15.3

1/ No. of Days from January 1 (146 = May 26).
2/ Yields are based on plot weights adjusted to a uniform 8 percent grain moisture for camelina.
3/ Oil percentage values are reported on a 92% dry matter basis.
4/ Oil Lbs/Ac = Lbs of oil produced per acre reported on a 92% dry matter basis.
5/ GLUCOSIN = % Glucosinolate level in crushed seed reported on a 92% dry matter basis.
6/ Gross Return does not take into account any input costs associated with the crop. Camelina price estimate from Gary Iverson, Great Northern Growers Cooperative ($0.10 per lb).
** 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).

TABLE 14. Camelina Nitrogen and Sulfur Fertility Evaluations Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-OC03-OC)

ENTRY	SO_4 RATE With Seed Lb/Ac	STAND %	PLANT COUNT	1/ FLOWER DATE	PLNT HT Inches	SHATTER %	2/ YIELD Lb/Ac	MOISTURE %	TEST WT Lbs/Bu	3/ OIL %	4/ OIL Lbs/Ac	5/ GLUCOSIN %	6/ RETURN $/ac
1	0	97.2	23.4	146.5	27.5	9.6	1638.7	4.9	52.4	38.3	628.5	pndg	$163.87
2	10	96.4	25.8	146.3	27.9	8.5	1674.1	4.9	52.8	38.6	646.0	pndg	$167.41
3	20	96.5	27.8**	146.2	27.5	8.7	1650.6	4.9	53.0	38.1	628.4	pndg	$165.06
EXPERIMENTAL MEANS		96.7	25.7	146.3	27.7	8.9	1654.5	4.9	52.7	38.3	634.3	-	165.4
LSD (0.05)		ns	1.8	ns	ns	ns	ns	ns	ns	ns	ns	-	ns
C.V.: (S / MEAN)*100		3.0	19.3	1.0	6.2	49.4	15.3	3.3	2.9	4.0	15.9	-	15.3

1/ No. of Days from January 1 (146 = May 26).
2/ Yields are based on plot weights adjusted to a uniform 8 percent grain moisture for camelina.
3/ Oil percentage values are reported on a 92% dry matter basis.
4/ Oil Lbs/Ac = Lbs of oil produced per acre reported on a 92% dry matter basis.
5/ GLUCOSIN = % Glucosinolate level in crushed seed reported on a 92% dry matter basis.
6/ Gross Return does not take into account any input costs associated with the crop. Camelina price estimate from Gary Iverson, Great Northern Growers Cooperative ($0.10 per lb).
** 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).

TABLE 15. Camelina Nitrogen and Sulfur Fertility Evaluations Under No-Till Dryland Fallow Conditions. Northern Agricultural Research Center. Havre, Montana. 2006.
(Exp# 06-OC03-OC)

ENTRY	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/ OIL Lbs/Ac	5/ GLUCOSIN %	6/ RETURN $/ac
1	Celine	97.6	25.9	148.7	29.8	9.3	1482.4	4.9	52.8	37.6	557.3	pndg	$148.24
2	Ligena	98.4	28.2	147.1	28.9	1.4	1540.7	4.9	52.1	38.4	590.5	pndg	$154.07
3	Robby	86.6	9.8	152.6	26.4	10.8	1552.2	5.1	53.1	35.7	555.2	pndg	$155.22
4	MT 1	97.2	22.8	144.3	27.6	4.9	1733.0*	4.9	52.1	39.1	677.6**	pndg	$173.30*
5	MT 3	97.6	27.2	144.0	27.0	8.7	1694.9*	4.9	53.2	39.3	665.4*	pndg	$169.49*
6	MT 5	96.9	24.8	143.7	26.7	10.6	1765.9**	4.9	52.7	38.1	673.9*	pndg	$176.59**
7	MT 12	98.1	28.8	144.9	28.5	11.8	1727.0*	4.9	52.5	39.0	673.8*	pndg	$172.70*
8	MT 15	98.0	25.8	146.4	27.9	5.2	1673.6*	5.0	52.2	37.8	632.4*	pndg	$167.36*
9	MT 32	98.2	32.0	147.9	27.7	13.9	1700.1*	4.9	53.0	37.7	640.5*	pndg	$170.01*
10	MT 38	98.5	31.3	143.7	26.0	13.1	1674.8*	4.9	53.4	40.4**	676.4*	pndg	$167.48*
EXPERIMENTAL MEANS		96.7	25.7	146.3	27.7	8.9	1654.5	4.9	52.7	38.3	634.3	-	165.4
LSD (0.05)		1.9	3.2	0.9	1.1	2.9	166.6	3.3	ns	1.0	68.8	-	16.7
C.V.: (S / MEAN)*100		3.0	19.3	1.0	6.2	49.4	15.3	3.3	2.9	3.9	16.5	-	15.3

1/ No. of Days from January 1 (146 = May 26).
2/ Yields are based on plot weights adjusted to a uniform 8 percent grain moisture for camelina.
3/ Oil percentage values are reported on a 92% dry matter basis.
4/ Oil Lbs/Ac = Lbs of oil produced per acre reported on a 92% dry matter basis.
5/ GLUCOSIN = % Glucosinolate level in crushed seed reported on a 92% dry matter basis.
6/ Gross Return does not take into account any input costs associated with the crop. Camelina price estimate from Gary Iverson, Great Northern Growers Cooperative ($0.10 per lb).
** 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# 06-OC03-OC)							
Field	A-7-4		SaltHaz(MMHOS/cm)6-24"	n/a		Dry Surf Soil (in.) @ Plnt'g	0.3
Quarter	NW		Soil Texture 0-6"	CL		2" Soil Temp (^{o}F) @ Plnt'g	n/a
Section	33		Soil Texture 6-24"	CL		4" Soil Temp (^{o}F) @ Plnt'g	n/a
Township	33N		Soil Texture 24-36"	CL		Fertilizer Formulation	Gran.Blend
Range	15E		Soil Texture 36-48"	CL		Fertilizer Placement	Bnd at Plntg
Latitude	N48 29.568'		Ca (ppm)	1501		Fert. Rate (lbs/ac) N	0 or 10
Longitude	W109 47.987'		Init Zn (ppm) 0-6"	0.56		Fert. Rate (lbs/ac) P2O5	0
Soil Series	Hillon CL		Init Mn (ppm) 0-6"	6.46		Fert. Rate (lbs/ac) K2O	0
pH 0-6"	7.5		Init Mg (ppm) 0-6"	338		Herbicide App. Date	none
Org.Matter (%) 0-6"	1.2		Init Cu (ppm) 0-6"	0.83		Herbicide Product	none
Init N (lbs/ac) 0-6"	8		Init Fe (ppm) 0-6"	20.8		Herbicide Rate (/ac)	none
Init N (lbs/ac) 6-24"	126		CEC 0-6"	11		Precip (in.) Plnt'g-Harvest	5.63
Init N (lbs/ac) 24-36"	22		Init PAW (in.) 0-6"	1.21		Precip (>.1) Plnt'g-Harvest	5.13
Init N (lbs/ac) 36-48"	12		Init PAW (in.) 6-24"	3.74		Harvest Date	7/18
Init N (lbs/ac) 0-48"	168		Init PAW (in.) 24-36"	2.16		Rooting Depth (in.)	30
Init P (ppm) Olsen 0-6"	19		Init PAW (in.) 36-48"	2.04		Post PAW (in.) 0-6"	0.47
Init K (ppm) 0-6"	258		Cropping System	NT-ChmFlw		Post PAW (in.) 6-24"	1.79
Init S (ppm) 0-24"	66		Planting Date	3/1		Post PAW (in.) 24-36"	1.16
Init Na (MEQ/100g) 0-6"	13		Planting Depth (in.)	0.125		Post PAW (in.) 36-48"	1.79
SaltHaz (MMHOS/cm) 0-6"	0.06		Moist Soil Depth @Plnt'g	48+		Precip (>.1) Hvst-Post	5.21