

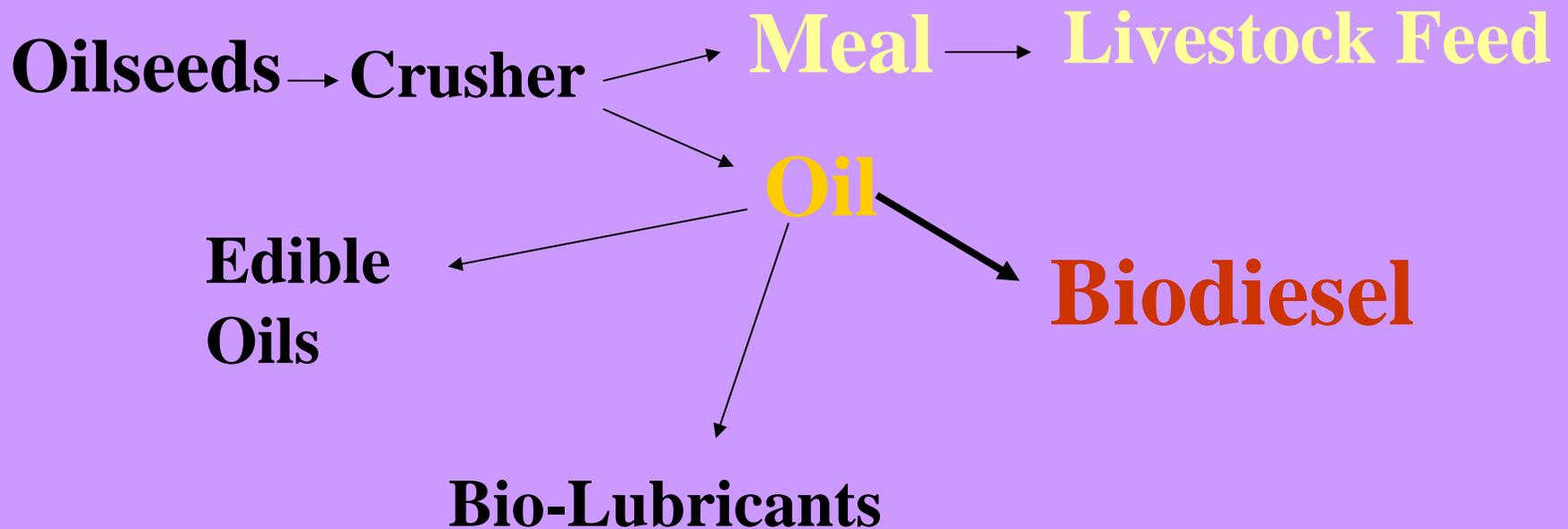
Crops for Biodiesel Research in Montana: Camelina



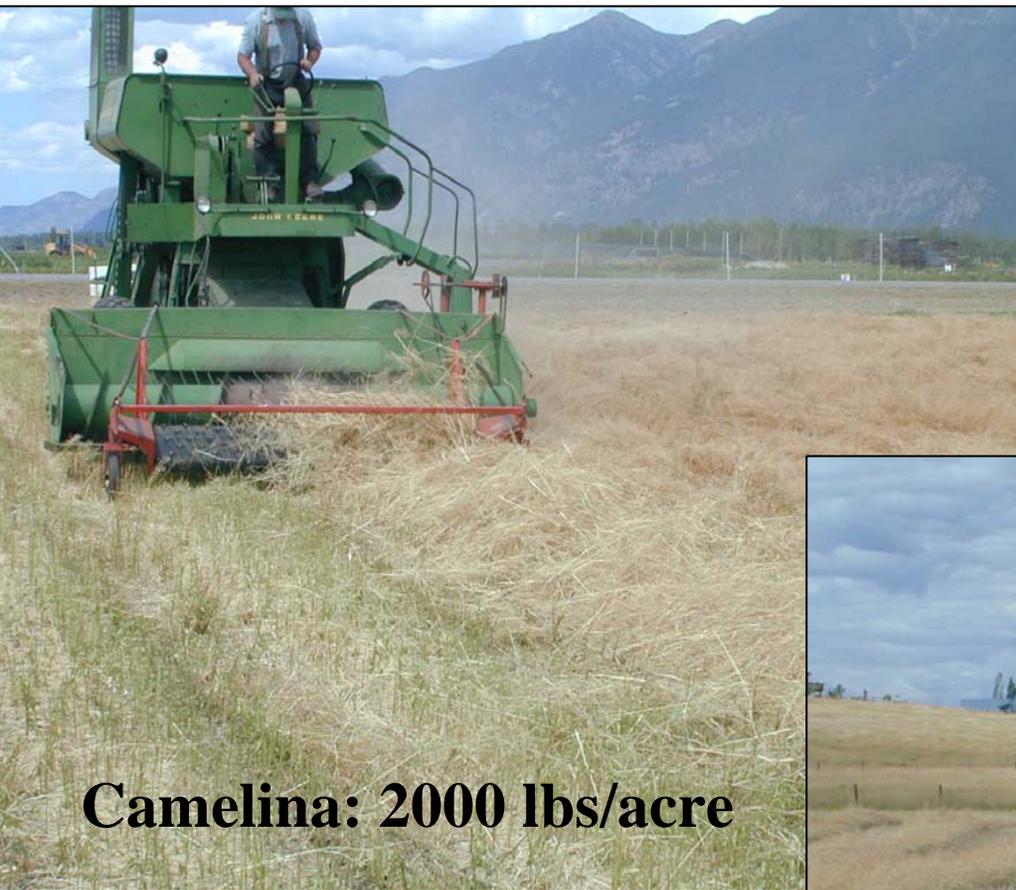
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The Paths are Many



Oilseed Brassicas



Camelina: 2000 lbs/acre



**2005 crop production,
Creston, MT**

Canola: 2200 lbs/a

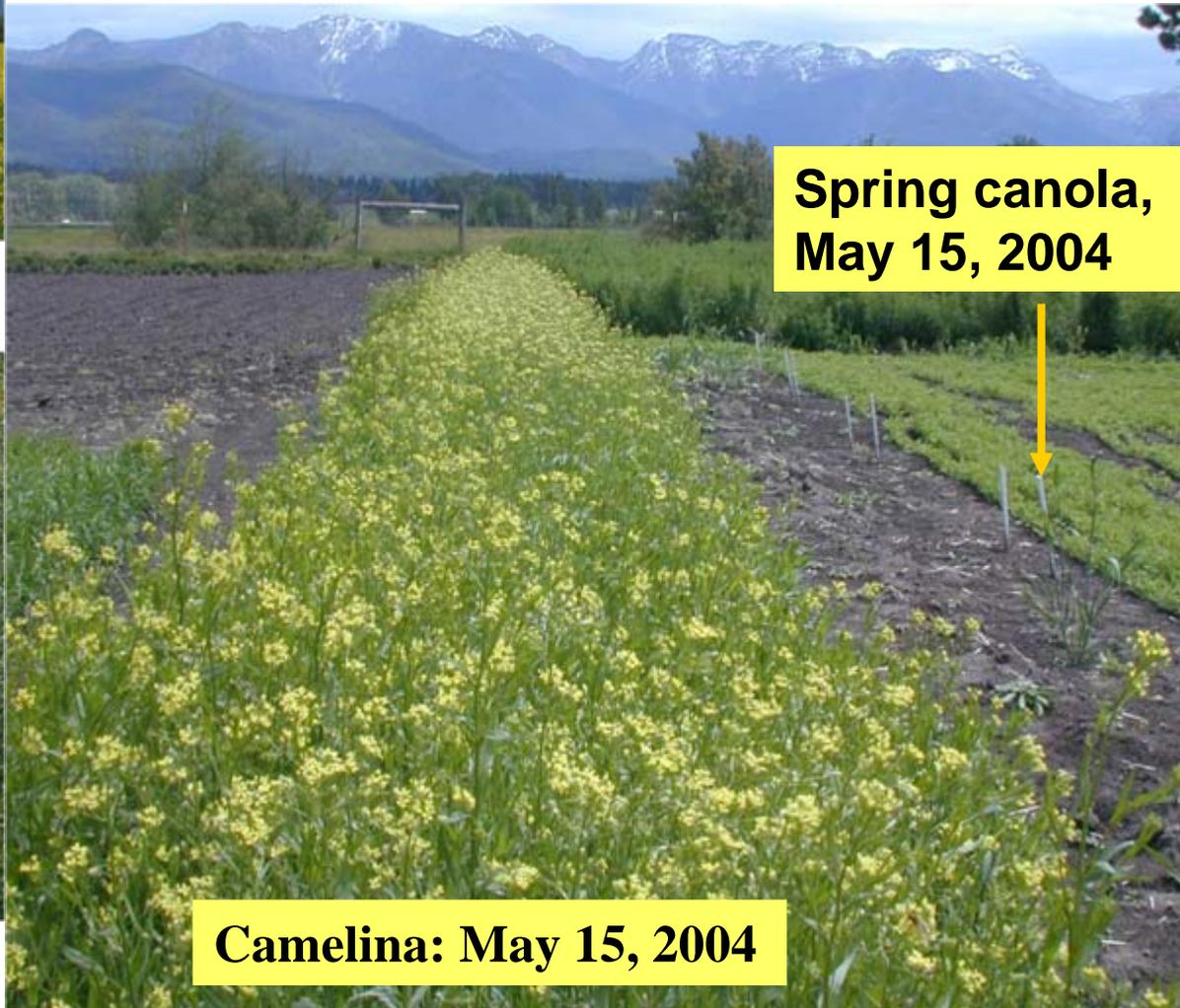
Camelina's advantage lies in better management of moisture and cold tolerance



Canola , July 5, 2004



Camelina: July 5, 2004



**Spring canola,
May 15, 2004**

Camelina: May 15, 2004

Camelina



“If it looks like a mustard, it’ll compete with a mustard”

Camelina sativa (a.k.a. Gold-of-Pleasure)

Camelina: an easy crop to grow

- **Seeding:**
 - No till or minimum till o.k., drilling, o.k., broadcast, o.k.
 - Broadcast with roller harrow or drill lightly, o.k.
 - 2.5-3.0 lbs/acre
- **Fertility:**
 - 35-50 lbs/acre nitrogen and 15-30 lbs/acre phosphorus
 - No yield response to sulfur; S did increase oil%- 1% per 10 lbs S
- **Herbicides:None.** Camelina produces a natural exudate from its roots – allelopathy.
- **Insecticides:** None required at this time.
- **Combining (direct or swathed):**
 - Screens: 6/64 to 3/64 slotted: alfalfa screens
 - air: low
 - Ground speed- slow, 1-2 mph

VARIABLE COST OF PRODUCTION/ACRE

WORKSHEET A

Grain: **camelina** Yield/Acre: **30** Year: **2004**

1. Operating Costs

		Price Per	Quantity	Value
		Unit		
A. Preharvest				
1. Seed	Bushel	1.00	3	3.00
2. Chemicals ___ Herbicide	Unit	10.00	0	0.00
_____	Unit	0.00	1	0.00
_____	Unit	0.00	1	0.00
3. Chemical Application	Acre	0.00	1	0.00
4. Fertilizer nitrogen	Lbs.	0.135	30	4.05
_____ phos	Lbs.	0.080	10	0.80
_____ potash	Lbs.	0.060	0	0.00
5. Fertilizer Application	Acre	1.00	1	1.00
6. Insurance (Fed. Crop, Hail, Multiperil,...)	Acre	2.30	1	2.30
7. Tractor Operating Costs (Fuel, Oil, Grease, Repairs)	Acre	2.68	1	2.68
8. Machine Operating Costs (Oil, Grease, Repairs)	Acre	1.90	1	1.90
9. Hired Labor				
A. Wages	Hours	6.25	0.5	3.13
B. Social Security	Hours	0.00	0	0.00
C. Workman's Comp.	Hours	0.00	0	0.00
10. Miscellaneous	Acre	2.93	1	2.93
11. Int on Operating Costs	Dollars	0.12	21.79	1.31
A. Average Months Loan Outstanding (1 Through 10)*(Ann Int Rate/12)*(Months Used)		6		
Subtotal - Preharvest Costs				23.09
B. Harvest Costs				
1. Combine Op Costs	Acre	12.00	1	12.00
2. Truck Op Costs	Acre	1.66	1	1.66
3. Int on Op Costs	Dollars	0.12	13.66	0.27
A. Average Months Loan Outstanding (1+2)*(Ann Int Rate/12)*(Months Used)		2		
Subtotal - Harvest Costs				13.93
C. Total Operating Costs (Preharvest Cost + Harvest Cost)				37.03
2. Breakeven Price to Cover Operating Costs (Total Operating Costs/Yield Per Acre)				1.23

**Camelina
breakeven
production
cost:
\$1.23/bushel**

**Yield 1500 lbs/acre
Bushel weight :50 lbs**

No-Till Dryland Oilseed trials: NARC, Havre, MT, 2005

Crop	Flower date	Yield lbs/acre	Test wt. lbs/bu	Gross Return \$/acre	Contract \$/lb
Celine (March plant)	May 10	1585	52.5	142.61	0.09
Celine (May Plant)	June 30	731	51.1	65.85	0.09
MT 1	May 5	1789	51.6	161.04	0.09
MT 5	May 5	1590	53.2	143.14	0.09
Canola	June 30	514	51.7	40.32	0.075
Flax	June 28	1146	53.2	109.60	0.096
Mustard	June 29	442	54.5	49.55	0.112

No-Till Dryland Oilseed trials: NARC, Havre, MT, 2005

Crop	Flower date	Yield lbs/acre	Test wt. lbs/bu	Gross Return \$/acre	Net Return \$/acre
Celine March	May 10	1585	52.5	142.61	105.61
Celine May	June 30	731	51.1	65.85	27.85
MT 1	May 5	1789	51.6	161.04	123.04
MT 5	May 5	1590	53.2	143.14	105.14
Canola	June 30	514	51.7	40.32	-48.68
Flax	June 28	1146	53.2	109.60	21.60
Mustard	June 29	442	54.5	49.55	-18.45

Minimum-Till Dryland Oilseed trials: NWARC, Creston, MT, 2005

Crop/ Planting	Flower date	Yield lbs/acre	Test wt. lbs/bu	Gross Return \$/acre	Net Return \$/acre
Celine/ Feb	May 24	2,057	52.5	185.13	135.13
Celine/ Mar	May 27	2,069	53.1	186.21	136.21
Celine/ Apr	June 16	1,673	52.6	150.57	100.57
Celine/ May	June 30	1,434	50.2	129.06	79.06
Canola	June 30	1,985	51.7	178.65	68.65
Winter canola	May 22	3,800	53.2	342.00	242.00
Mustard	June 29	1,678	50.5	167.80	57.80

Canola

- **Spring and Winter varieties available**
- **Imi- and Roundup-resistance available in spring canola**
- **High Oleic types available in spring canola**

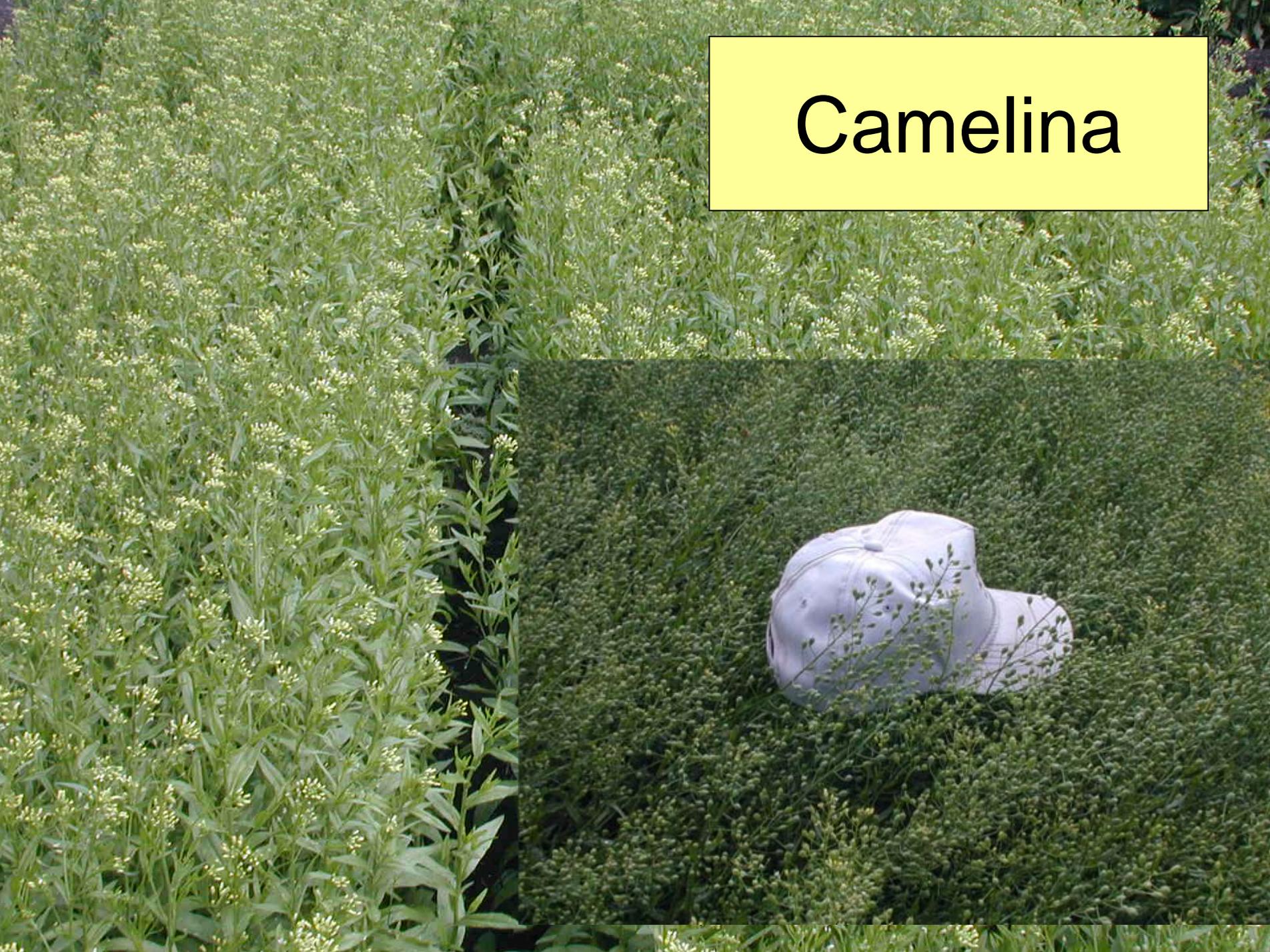


Canola

- **Seeding rate of 4-5 lbs/acre in spring canola & 5-6 lbs/acre in winter canola**
- **Spring seeding: Typically mid-April to early May. Insect control and herbicides may be required.**
- **Fall seeding: early to mid-September. Herbicides for winter weeds. Generally no spring control required. Good fall moisture required.**



Camelina



Camelina

Early planting is critical for plant establishment and weed control

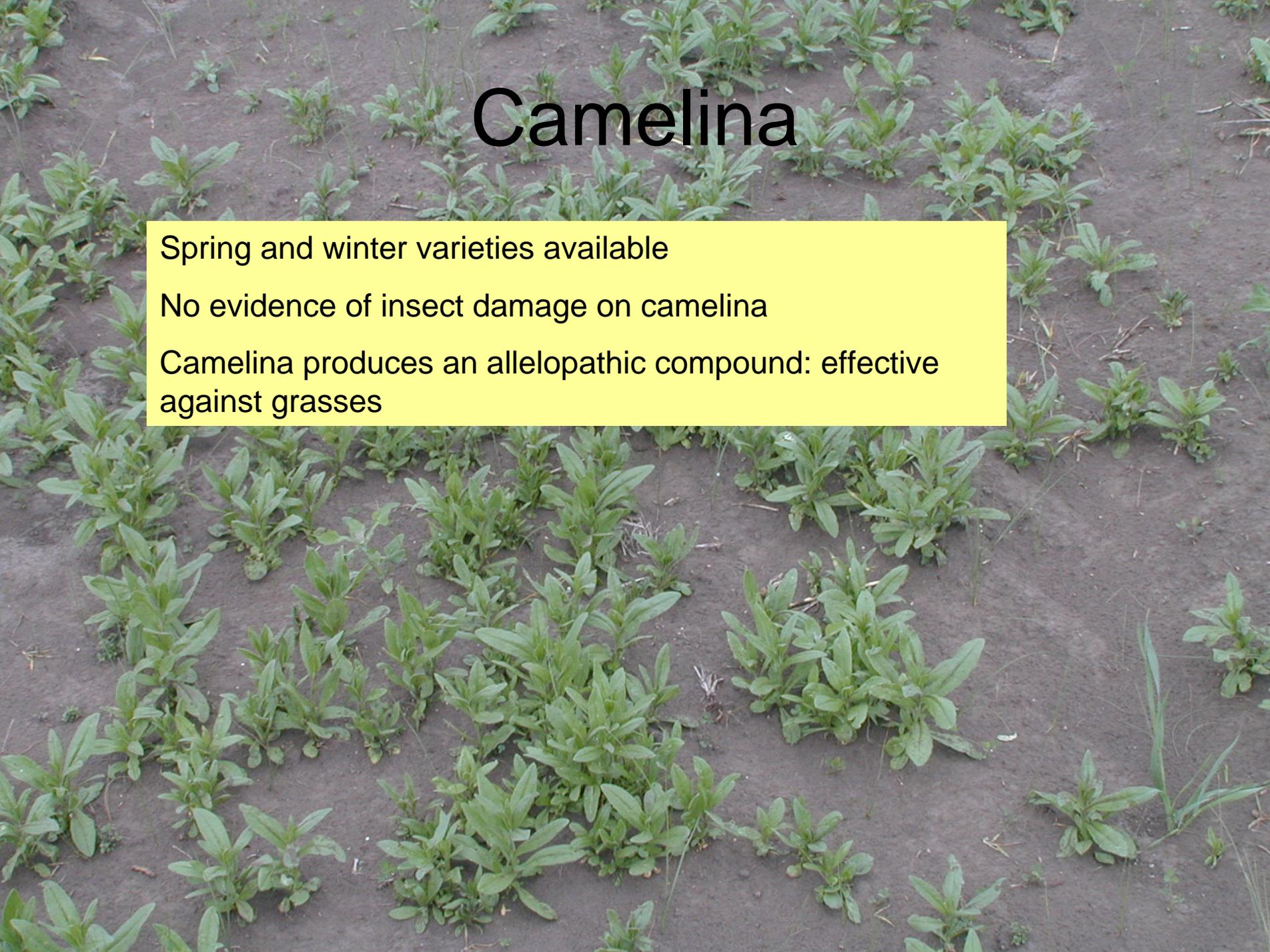
Seedbed must be firm- either well packed or no-tilled

Seeding rate of 2.5-3 lbs/acre (347,000 seed per pound)

No seed dormancy



Camelina

A photograph showing a field of young camelina plants. The plants are small, green, and have several leaves. They are arranged in rows on dark, rich soil. The background is filled with more of these plants, extending to the horizon.

Spring and winter varieties available

No evidence of insect damage on camelina

Camelina produces an allelopathic compound: effective against grasses

Winter Camelina: May 24, 2006



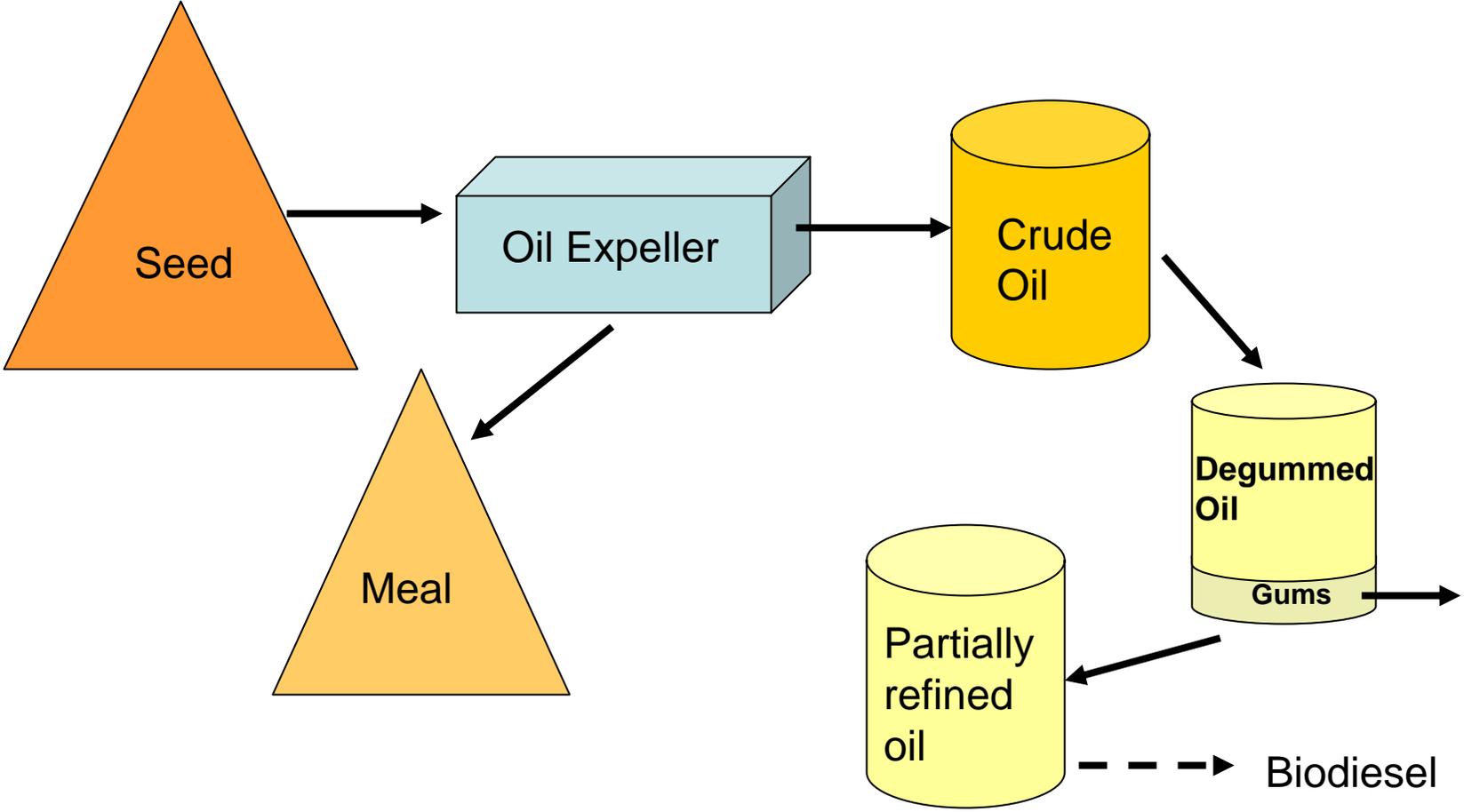
Proposed Oilseed Production for Biodiesel



Developing a Crop Rotation (Proposed for WY, MT and NB)

2006	2007	2008	2009
Camelina or Canola	Wheat	Legume	Camelina or Canola
Wheat	Legume	Camelina or Canola	Wheat
Legume	Camelina or Canola	Wheat	Legume

Production from Seed to Oil



Base Oil Processing Costs (break even)

- Spring canola/mustard
(per seed ton)

- Seed Cost: \$270
(\$0.135/lb)
- Cleaning Cost: \$9.17
- Expeller Cost: \$6.40
- Refining Cost: \$1.56
- Expected Cost: \$287.12
- 667 lbs of oil (87.7 gallons)
- Meal Return: \$106.64
- Soapstock Return: \$13.34
- Oil Cost after Meal:
\$167.14
- Refined Oil Cost/Gallon:
\$1.91

- Camelina (per seed ton)

- Seed Cost: \$180
(\$0.09/lb)
- Cleaning Cost: \$9.17
- Expeller Cost: \$6.40
- Refining Cost: \$3.00
- Expected Cost: \$198.57
- 665 lbs of oil (87.5 gallons)
- Meal Return: \$124
- Soapstock Return: \$13.34
- Oil Cost after Meal:
\$61.23
- Refined Oil Cost/Gallon:
\$0.70

Base Oil Processing Costs (break even)

- Winter canola (per seed ton)

- Seed Cost: \$200
(\$0.10/lb)
- Cleaning Cost: \$9.17
- Expeller Cost: \$6.40
- Refining Cost: \$1.56
- Expected Cost: \$307.12
- 740 lbs of oil (97.4 gallons)
- Meal Return: \$106.64
- Soapstock Return: \$13.34
- Oil Cost after Meal: \$80.02
- Refined Oil Cost/Gallon: \$0.82

- Mustard (per seed ton)

- Seed Cost: \$220
(\$0.11/lb)
- Cleaning Cost: \$9.17
- Expeller Cost: \$6.40
- Refining Cost: \$3.00
- Expected Cost: \$238.57
- 620 lbs of oil (81.6 gallons)
- Meal Return: \$50
- Soapstock Return: \$13.34
- Oil Cost after Meal: \$175.23
- Refined Oil Cost/Gallon: \$2.15

Iodine Numbers in Camelina Oil

Camelina Source	Iodine Number
Calena	66.15
Ligena	53.40
MT 1	59.33
MT 3	63.45
MT 5	56.79

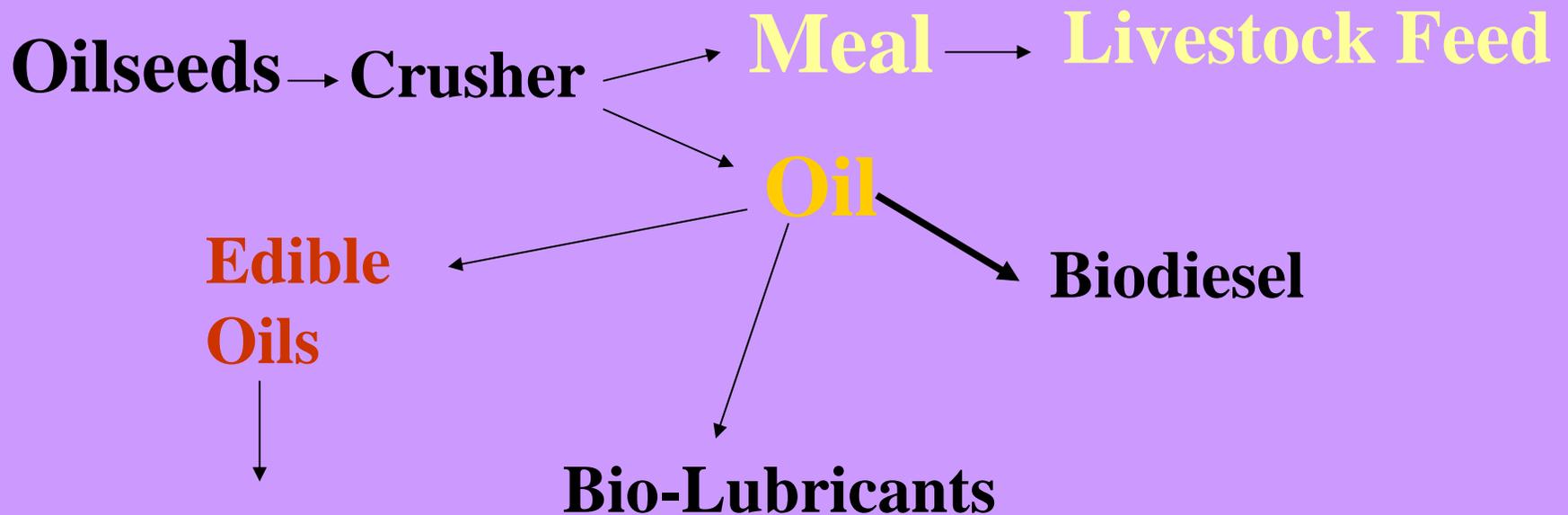
European Iodine Number Standards for Biodiesel

Europe: 120

France, Germany: 115

Sweden: 125

The Paths are Many

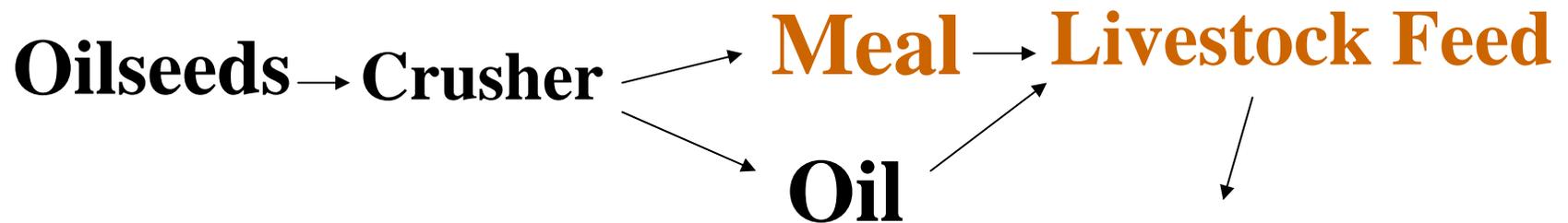


An excellent source of
omega 3 oils and
tocopherols (vitamin E)

Camelina Oil Profile as a Healthy Oil

Saturates	16:0	3-8%
	18:0	2-3%
	20:0	0-2%
Mono-unsaturates	18:1	12-27%
	20:1	9-17%
	22:1	1-3%
Poly-unsaturates	18:2	16-25%
Alpha Linolenic Acid	18:3	30-42%
Other	20:1 n-5	16.4%
EPA precursor	20:2	2%
	22:2	1%
DHA precursor	22:3	2.1%

The Paths are Many: Camelina as an omega 3 oil



**Farmed Trout and
Salmon (omega 3):
high EPA and DHA**

Omega 3 beef

Omega 3 eggs

Omega 3 dairy

Camelina as an Edible Oil



**European and
Asian Markets**



MT Camelina Markets in Development

Production Company	Biodiesel	Cosmetics	Poultry /Fish	Functional Foods	Beef/Lamb
Great Northern Growers (Shelby)		X	X	X	X
Sustainable Systems (Culbertson)	X				
Greater Montana Oil (Havre)	X				X
Undisclosed (Shelby)	X				X
Western MT Growers (Arlee)	X			X	

Summary

- **There are many oilseed crops suitable for biodiesel. Those most cost effective resulting in being cost competitive are camelina, flax and mustard.**
- **Oilseeds serve as a natural crop rotation for small grains (oilseeds 1 in three or one in two years)**
- **Additional industries can be spawned from the initial production of biodiesel.**