

Biofuel Crops and Integrated Pest Management

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Biofuel and BioDiesel

Fuel for transportation, heating

Electrical generation

Biomass – combustion, ethanol

Why BioDiesel

US use: 20M barrels oil per day

(World use = 80M)

60% imported, cost \$700 M / day

Diesel = 8 gal of each 42 gal barrel

**Biodiesel may reduce part of the
dependence on foreign oil, \$ - USA.**

BioDiesel Benefits

Renewable – immediate, seamless
No or minor changes to equipment
Energy efficient, = power, torque
Use as diesel fuel, home heating oil
No net carbon gain - environment

BioDiesel Benefits

11% O₂ in B100, burns >efficiently

B20: Fewer unburned emissions,

PM, HC and CO < by 20-40%

B20: CO₂ < by 16%

Less toxic, degrades 4X faster



Biodiesel is an established and fast-growing industry. Current production is about 250 M gpy

BioDiesel – Oil Sources

- **Waste oil**
- **Oil seed crops**

CAES Oilseed Crop Research

Crops that grow well in CT

Fit with CT agriculture? (value)?

Other benefits – added value?

- Integrated Pest Management**
- Feed and fertilizer (meals)**

Oilseed Crops:

<u>Crop</u>	<u>Seed lb/a</u>	<u>% oil</u>	<u>gal oil/a</u>
Canola / rapeseed	2000	40-45	125
Soybean	2500	18-20	50
Sunflower	2000	~ 40	100
Pearl Millet	4000	5 - 7	30
Cottonseed			35
Castor bean			150

N. American Oilseed Production

> 12 million acres canola (11 in Canada), primarily food oils.

> 73 million acres of soybean (US), primarily food crop.

CT – supplement other sources





















Canadian
Orange Pearl
millet
1/2 lb.

Oilseed Crops – Plot Yields '06

Canola (spring) (national ave = 1366 lb/a)

Hyola 357 Magnum 1356 lb/a

DeKalb 38-25 1319 lb/a

Soybean (Maturity Group I-9)

6193 RR 3695 lb/a = 61.6 bu/a

(national ave = 43 bu/a)

Oilseed Crops – Economics

Canola (NASS 2006 ave prices)

$1338 \text{ lb/a} \times \$11.10 / \text{cwt} = \$148/\text{a}$

Soybean

$61.6 \text{ bu/a} \times \$6.25 / \text{bu} = \$385/\text{a}$

Oilseed Crops – Economics

(NASS 2006 production, prices)

Canola = \$150/a

Soybean = \$385

Corn = \$475 (\$300 in 2005)

Winter wheat = \$175

Hay = \$250

Oilseed Crops – IPM Aspects

Soybean fixes nitrogen fertilizer

carryover of 15-20 lbs N/a

Weed control – competes well

Roundup Ready helps

control problem weeds

Oilseed Crops – IPM Aspects

Herbicides used on crops do not control all weeds, repeated use selects for problem weeds.

Ex. Tobacco – solanaceous weeds, galinsoga, ragweed.

Oilseed Crops – Meals

Remains after crushing seed

Use -Animal feeds or fertilizer

Tobacco crops in CT and MA

use ~ 1 million lbs meals/yr

(200 lb organic N/a – 4500 a)

Soybean Crops – IPM

Rotation crop 1 year in 4 or 5

Adds nutrients to soil (fix N)

Weed control - (RR option)

Meals used to supplement

organic N sources replace

cottonseed or castor meals

Canola versus Rapeseed

Both are *Brassica* species

Canola versus Rapeseed

Canola - *Brassica* oilseed bred for human consumption.

- Released in Canada 1970's
- Low erucic acid,
- Low meal glucosinolates

Canola versus Rapeseed

Rapeseed - *Brassica* oilseed with high glucosinolates in meals, low or high erucic acid in oil. Low -edible oil rapeseed, High –industrial rapeseed.

Erucic acid

Fatty acid, may be 40-50% of fatty acids in some *Brassica* spp. May have a variety of negative health effects. Amounts limited (< 2%) for human consumption.

Glucosinolates

Class of ~ 100 thioglucosides.
Secondary metabolites common
in *Brassica* spp. (odors / flavors)
Break down to nitriles, ITC,
thiocyanates etc – plant defense.

Biofumigation

Release of pesticidal products from green manures or meals. Brassicas 1-2 doz glucosinolates with different breakdown profiles, activities. (meals 10x)



Glucosinolates \Rightarrow isothiocyanates etc. in soil

Biofumigation

**Target management of difficult
to control pests and pathogens
Weeds, soil fungi, nematodes.**

Biofumigation Publications

Herbicide: Tissues, meals or extracts reduced germination or growth of certain weeds. Lot of variability related to SCN-

Weed control Rating (0-10)

Microplot experiments - CT

Rapeseed	1.7 a
Small Grain	2.6 b
Potato	3.9 c

(weed rating of 1-10, low – high)

Biofumigation Publications

Fungicide and Bactericide: ITC amount, type, solubility and volatility related to toxicity vs *Pythium*, *Rhizoctonia*, *Fusarium* or *Verticillium*. (vapor, water)

Biological Control

**Incorporated plant material stimulates microbial popns in soil, leads to general biocontrol, especially with low C/N ratios.
(Competition, antibiosis)**

Published Results - PNW

Plant

Pea root rot

Dwarf Essex
(high glucosinolates)

77% control

Stonewall
(low glucosinolates)

No control

Published Results - PNW

Plant

Sclerotinia

Dwarf Essex
(high glucosinolates)

0% germination

Stonewall
(low glucosinolates)

56% germination

Nematode Control

**Rotation or green manures:
Brassicas reduced lesion
nematodes in strawberry, root-
knot in potato, and controlled
dagger nematodes in orchards.**

Plant parasitic Nematodes

Lesion: *Pratylenchus* spp.

Root-Knot: *Meloidogyne hapla*

Dagger: *Xiphinema* spp.

Difficult and expensive to control

Lesion nematode
Pratylenchus spp.





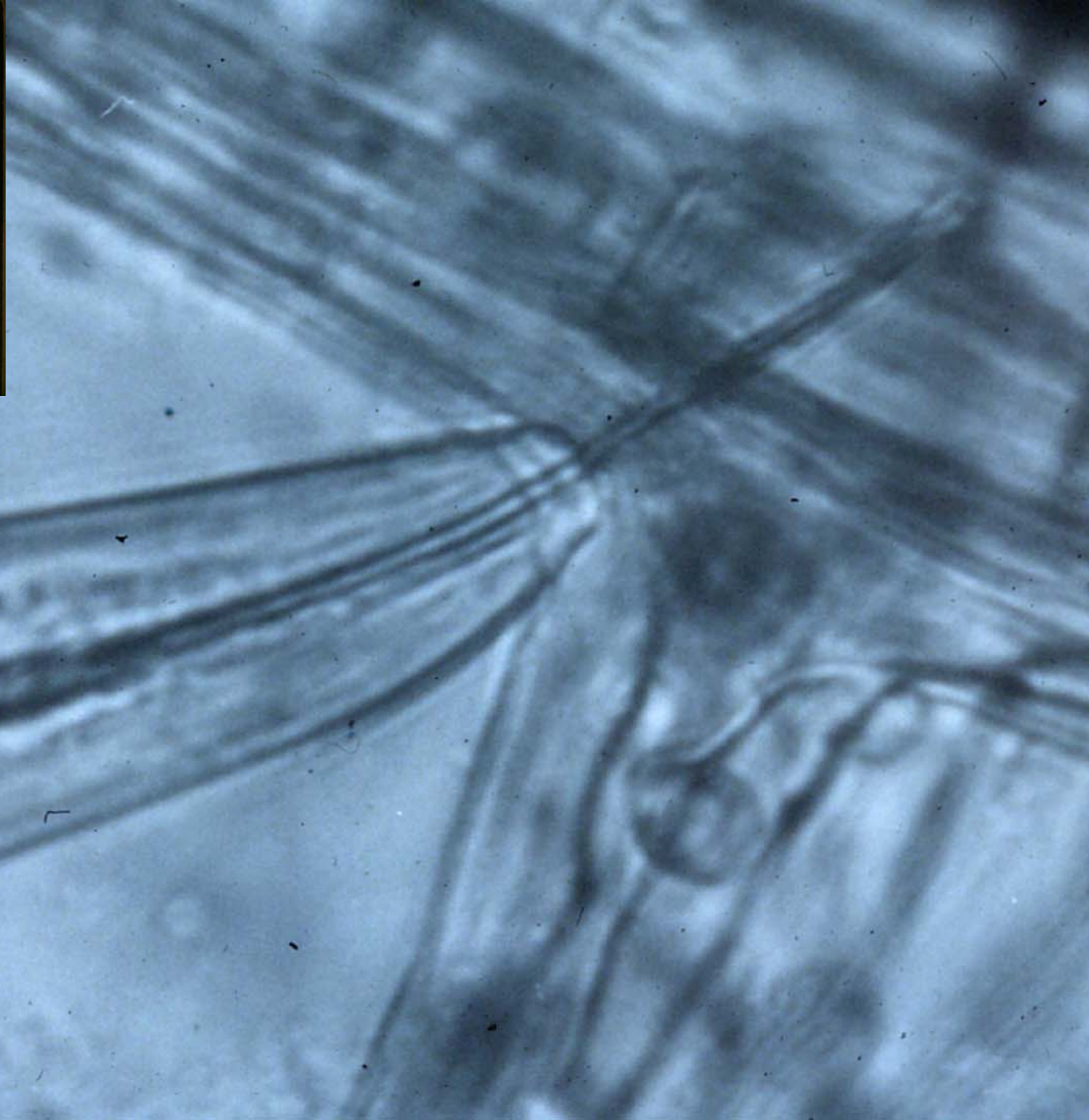




Root-knot nematode
Meloidogyne hapla







Dagger nematode
Xiphinema spp.





Nematodes per pot (roots and soil) - CT

<u>Crop</u>	<u>Lesion</u>	<u>RKN</u>	<u>Dagger</u>
Tomato	-	23065 a	-
Rye	1110 a	-	-
Sudangrass	190 b	0 b	221 a
Pearl millet 101	132 b	0 b	105 b
Dwarf Essex rapeseed	198 b	5185 ab	49 b



Effect of Crops on *Pratylenchus*
CT Microplots – Potato Early Dying

Year 1:

Grew rotation crops in infested soils

Year 2:

Planted potatoes

Crop effect on *Pratylenchus*, CT Microplots

<u>Crop</u>	<u>Soil</u>	<u>Roots</u>
Potato	24 a	16 bc
Oat	14 ab	44 a
Dwarf Essex rapeseed	5 b	29 b
Pearl Millet 101	8 b	2 c

Crop effect on *Pratylenchus*, Year 2 -potato

<u>Crop</u>	<u>Tuber Yield</u>	<u><i>Pratylenchus</i></u>
Potato	910 a	147 a
Oat	872 a	160 a
Dwarf Essex rapeseed	850 a	149 a
Pearl Millet 101	1071 b	45 b

Effect of Crops on *Pratylenchus*, CT Microplots – Strawberry

<u>Crop</u>	<u>Shoots Incorporated</u>	<u>Removed</u>
Strawberry	269	210
Dwarf Essex rapeseed	14	536
Pearl Millet 101	0	120

Nematode IPM

Nematode-antagonistic crops do not reduce all nematodes (fungi)

Efficacy vs. genera research.

Host vs. biofumigation effects.

Oilseed IPM Research

**Identify effective crop cultivars
- glucosinolate project.**

**Integrate crops into production
systems – winter cover or
summer rotation**

Brassica – nematode host

Winter crops of Brassicas may not allow nematode increase, may have increased yields, and may be valuable winter covers. Research is under way.



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VALLEY LABORATORY



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