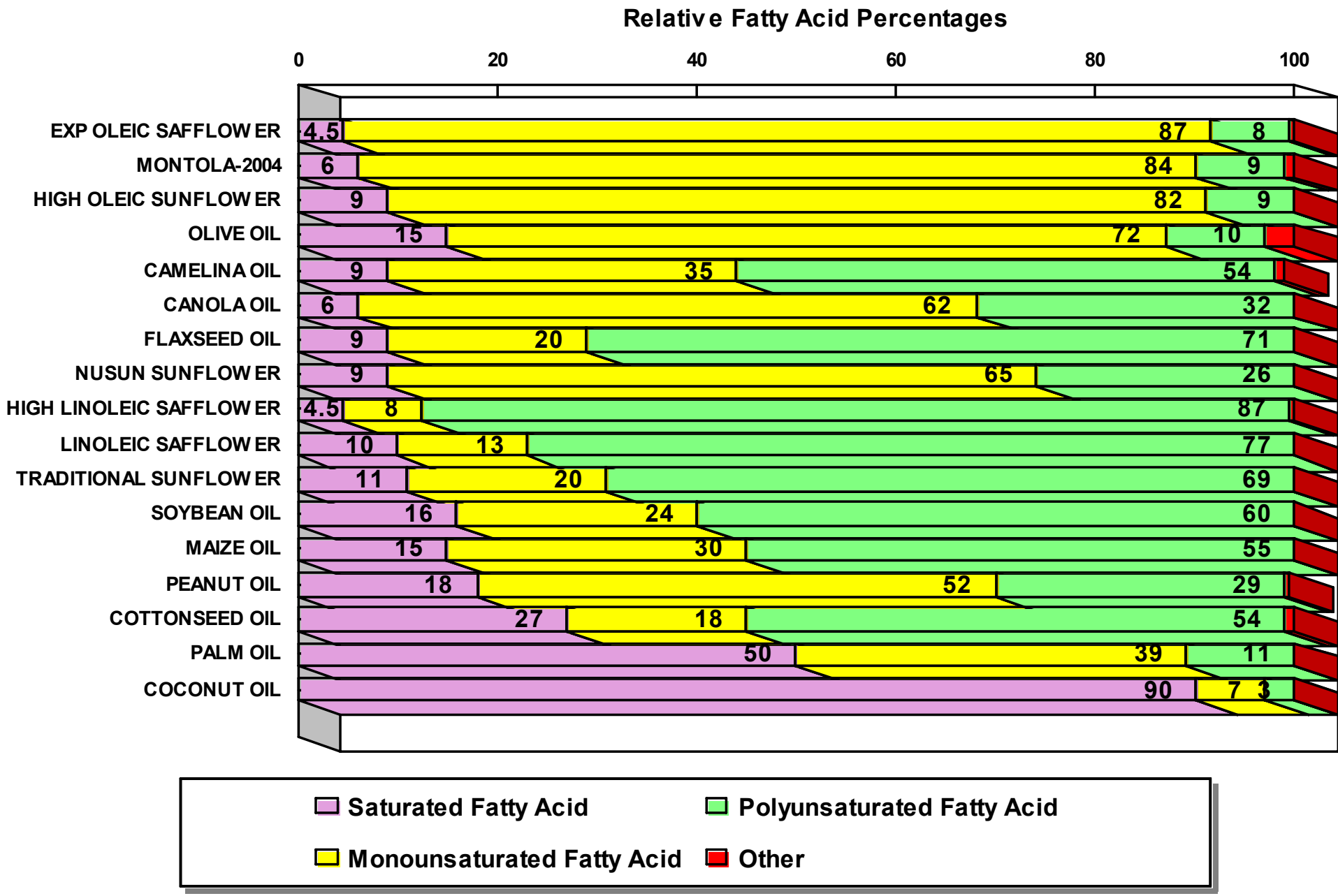
Desirable Vegetable Oil Characteristics

- Cost
- Acceptable low-temperature properties (mineral oil -18ºC, H.O. safflower -21ºC)
- Oxidative Stability
- High temperature Stability
- Additive compatibility

Gawrilow, I., 2004, Vegetable Oil Usage in Lubricants, *Inform,* Vol 15 (11), 702-704,

VEGETABLE OIL COMPARISONS



Genetic Variability of Tocopherol and Fatty Acids in Sunflower Seeds

----Tocopherol Content (%)----- -----Fatty acid composition (%)-----

Oil ID	α Toco. %	B Toco. %	Γ Toco. %	Δ Toco. %	Oleic 18:1 %	Induction Period hrs	Relative Stability	Relative Stability
1	97.2	2.8	--	--	26	4.8	1.0	
2	58.4	41.6	--	--	33	5.8	1.2	
3	81.9	3.3	14.3	4.8	24	6.7	1.4	
4	30.4	21.0	26.1	22.5	32	8.7	1.8	
5	96.4	2.8	0.8	--	86	26.5	5.5	1.0
6	66.1	33.0	.5	.4	87	59.6	12.4	2.3
7	30.0	20	66.2	2.6	86	78.5	16.4	3.0

Y. Demurin,et al., Plant Breeding, 115, 33-36 (1996)

Genetic Variability of Tocopherol and Fatty Acids in Safflower Seeds (carthamus tinctorius)

Oil ID	Tocopherol				palmitic	stearic	oleic	linoleic
	α	B	Γ	Δ	16:0	18:0	18:1	18:2
Morlin	745	29	10-20		5.7	2.6	8.5	80.8
M-2001	639	18	10-20		4.1	1.0	81.1	11.4
Range of tocopherol and fatty acids found in accessions of the world collection of safflower								
Range	1600-180	50-10	120-10		3.7-3.8	4.5-6.2	6.2-81.9	11.0-83.1

----Tocopherol Content (mg/kg)----- -----Fatty acid composition (%)-----

Oxidative Stability of Safflower Oil Could be Further Improved

- Higher oleic levels have been attained in breeding lines (87% Oleic)
- Higher β- and γ- tocopherol levels with reduced level of α-tocopherol

Genetic Variability of Tocopherol Safflower Seeds (Carthamus sp.) from World Collection of Safflower

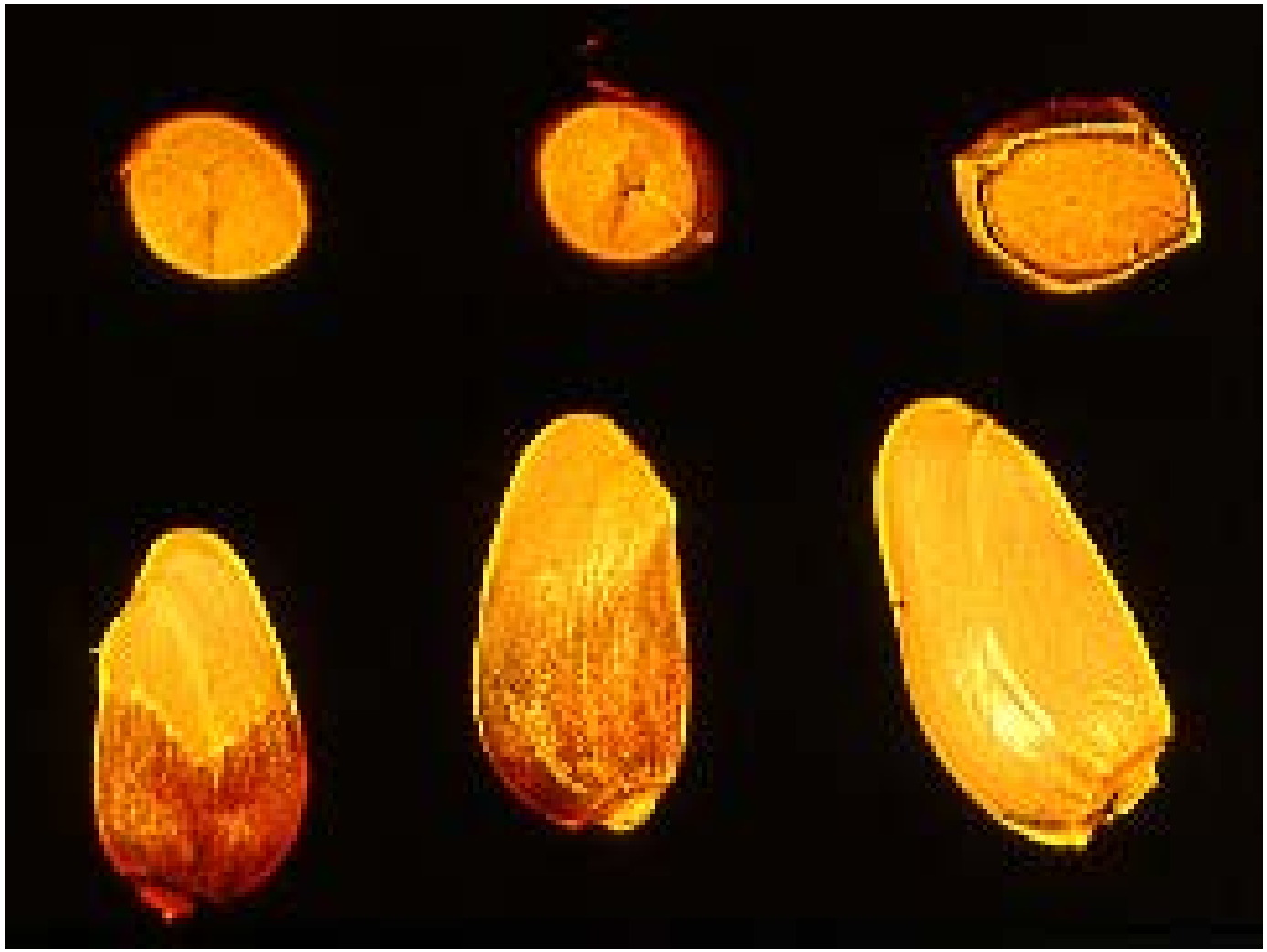
----Tocopherol Content (%)-----

Genetic Line ID	Country Of Origin	α Toco.	B Toco.	Γ Toco.	Δ Toco
426482	Pakistan	100			
426489	Pakistan	98.1	1.9		
305218	India	79.2		12.8	8.0
426512a	Spain	51.7	trace	48.2	
426512b	Spain	34.6		65.4	
426512c	Spain	5.4		94.6	
426512d	Pakistan	trace		100	

High Oleic Safflower as a Diesel Fuel Extender

A Potential New Market for Montana Safflower

Reduced Hull / High Protein Oil Genetic Stocks



Seed, Oil and Meal Yields, and Break-even Price for Seven Safflower Genetic Oilseed Stocks

Oil Content Dry Seed Basis (%)	Protein Wt % Meal [2]	Fiber Wt % Meal[2]	Predict Seed Yield Lbs/A	Oil Yield Gal/A[3]	Meal Yield Lbs/A [4]	Meal Price $/Ton	Meal Value $/A	Break-even Price of Safflower Oil[5]: Prod Cost[1] Basis	Prod Cost[2] Basis	Cost[2] w/o Land Rent & Mgmt	Prod Cost[2] Variable Costs Only
36.0	22.0	35.0	1290	59.4	793	60	23.78	2.48	1.92	1.19	0.71
38.0	32.0	32.0	1251	60.8	745	110	40.96	2.14	1.59	0.88	0.42
40.0	34.0	29.0	1213	62.0	698	120	41.91	2.09	1.55	0.85	0.40
42.0	36.0	26.0	1174	63.1	654	130	42.49	2.05	1.52	0.82	0.39
44.0	40.0	22.0	1122	63.2	603	150	45.25	2.00	1.48	0.78	0.34
47.0	44.0	18.0	1071	64.4	545	170	46.31	1.95	1.44	0.75	0.32
50.4	36.4	27.2	1189	76.7	566	132	37.38	1.79	1.36	0.74	0.42

High Oleic Safflower as a Diesel Fuel Extender – A Potential New Market for Montana Safflower

J.W. Bergman and C. R. Flynn
Montana State University
Eastern Agricultural Research Center, Sidney Montana USA

- Fuel additive to reduce smoke and particulates
- Safflower is desirable as an alternative crop to break wheat disease and pest cycles
- Great plains safflower can potentially produce more oil per acre than soybeans in Iowa
- Research on safflower continues to improve yield and oil quality in the Mondak Region.

High Oleic Safflower as a Diesel Fuel Extender – Testing Results

J.W. Bergman and C. R. Flynn
Montana State University
Eastern Agricultural Research Center, Sidney Montana USA

- Lowest exhaust emissions compared to other alternative fuels
- Safflower oil/diesel fuel (25/75) reduced hydrocarbon emissions (14%).
- No significant engine performance or emissions change over 200 hour testing time
- No significant carbon deposits observed during test
- High oleic safflower (80%) performed best in testing, EARC continues to improve oleic levels

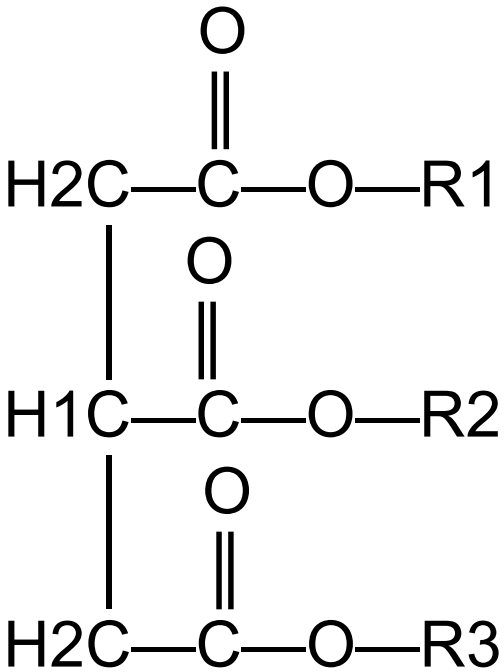
Triacylglycerol Analyses of Safflower Oil and it's Potential For Oil Seed Breeding Advances

Jerald Bergman and Charles Flynn

MSU-Eastern Agricultural Research Center
Sidney, Montana

Introduction

Analytical procedure based on high temperature, capillary gas-liquid Chromatography (GLC) has been used to separate Triacylglycerol constituents (TAGs) in safflower oil.

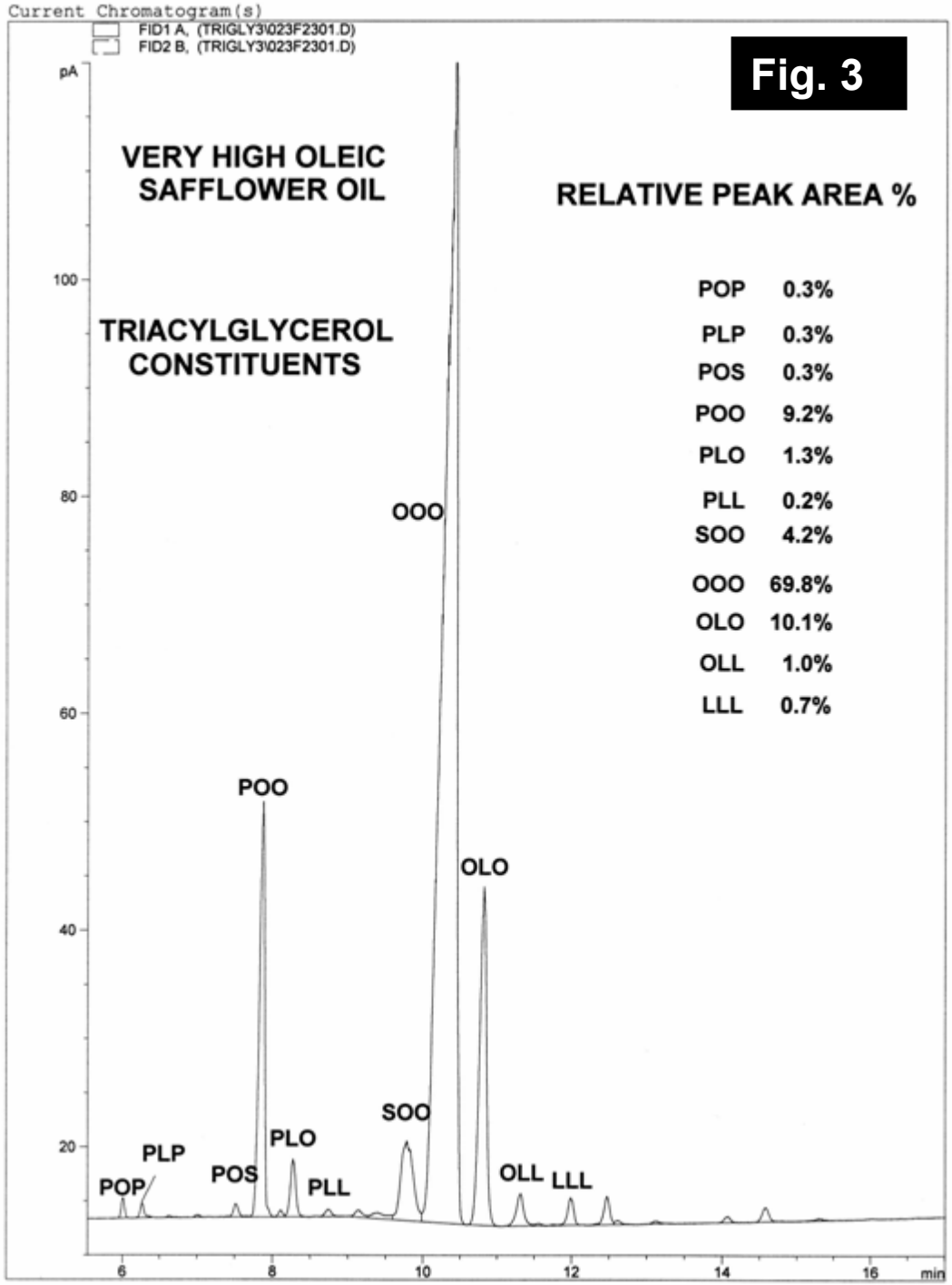


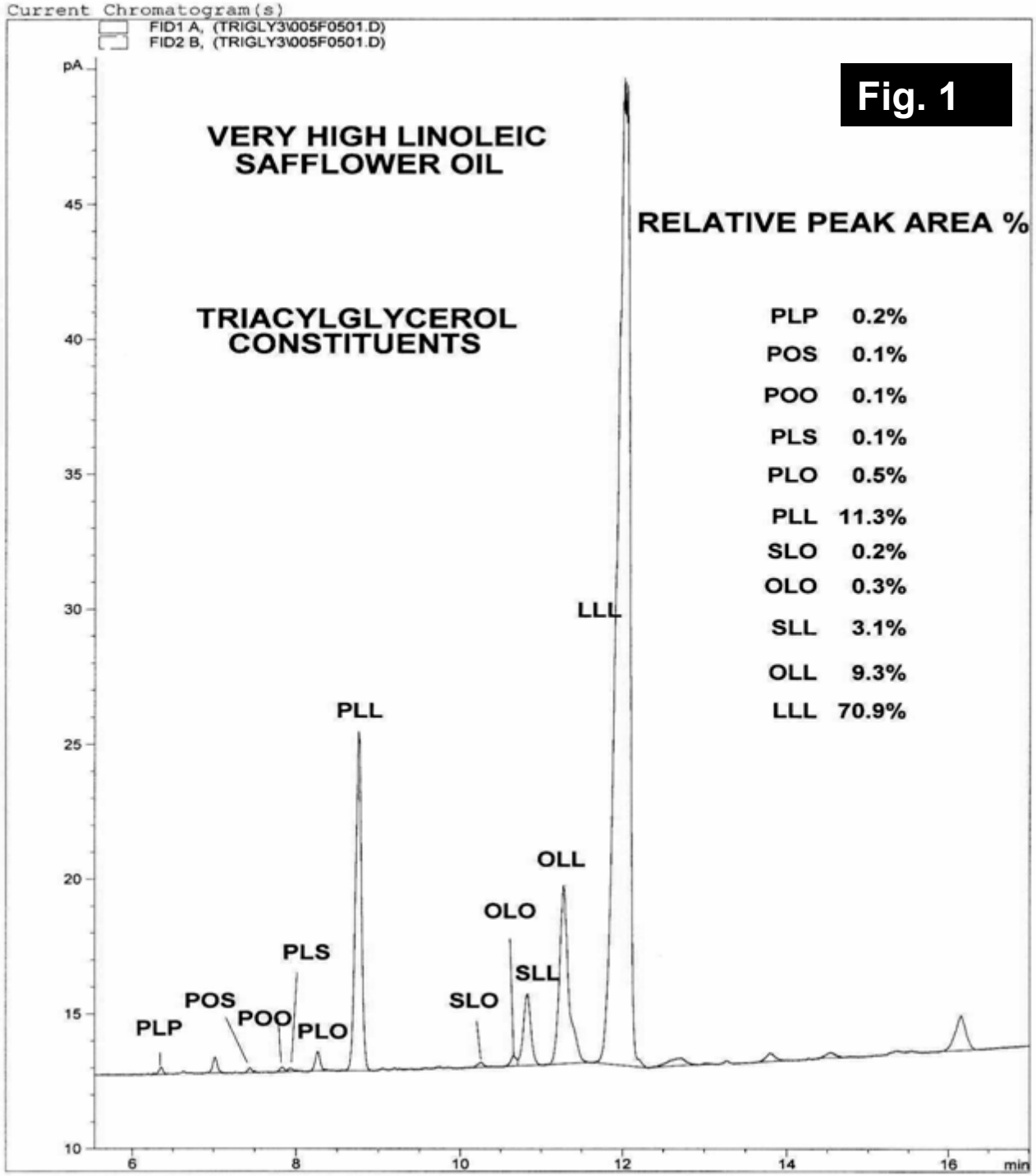
<u>R designates</u>

P, palmitic acid	(C16:0)
S, Stearic acid	(C18:0)
O, Oleic acid	(C18:1)
L, Linoleic acid	(C18:2)
A, Arachidic	(C20:0)

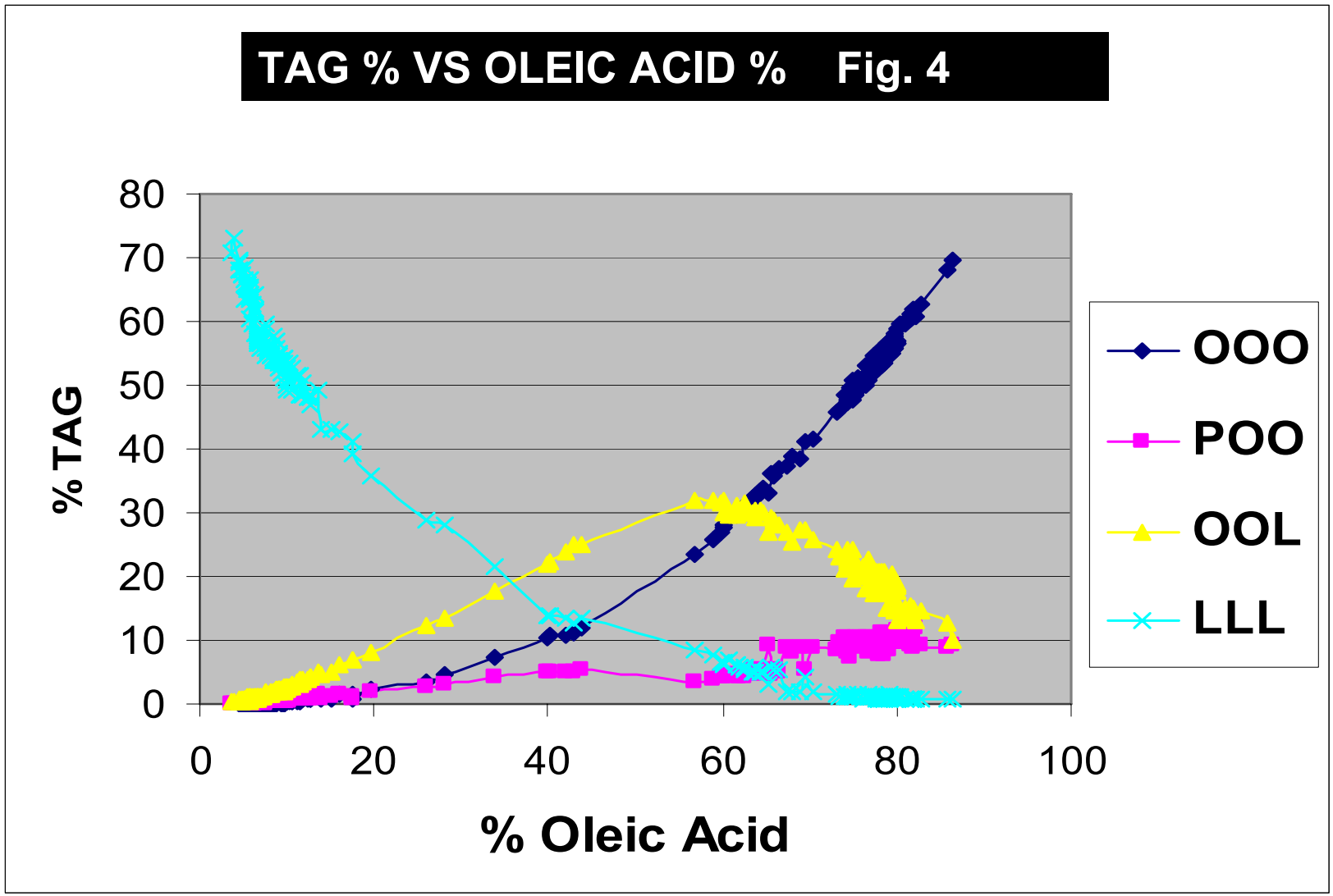
Sample Preparation

- TAG samples for analysis prepared by soaking a half seed in isooctane
- Isooctane extract injected in GLC
- Other half seed used to prepare fatty acid methyl ester (FAME) for fatty acid profile analysis by GLC or for greenhouse planting


Current Chromatogram(s)
FID1 A, (TRIGLY3\023F2301.D)
FID2 B, (TRIGLY3\023F2301.D)
Fig. 3
pA
VERY HIGH OLEIC SAFFLOWER OIL
TRIACYLGLYCEROL CONSTITUENTS
RELATIVE PEAK AREA %
POP 0.3%
PLP 0.3%
POS 0.3%
POO 9.2%
PLO 1.3%
PLL 0.2%
SOO 4.2%
OOO 69.8%
OLO 10.1%
OLL 1.0%
LLL 0.7%
OOO
POO
OLO
SOO
PLO
PLP
POS
POP
PLL
OLL
LLL
100
80
60
40
20
6
8
10
12
14
16
min


Current Chromatogram(s)
FID1 A, (TRIGLY3\005F0501.D)
FID2 B, (TRIGLY3\005F0501.D)
Fig. 1
VERY HIGH LINOLEIC SAFFLOWER OIL
TRIACYLGLYCEROL CONSTITUENTS
RELATIVE PEAK AREA %
PLP 0.2%
POS 0.1%
POO 0.1%
PLS 0.1%
PLO 0.5%
PLL 11.3%
SLO 0.2%
OLO 0.3%
SLL 3.1%
OLL 9.3%
LLL 70.9%
pA
45
40
35
30
25
20
15
10
6
8
10
12
14
16
min
PLP
POS
POO
PLS
PLO
PLL
SLO
OLO
SLL
OLL
LLL

Change in TAG % as Oleic Acid Content in Seed Oil Increases



TAG Peak Areas as % of Total Area

Montana Oleic Breeding Lines

Single Seed Analysis by GLC

Table 1

Montana Line	POO %	SOO %	OOO %	OOL %	OLL %	Calculated Oleic %	FAME[1] %
01	9.2	4.2	69.8	10.1	1.0	86.9	88.0
Healthola	8.3	3.3	62.3	17.4	2.6	83.4	83.0
MT-2000	10.0	3.2	54.9	19.5	3.9	79.5	80.0
05	8.2	2.0	47.6	24.0	6.2	74.3	75.3
07	4.5	1.2	29.5	29.8	18.2	61.2	60.6
08	3.6	0.8	23.6	31.9	22.1	56.6	55.9
09	5.2	0.1	11.9	25.0	24.8	44.4	46.3

[1]Value Determined by fatty acid methyl ester procedure on same seed sample used for Tag Analysis using

TAG Peak Areas as % of Total TAG Area

Montana Linoleic Breeding Lines

Single Seed Analysis by GLC

Table 2

Montana Linoleic Line	PLO %	PLL %	OOL %	SLL %	OLL %	LLL %	Calculated Linoleic %	FAME[1] Linoleic %
L1	.05	11.3	0.3	3.1	9.3	70.9	87.0	89.5
L2	0.8	12.1	0.6	4.0	11.7	68.3	87.3	87.1
Morlin	3.5	15.2	2.2	4.7	15.1	51.5	77.4	80.2
Centennial	5.2	15.2	3.7	3.1	21.0	44.8	74.4	76.7
L7	6.9	8.9	13.5	2.4	25.5	28.0	60.1	62.0
L8	7.4	7.0	17.6	1.6	26.0	21.6	53.7	55.8
L9	7.3	4.7	23.9	1.0	25.0	13.6	45.3	46.8

[1]Value Determined by fatty acid methyl ester procedure on same seed sample used for TAG Analysis using

Results

- Over 200 varieties and breeding lines were analyzed for triacylglyceride composition.
- TAGs OOO, SOO and POO increased with increasing levels of oleic acid
- TAGs LLL, SLL, PLL increased with increasing levels of linoleic acid

Summary

- A number of unique triacylglyerol profiles have been identified offering new breeding possibilities
- We continued to analyze the TAG composition of safflower species and lines from different locals and sources looking for TAG variability that allow possible breeding opportunities.

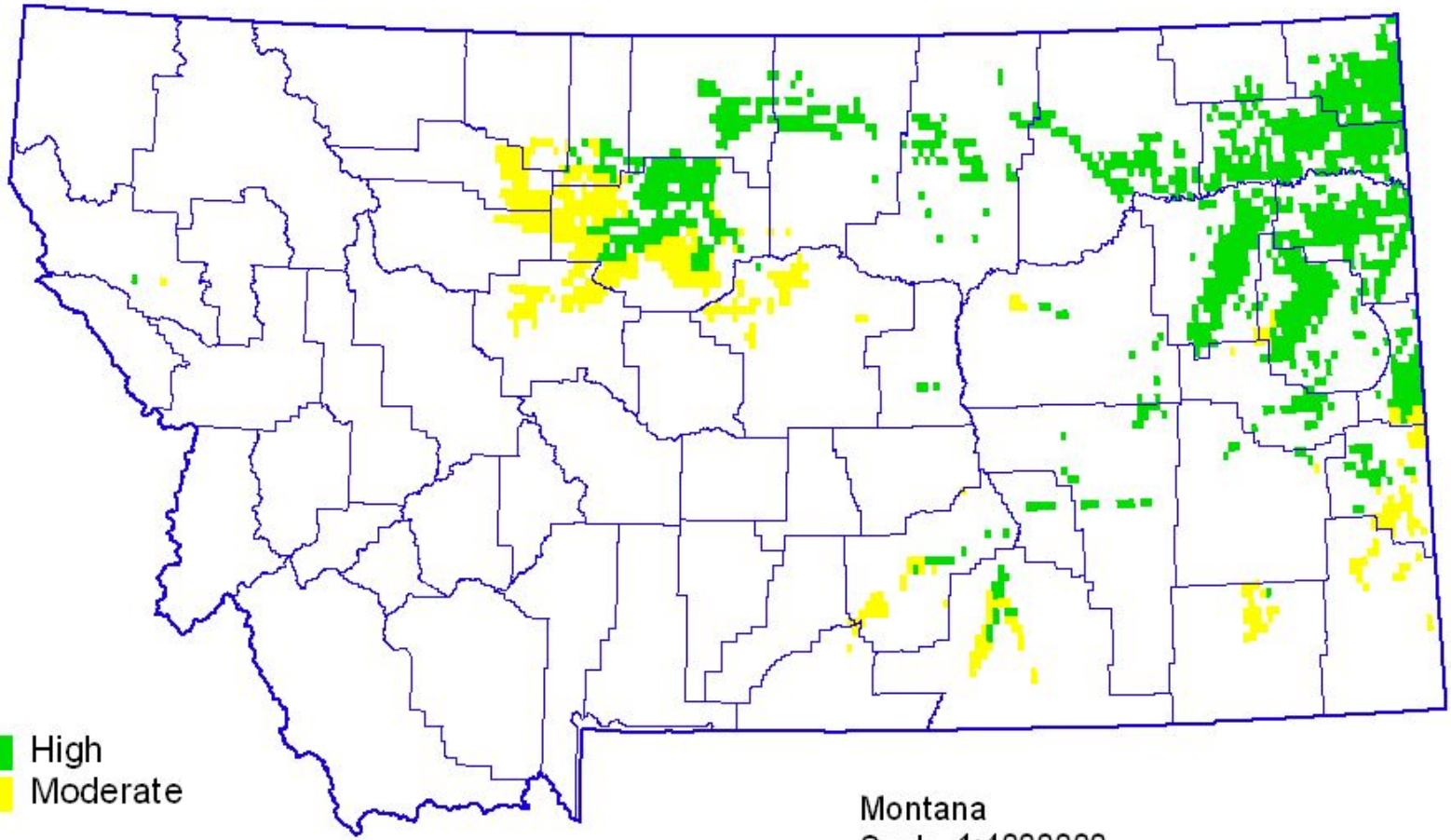
SAFFLOWER PRODUCTION IN MONTANA

Dr. Jerald Bergman

MSU Eastern Agricultural Research Center - Sidney, MT

NDSU Williston Research Extension Center – Williston, ND

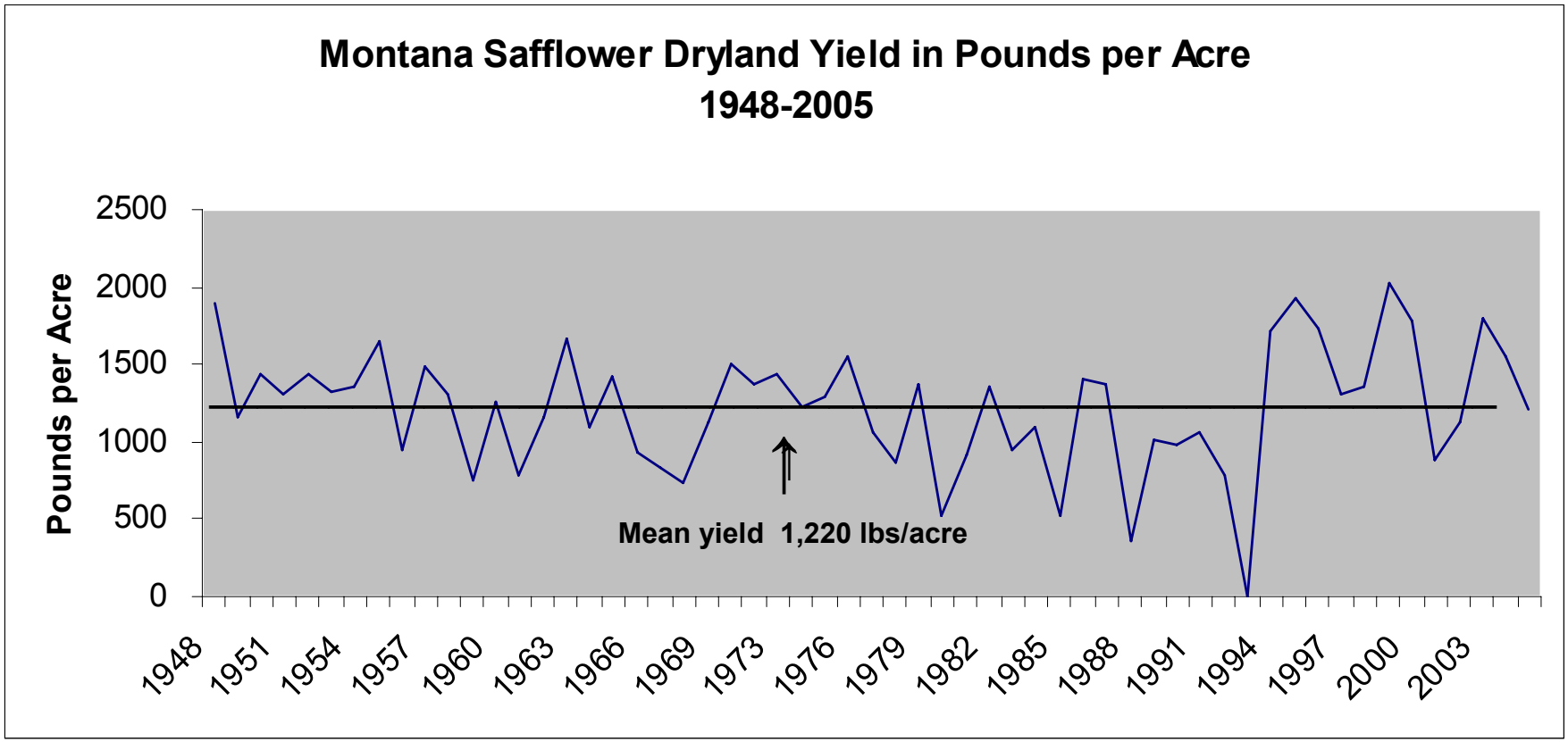
Areas With Safflower Growing Potential



Montana
Scale 1:4000000

High: Dryland and irrigated cropland
with growing degree days >= 2200
and elevation <= 3000
Moderate: Dryland and irrigated cropland
with growing degree days >= 2200
and elevation between 3000 and 3500

G. Nielsen, D. Cooksey, J. Bergman
Department of Land Resources and Environmental Sciences
Montana State University - Bozeman
Montana Agricultural Experiment Station
June 28, 2001


Montana Safflower Dryland Yield in Pounds per Acre
1948-2005
Pounds per Acre
2500
2000
1500
1000
500
0
Mean yield 1,220 lbs/acre
1948
1951
1954
1957
1960
1963
1966
1969
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003

SAFFLOWER

- Fertility Requirements
- 5 lb/a N per 100 lb/a Seed
- P about like Wheat

Figure 3. Six-year average of soil and groundwater nitrate-N contents under irrigated safflower

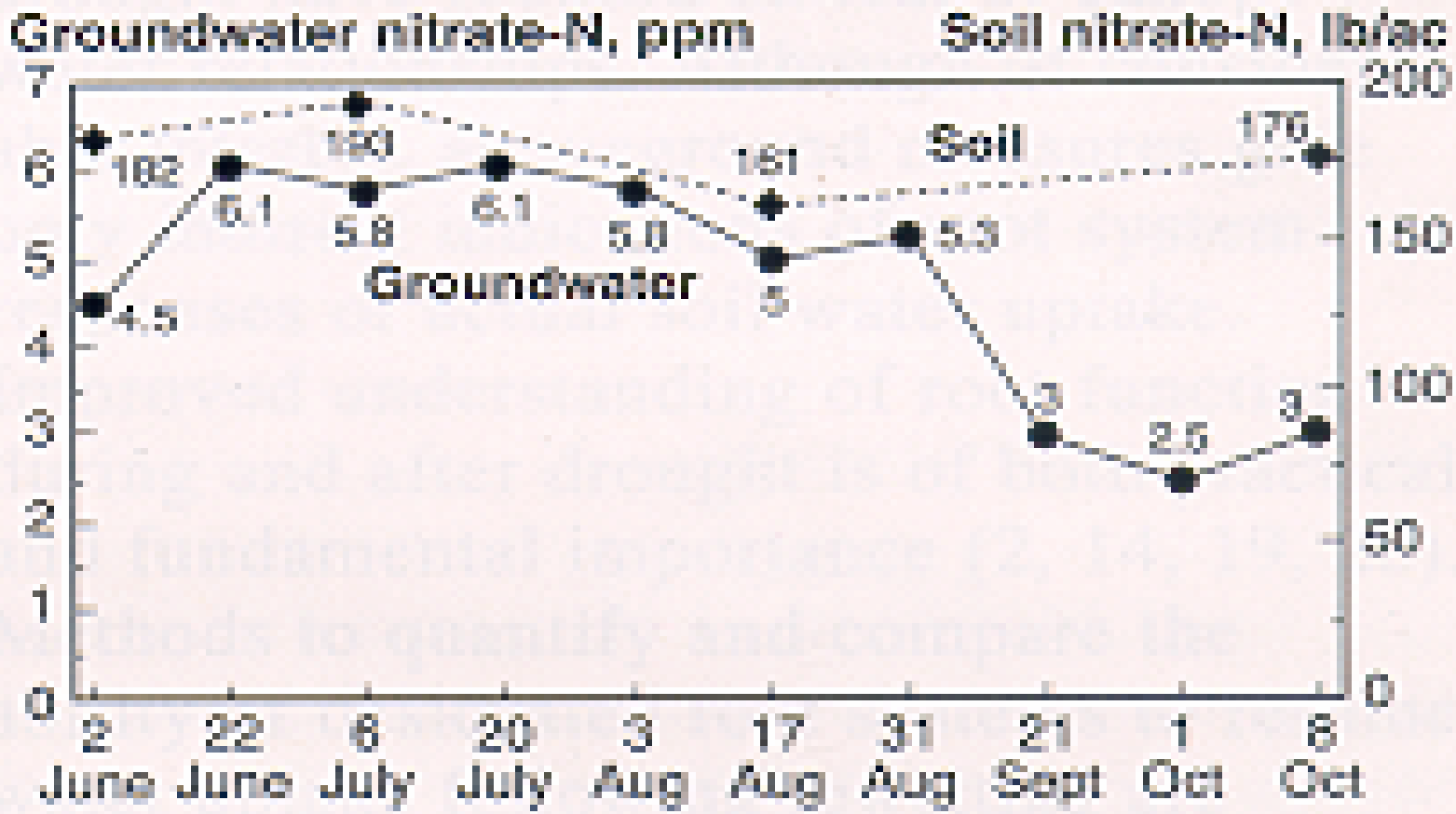
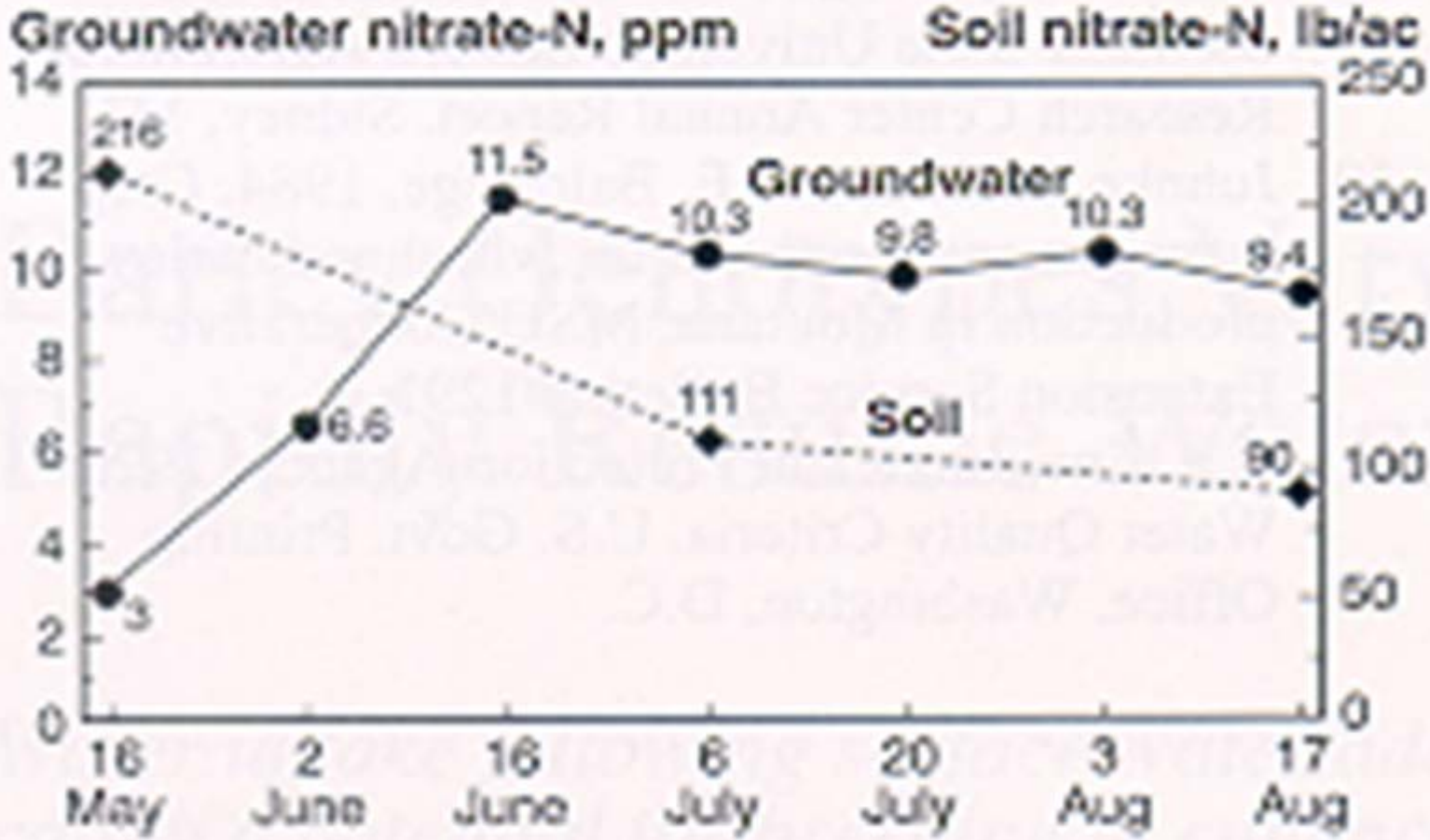


Figure 1. Six-year average of soil and groundwater nitrate-N contents under irrigated small grain



Residue C / N Ratio – Nitrogen Credits

	Total (lbs)	Carbon (lbs)	Nitrogen (lbs)	Nitrogen Available
Safflower Residue	2000	800	80	53 lbs
Wheat Residue	2000	800	10	17 lbs
After Decomposition	670	270	27	

Low C/N ratio residue, increased biological activity, nitrogen decomposition, and nitrogen availability

Safflower Seeding Rate Study-1986

Seeding Rate	Yield Lbs/A	Test Wt.	Oil %	# Seeds / Plant	1000 Kwt	Sec H/P	Tert H/P	Total H/P
10 lbs	1563	38.8	47.1	191	39.4	4.6	1.4	7.0
15 lbs	1591	39.0	46.7	139	39.5	3.7	0.5	5.1
20 lbs	1647	39.2	47.6	125	39.3	3.5	0.3	4.7
25 lbs	1585	39.2	47.4	102	39.3	3.1	0.3	4.1
LSD .05	62	NS	NS	27.0	NS	0.5	0.5	.95

2005 Seeding Rate Study-Finch

Seeding Rate	Seeding Rate	Established Plant Density		Test Weight	Seed Oil %	Yield
Lbs/A	Plants/ft^2	#/ft^2	% of SR	Lbs/Bu		Lbs/A
7	2	1.17	59	44.4	35.2	822
14	4	2.67	67	44.5	35.0	1063
21	6	4.10	68	44.3	34.7	1105
28	8	5.33	66	44.5	34.7	1144
35	10	5.86	58	44.1	34.6	1146
42	12	6.62	56	44.5	34.6	1220
LSD .05				NS	NS	161.4

Depth of Planting Study (4 year avg)

Planting Depth					
1 inch		2 inch		3 inch	
Yield Lbs/a	% Plt*	Yield Lbs/A	% Plt*	Yield Lbs/A	% Plt*
1356	74	1192	48	949	32

*Plt—Emerged Plants Relaltive to Planted Seed

PEST CONTROL RESEARCH

- **Fungicide Disease Control Research**

  Quadris (Section 18) .10 -.15ai

  BAS 516

  Headline

  Omega

- **Insecticide Research**

  Mustang (IR4 testing) thrip, lygus, grasshoppers

- **Herbicide Research**

  Post-emergent broadleaf herbicide

Exp. Herbicide
Post-emergence
No Herbicide

Alternaria Blight

- Important foliar disease: causes reduced yields (30->50%), oil content, seed weights and protein content
- Reported as occurring in: Australia, Canada, Ethiopia, Germany, India, Israel, Italy, Kenya, Mexico, New Zealand, Pakistan, Romania, Russia, Spain, Tanzania, USA, Zambia and Zimbabwe
- Most important in irrigated fields or in regions with frequent showers and temperatures 18-30^{0}C

Safflower Alternaria Blight

Effect of Quadris application on Alternaria Blight

VALLEY IRRIGATED SAFFLOWER FOLIAR FUNGICIDE TRIAL

SIDNEY, MT 2002-2004

Treatment	Test Wt lbs/bu 3 yrs	Oil % 3 yrs	Yield lbs/A (2002)	Yield lbs/A (2003)	Yield lbs/A (2004)	Yield lbs/A 3 yrs	Leafspot disease rating [9] 3 yrs
			----------Mean of 3 varieties----------				
Check [1]	33.4	32.8	1814	2415	635	1621	6.6
Quadris 3 App [2]	36.7	34.9	2448	2937	1068	2151	3.5
Quadris 1 App [3]	36.2	35.3	2266	3092	792	2050	4.7
Quadris 2 App [4]	36.6	35.2	2320	3034	845	2066	3.7
Quadris 1 App [5]	36.2	35.2	2265	3000	837	2034	4.9
Headline 1 App [6]	36.6	35.0	2055	3029	931	2005	4.9
Bas 516 1 App [7]	36.6	35.2	2243	3024	892	2053	5.1
Headline+Bas 516 [8]	37.4	35.0	2314	3087	1146	2182	2.8
LSD 5%			166.0	204.0	163.1		

[1] Untreated
[2] Quadris 0.10 lbs/A at first sign of disease, at first flower, and 14 days later
[3] Quadris 0.10 lbs/A at first flower
[4] Quadris 0.10 lbs/A at first flower plus 14 days later
[5] Quadris 0.15 lbs/A at first flower
[6] Headline 0.10 lbs/A at first flower
[7] Bas 516 at first flower
[8] Headline 0.10 lbs/A at first sign of disease plus BAS 516 at first flower
[9] Leafspot rating of 1-9, 9 being most susceptible

No Fungicide
Quadris
Fungicide
Applied

Economics of Fungicide Application net returns over unsprayed-3 yrs.

Treatment	Montola 2004	Centennial
3 sprays	-$9.75	$66.00
2 sprays	$24.65	$51.10
1 spray-first flower	$54.25	$120.26

Safflower $0.275/kg, aerial application=$16.80/ha, Quadris =$35.65/ha

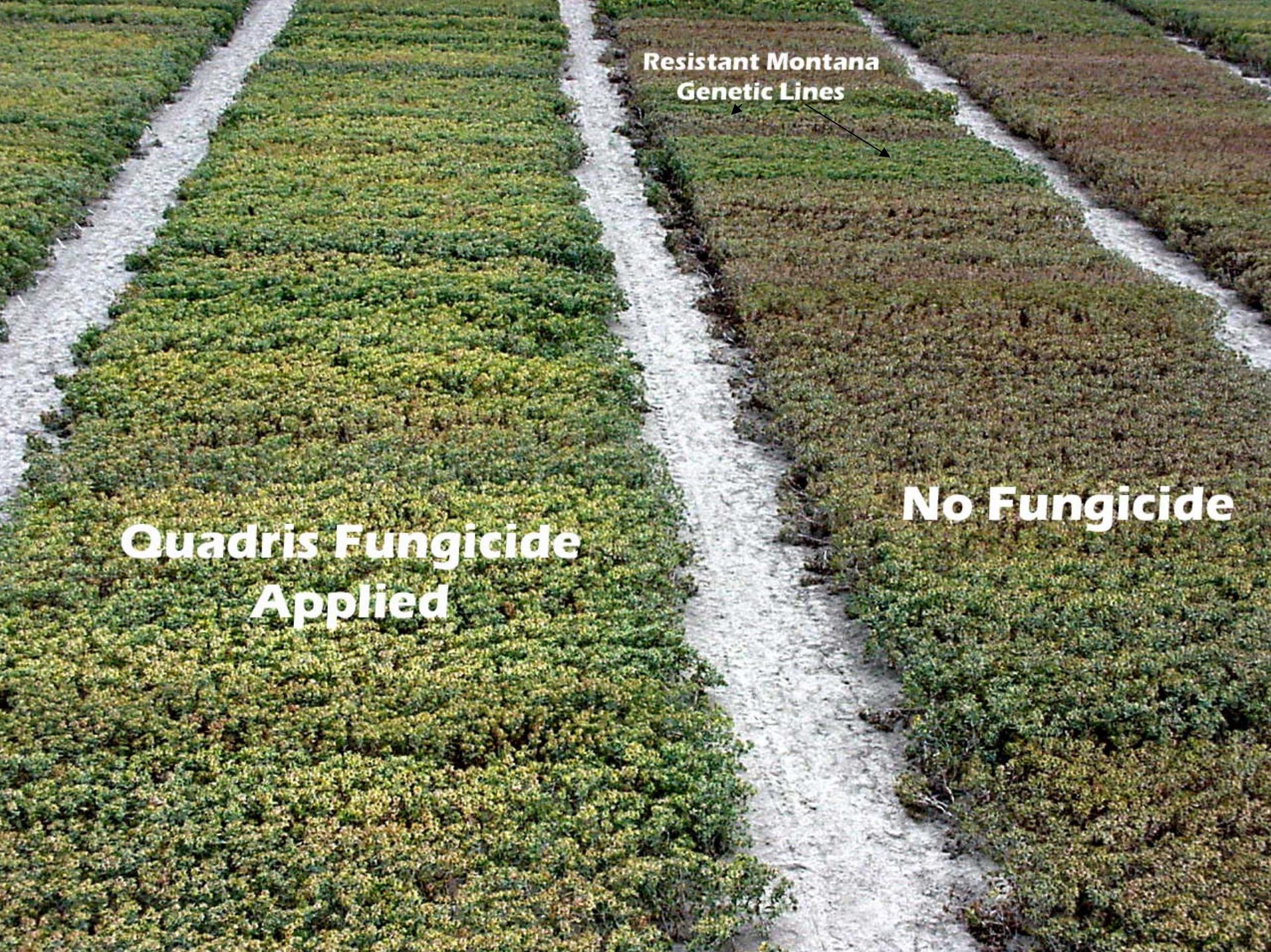
Conclusions

- In 3 years of field trials, Quadris (azoxystrobin), increased yields by 24->100% and oil content by 5-11% and seed weights by 8-11%

- A single application at first flower was nearly as effective as 2 or 3 applications in increasing yield, oil content and test weights

Conclusions

- Yield increases were from both greater number of seed and from greater seed weights
- Yield and percent oil content increases were similar on dryland trials with yield being approximately 30% lower than irrigated trials
- First symptoms of infection were noted ~7 days before first flower


Resistant Montana
Genetic Lines
Quadris Fungicide
Applied
No Fungicide

IRRIGATED
Resistant
Montana
Genetic Line
Susceptible
Variety

SAFFLOWER VARIETAL RESPONSE TO QUADRIS FUNGICIDE AT FIRST FLOWER GROWTH STAGE VALLEY SITE (PRIOR FALL IRRIGATED) SIDNEY, MT

	CHECK			QUADRIS [1]		
CULTIVAR	TW	OIL	YIELD	TW	OIL	YIELD
	LB/BU	%	LB/A	LB/BU	%	LB/A
CENTENNIAL	33.0	36.4	945	35.8	38.7	1546
S-541	36.0	37.2	1106	37.8	39.4	1714
FINCH	40.5	33.5	1586	41.8	35.2	1755
MORLIN	39.0	34.5	1673	38.3	35.7	1872
S-518	33.5	35.6	1259	36.3	39.3	2252
MONTOLA 2000	36.0	35.8	1434	38.0	38.2	2050
MONTOLA 2001	34.5	36.1	1484	38.0	37.0	2443
MONTOLA 2004	36.5	34.4	1773	38.0	37.0	2443
HYBRID 9048	41.5	32.5	2173	41.8	33.4	2771
HYBRID 9051	41.5	32.0	2575	42.0	33.0	2816
MONTOLA 2003	39.0	35.3	2493	40.3	38.5	3068
MT9102	37.5	33.8	2522	39.3	35.9	3899
MT2195	37.0	35.0	3142	38.5	37.3	3629
MT6144	37.5	43.1	1592	37.8	43.8	2295
MT6524	40.5	36.0	1821	43.3	36.9	2516

PLANTED: MAY 14 HARVESTED: OCTOBER 9

[1] Quadris applied at 0.15 lb/a on 7-19.

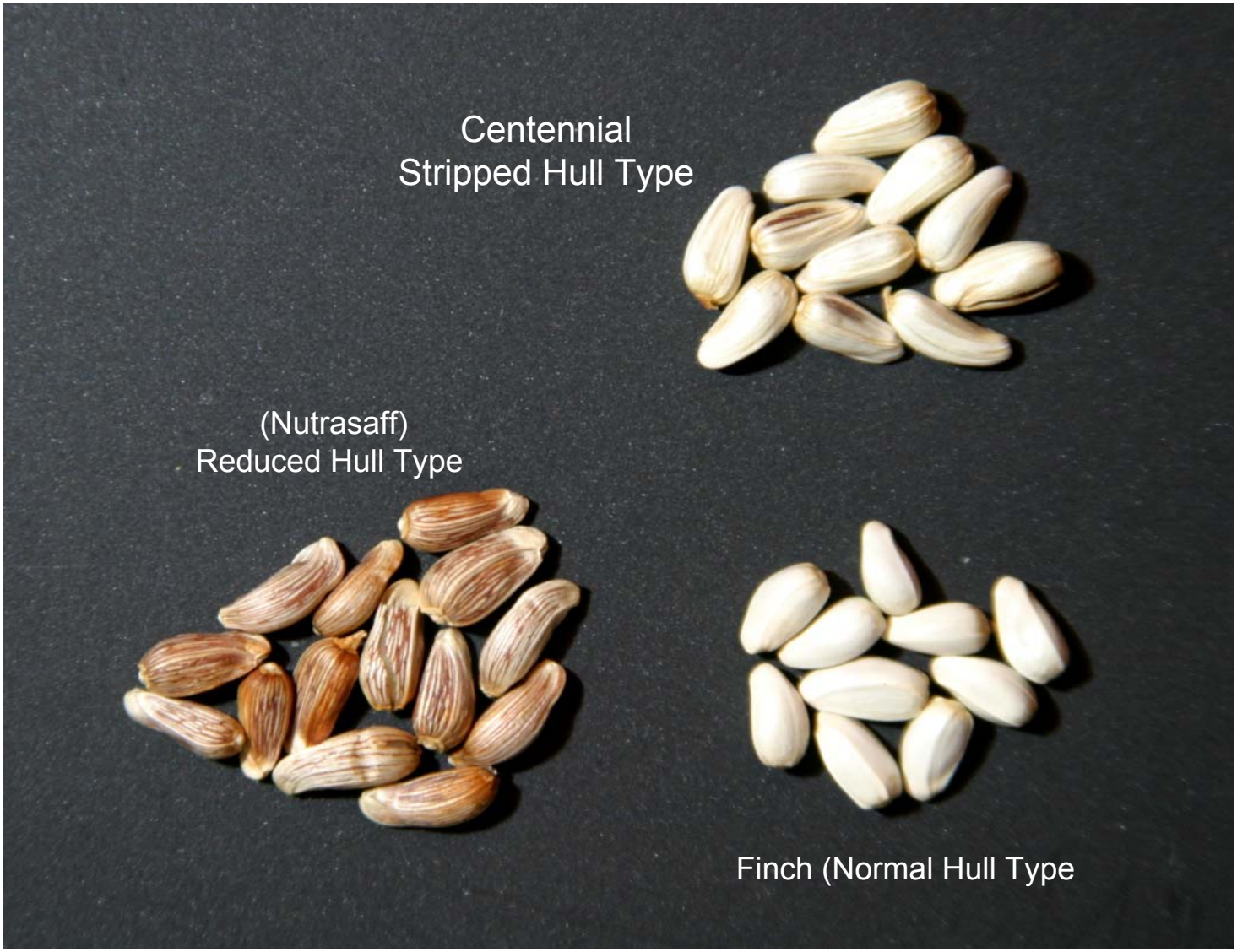
HARVESTING

- Leaves and flower bracts brown
- Seed white in color (easily separates)
- Cylinder speed 400-500 RPM
- Reduce reel speed (avoid shattering)
- Seed moisture - 8% or less (safe storage)

Safflower

1. Long Season Crop
2. Drought Tolerant
3. Plant Early
4. 300,000 Plants/Acre
5. Weed Control
6. Harvest

Nutrasaff-New Safflower Variety for Enhanced Nutrition in Feedstocks



Nutrasaff Compared to Other Safflower Varieties

Variety	% Meal Protein	% Seed Oil	Whole Seed % Fiber	Whole Seed % Protein
Nutrasaff	40.5	47.1	13.8	20
Finch	25.5	36.4	24.2	15.9
Centennial	27.3	40.5	21.9	16.6

Conclusions

Feeding diets high in linoleic oils

- **Increased ADG and feed efficiency**
- **Increased CLA concentration in meat**

Benefits of Feeding Nutrasaff-1

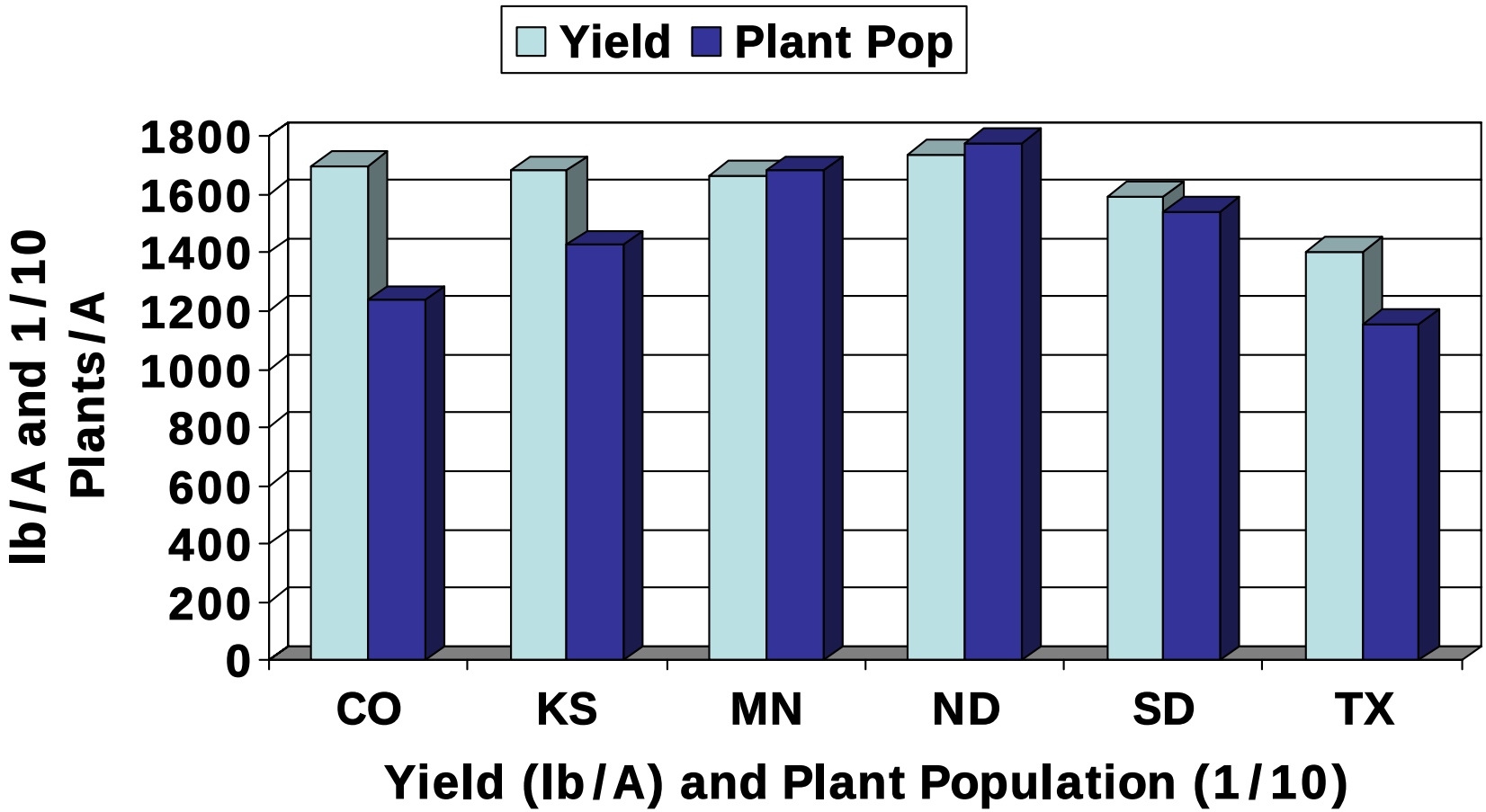
- ✓ Improved cattle production

  Linoleic fatty acid building in adipose body fat helps regulate body temperature,reduce animal stress and improve calf vigor.

- ✓ Heifers fed high linoleic safflower supplement prior to breeding have shown higher fertility rate and rebreed faster
- ✓ High linoleic dietary fat supplement shows promise to reduced saturated fat and increase unsaturate fat and CLA levels in lamb and beef meat

Sunflower Production

Sunflower Yield and Plant Population: 2005



Sunflower Development

- Warm, long-season, oil-seed crop
- Soil temperature important consideration rather than the actual planting date
  - Southwest vs. northern regions
- 44° F minimum soil temp for germination
  - Seeding into cold soils will increase the risk of emergence problems due to seed rot (Pythium), wireworm, cutworm, etc.

Sunflower Growth Stages

- Vegetative Stages: V-E through V-20
- Reproductive Stages: R-1 through R-9

- The growing point emerges with the cotyledons
  - **Rule of thumb: start planting sunflower within two weeks of last killing (28° F) frost**
  - **Frost issues with very early plantings**

Sunflower Growth Stages

- The growing point emerges with the cotyledons
- Early frost concerns?:
  - **Cotyledon stage: can handle temps as low as 24° F**
  - **2 to 6 leaf stage: frosts of 26 - 28° F**

Stage V-2:

- Plant populations should be calculated
  - Re-plant decisions need to be made at this time
- Optimum plant population
  - Oilseed: 18,000 to 24,000 plants/A
  - Confection:15,000 to 18,000 plants/A
- Minimum sunflower stands:
  - **8,000 to 10,000 plants/A**

Stages V-4 to V-10:

- Sunflower plant begins to grow rapidly
  - 4 leaf to 10 leaf stage in 15 days
  - Most weed control applications have now been made
  - Plant can now handle moderate insect feeding activity

Stages V-12 to R-1:

- Head or floral initiation stage: 45-55 DAP
  - Maximum head size and number of seeds per head is being determined
    - Any stress, ie. drought, reduces yield more than at any other stages of sunflower development
    - Plant now exhibits sensitivity to day length or photoperiod

Stage R-5:

- Beginning of flowering- 70-80 DAP
- Ray flowers fully extended and all disk flowers are visible
- This stage can be divided into substages (R5.1, R5.2, etc.) depending on the percent of the head area that had completed flowering

Stages R-6 – R-9:

- Stages most tolerant to drought
- Growing Degree Day Units
  - Base temperature 44 degrees F
  - Max temperature no limit
  - Average Sunflower GDD units planting to maturity
  - = 2400 units

- These stages are now being driven by temperature alone, especially if temps are cooler than normal
  - Seed fill, seed size, oil content

Seed Characteristics

Planting Seed "Oil Types"

- Seed sizes - #2, #3, #4 and #5 (size #2 is largest)
  - Packaged in 200,000 seed count bags
  - Plant from 7 to 10 acres per bag!!
  - Some companies vary seed count by seed size
- **Planting Seed "Confection Types"**
  - Seed sizes - small, medium, large and ex-large
  - Packaged in 100,000 seed count bags

PRODUCTION PRACTICES

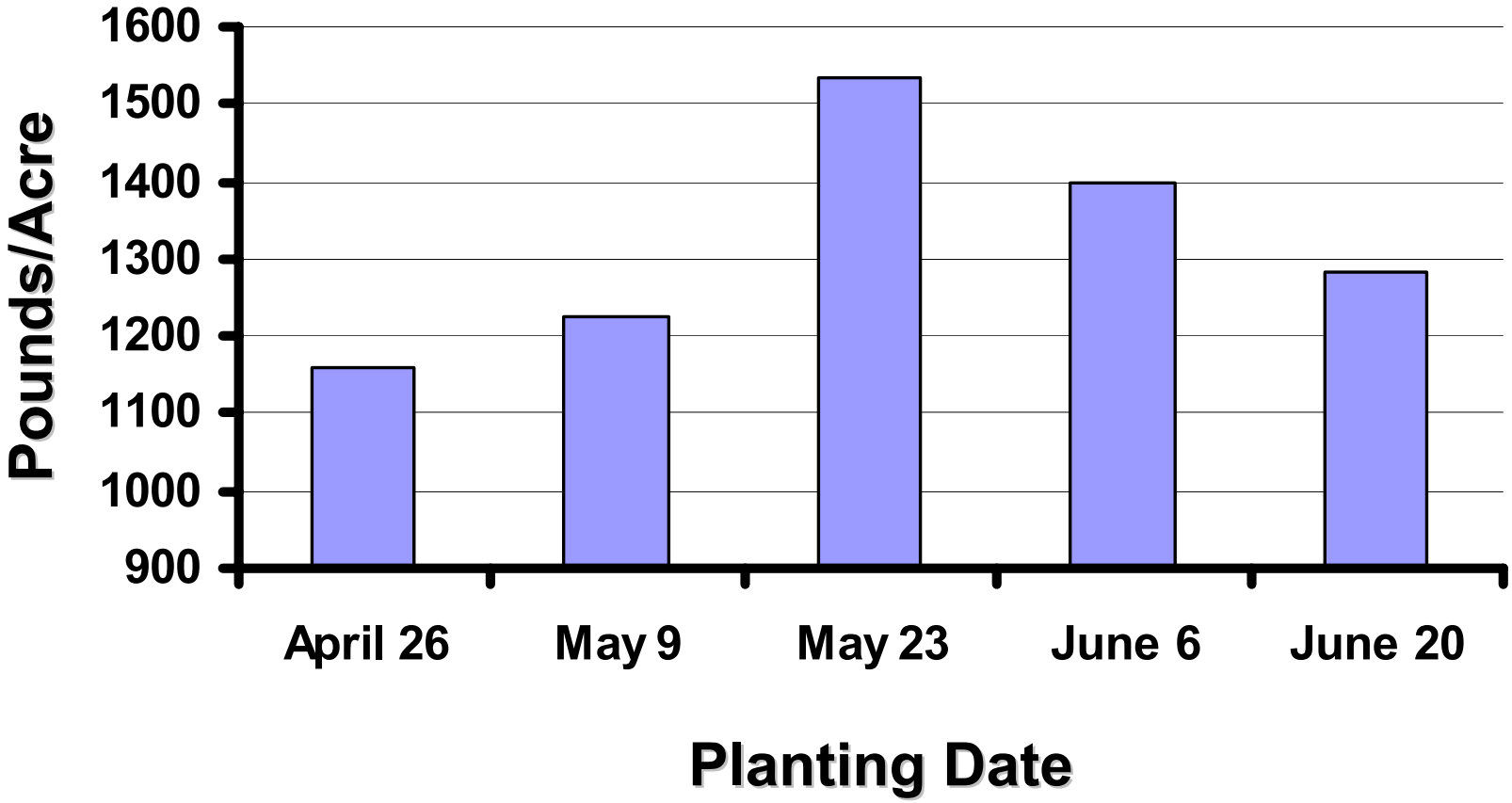
- **Planting Rates**
  - **Rows:**
    - **Oil types – 18,000 to 22,000**
    - **Confection types – 15,000 to 18,000**
  - **Solid Seeded: Narrow rows**
    - **Oil types – 24,000 to 28,000**
    - **Confection types – 18,000 to 22,000**
  - **Lower populations in drier soils, higher under irrigation**
  - **North/South vs East/West rows?**
    - **N/S probably better, heads hang between rows**
    - **Harder for birds to feed**
    - **Less damage and shattering during storms**

PRODUCTION PRACTICES

- **Planting Dates**
  - **May 15 to May 31st is ideal for most parts**
    - **Planting earlier: more risk of frost, and insects**
    - **Soil temperature should be at least 50 degrees F.**
    - **Cotyledon stage can handle 24 degrees**
      - **V2, V4, V6 can tolerate 26-28 degrees**
    - **Planting later: yield curve goes down**

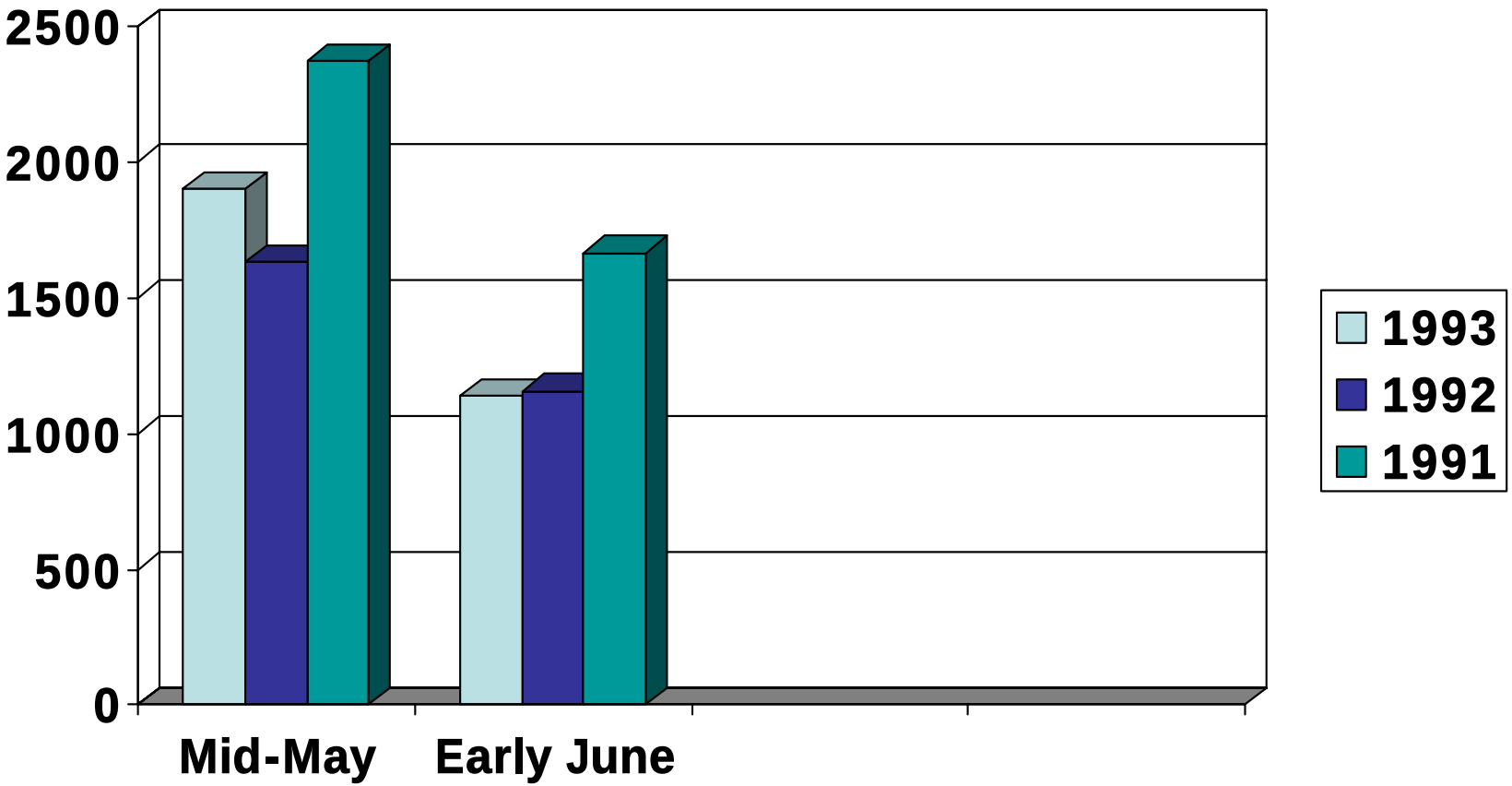
Sunflower Date of Planting

Oilseed Yield-SW North Dakota



Ashley, Eriksmoen, Whitney, and Rettinger 2001

Sunflower Date of Planting-Minot, ND



Planting Depth

- 1.5 to 2.5 inches
  - Can emerge from 3” or more if needed
  - Don’t plant too shallow!
  - Avoid planting on dry soil-wet soil zone interface

- **Row Width**
  - 18 to 20 inches

    24,000 plants/acre plants are 13 inches apart in the row
  - 30 inches

    24,000 plants/acre plants are 8.5 inches apart in the row

Fertility

Nitrogen

- Number 1 nutrient yield limiting factor
- Promotes plant growth
- Promotes higher oils

  5 # N per 100# of yield

  2000# yield goal = 100

  3000# yield goal = 150 lbs of N

- Not recommended to put N or K in furrow with the seed: Maximum of 10 lbs. total.

Fertility

Phosphorus

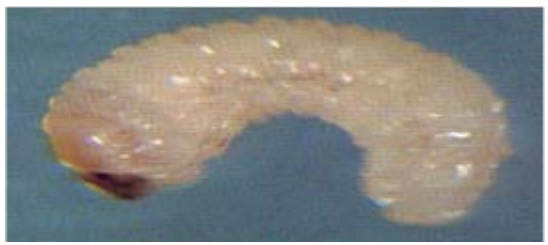
- Energy for plant
  - Faster emergence
  - Banding by seed is most efficient

Recommendation

- Soil Test
  - Medium Testing Soils- Add additional Phos. (20 lb. for 2000 lb. Yield goal, and 25 lb./A for 2500 lb. Yield.

SUNFLOWER INSECTS

- Early insect control
  - Wire worm
    - Planter box treatments
  - Cutworms
  - Stem Weevil:



Stem Weevil Larva

Stem Weevil Adult

Banded Sunflower Moth (Mid-season pest)

Banded Sunflower Moth Larva

Banded Sunflower Moth Adult

- Economic Threshold:
  - One moth per 2 plants
  - Scout early morning or late evening when moths are active

Sunflower Moth

- Economic Threshold:
  - two moths per 5 plants
- Start scouting at R-3 stage thru R-5.9
- Scout early morning or late evening when moths are active

Red Seed Weevil

- Emerges from soil early July to mid August
  - Lay eggs in the sunflower seed
  - Larva eat the sunflower meat
  - Scout from R5.0 to R5.7

Red Seed Weevil Larva

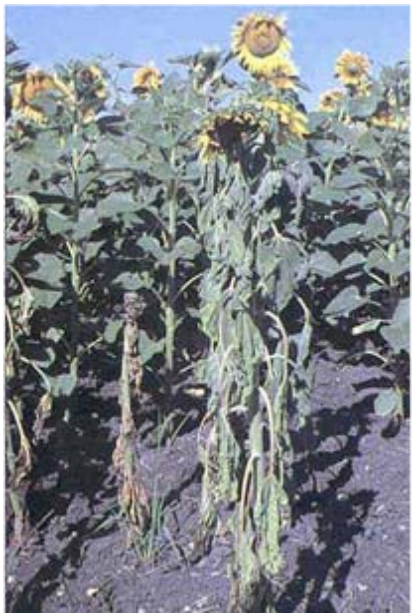
Red Seed Weevil Adult

Sclerotinia Diseases

- Also known as “White Mold”
  - Survives in soil for many years
  - Prevention is key, crop rotation is important
  - Rotation of at least one grass crop between other broadleaf crops

Head Rot

Stem Rot



Wilt

Sprinkler Irrigation Oilseed Crop Trial

Variety	Harvest Date	TW lb/b	Oil %	Yield lb/a	Oil Yield lb/a
NuSun Sunflower	9/15	33.8	41.4	2806	1165
Sclero. R. Sunflower	9/15	34.2	49.7	3057	1518
CROPLAND 378 Sunflower	9/15	34.0	43.4	2961	1286
MYCOGEN 8N270 Sunflower	9/15	33.2	45.6	3093	1411
01B 7113 Safflower	9/8	40.0	46.2	3443	1589
02B 6655 Safflower	9/8	40.0	45.8	3118	1427
MT 2004 Safflower	9/8	40.5	39.6	3423	1353
NUTRASAFF Safflower	9/8	39.8	48.6	3011	1464
95B 7446 Safflower	9/8	42.0	39.8	4070	1620

Dryland Fallow Hybrid Sunflower Trial

	Yield - lbs/a -		TW lb/b	Oil -- % --	
Variety	**2006**	**3 yr**	**2006**	**2006**	**3 yr**
IS4575 NS/CL	1258	1589	35.9	43.1	43.4
Hysun 521	1149	1463	35.0	42.6	41.8
Viper CL NS	1222	1423	35.6	43.1	43.1
HyOleic 120	970	1380	33.7	45.9	46.1
IS4704 NS	1064	1371	34.0	41.7	41.1
Defender DMR	1132	1329	34.4	42.1	41.6
Hybrid 894	953	1287	36.8	43.4	41.2

Alternate Crop Performance on Fallow

Williston, ND

Crop	Variety	Selling	5 Year Avg	Gross*
		2005 $/bu	**Yield bu/A**	**Return $**
Flax (brown)	Neche	5.80	18.0	104
Flax (Yellow)	Omega	6.50	14.7	96
Soybeans	Proseed PS00	5.10	19.0	97
		$/Cwt	**Yield lbs/A**	**Return $**
Yellow Mustard	Tilney	12.00	1153	138
Canola	Hoyola 357Mag	9.80	1592	156
Crambe	Meyer	9.00	1491	134
Safflower	Avg of 3 varieties	13.00	1393	181
Sunflower (oil)	IS 6521	9.00	1688	152

*Does not include LDP Payments