Cégep de Victoriaville

SÉMINAIRE
Résultats de la recherche en agriculture biologique dans l'Est du Canada –

Programme

Partie 1

Review of Organic Grains Research

Andy Hammermeister PhD, PAg
Organic Agriculture Centre of Canada,
Nova Scotia Agricultural College

Maritime Organic Grains & Oilseeds Network

Established in Summer of 2007
Collaboration with ACORN
Funded

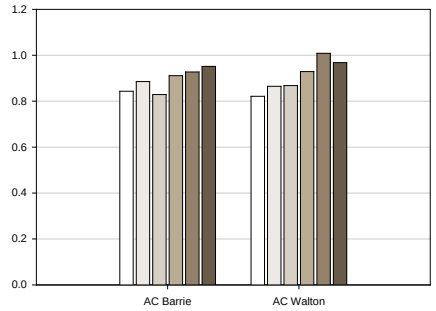
Organic Grains & Oilseeds Network What should it do?

- Quarterly newsletter
- Field days
- Fact sheets
- Market reports
- Buyer need and preferences
- Seed supplier lists
- Field trips to QC and ON
- Presentations to growers
- Cost of production analysis

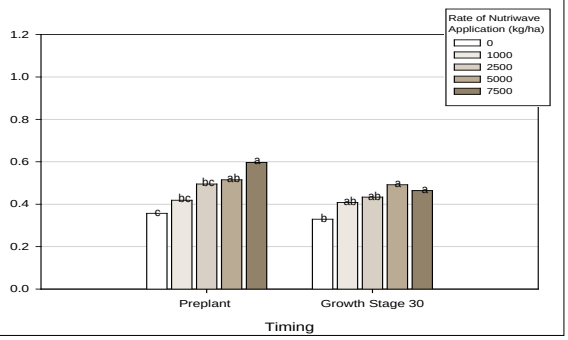
Peter Fuchs – Foxmill

Wheat Fertility Trial 2007

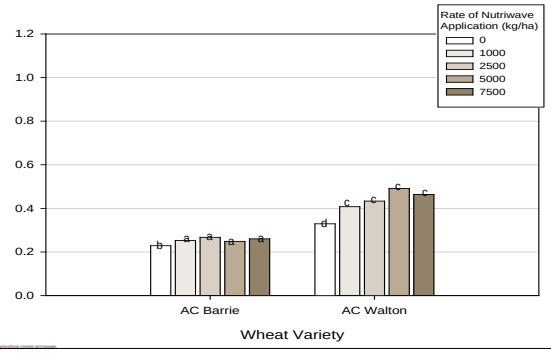
Yield response of AC Barrie and Walton wheat in NB. No statistical difference among rates. Note: 20000 kg/ha rate is a commercial compost not Nutriwave).



Yield response of Walton on PEI to Nutriwave applied before planting or at GS30. Within a timing, columns with the same letter are not statistically different.



Yield response of AC Barrie and Walton to Nutriwave applied at GS30 in PEI. Columns with the same letter are not significantly different.



Protein response to Nutriwave applied to Walton at Preplant and GS30 and to AC Barrie at GS30. For Walton, columns with the same letter are not statistically different.

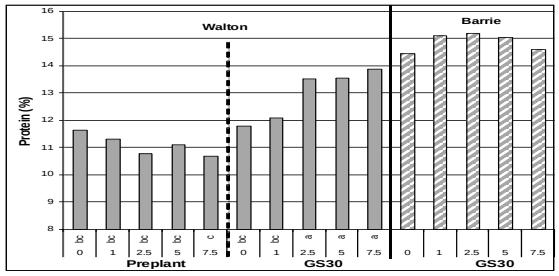
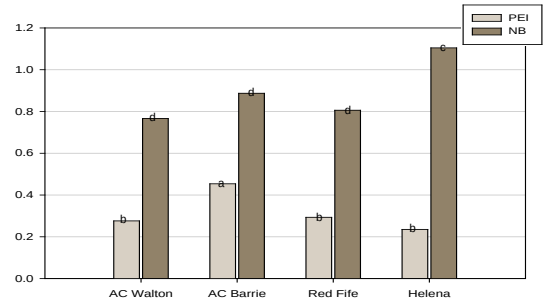


Figure 4: Yields of wheat varieties grown in PEI and NB.



Protein Trials:

soybean, lupin, faba bean, mixed crops

Mixed Crop /Intercrop Research (Barley, Oats & Peas)

Objective: To assess efficacy of pea/cereal mixtures for production of a high protein grain supplement.

Brookside, NSAC

Locations:

1. OACC/NSAC Brookside, NS
2. AAFC Charlottetown, PEI
3. Five farms in NB, PEI and NS

Harrington, PEI

Mixed Crop /Intercrop Research

Varieties

Peas: Miami, Carrera, 746-3*

On-farm trials: Lenca, Mozart

Barley: Westech

Oats: Nova

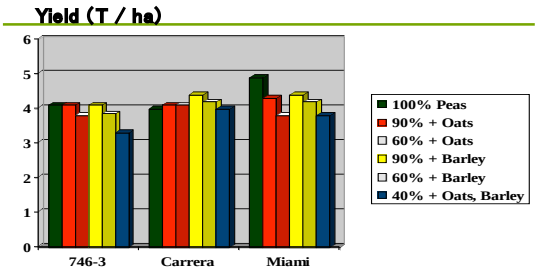
Treatments / Seeding Rates(%)

Peas:	100%= 90 seeds/m^2	100	90	60	40
Barley:	100%= 375 seeds/m^2	100	30	60	40
Oats:	100%= 350 seeds/m^2	100	30	60	40

Pea/cereal intercrop weed management - What works?

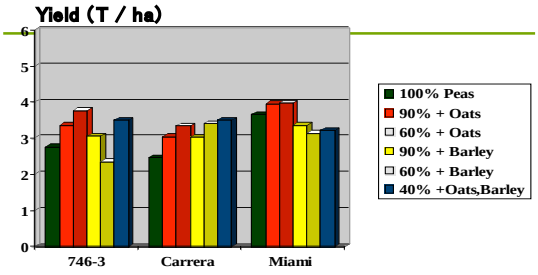



Mixed Crop /Intercrop Research



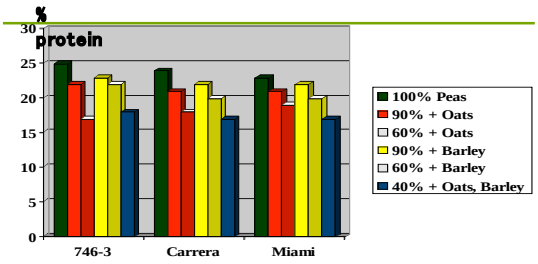
Harrington, 2003

Mixed Crop /Intercrop Research



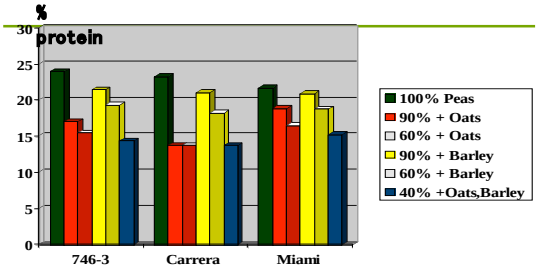
Brookside, 2003

Mixed Crop /Intercrop Research



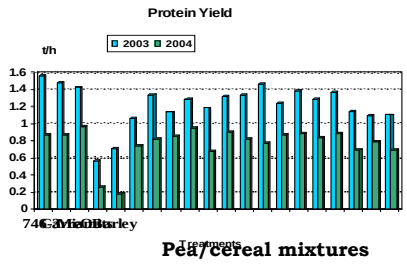
Harrington, 2003

Mixed Crop /Intercrop Research



Brookside, 2003

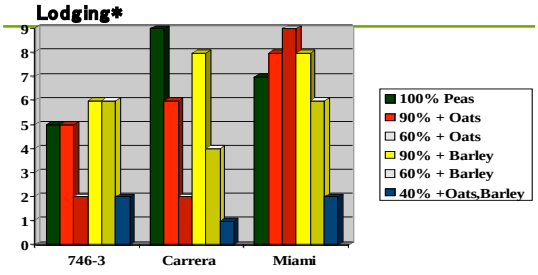
Mixed Crop /Intercrop Research



Pea/cereal mixtures

Harrington, 2003-2004

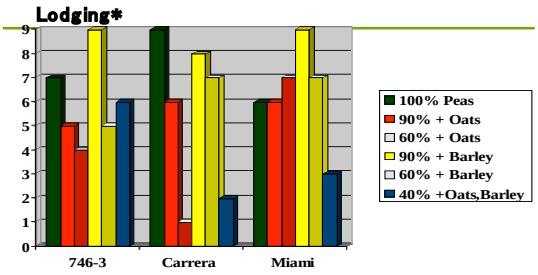
Mixed Crop /Intercrop Research



Brookside, 2003

*9 is severe

Mixed Crop /Intercrop Research



Brookside, 2004

*9 is severe

Mixed Crop /Intercrop Research

Results of Small Plot Trials (2003-2004):

- Monocrop pea yields 3 - 4 t/ha
- All mixed crops contained > 14% protein.
- Peas at < 20% of stand reduces lodging.
- 746-3 less lodging prone, highest protein (25%).
- Timely finger-weeding effective for weed control.

Mixed Crop /Intercrop Research -Farm Trials-

Objective: Farm-scale comparison of mixture vs. cereal alone.

Locations: Five farms in NB, PEI and NS

Pea varieties: Lenca, Miami, Mozart

Pea Seeding rate: 25% (1:2) and 50% (1:1)

Measurements: % peas in stand mid-season

% protein (quadrats & combine)

Mixed Crop /Intercrop Research

What is the best combined seeding rate?

Variety	TKW	% pea seeds at 1:1*
746-3	188	20
Mozart	219	17
Lenca	220	16
Miami	260	14
Carrera	310	12

*wt:wt in seed mixture with cereal

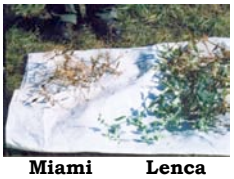
Mixed Crop /Intercrop Research




OACC

Mixed Crop /Intercrop Research



Miami Lenca

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Mixed Crop /Intercrop Research

Farm	Cereal	% peas in stand
Jopp	Oats	9.4
Martin	Oats	11.1
Fleishaker	Oats	18.8
Gillis	Barley	15.6
Boyle	Barley	15.1
	Oats	22.3

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Mixed Crop /Intercrop Research

Farm trials (2004)	% peas in stand	% protein (quadrat)	% protein (combine)
Jopp	**9.4**	**11.8**	**11.8**
	Grain	9.0	9.1
Martin	**11.1**	**-**	**13.8**
	Grain	-	13.6
Fleishaker	**18.8**	**14.4**	**15.3**
	Grain	12.6	14.4

OACC

Mixed Crop /Intercrop Research

Farm trials (2003)	% peas in stand	% protein (quadrat)	% protein (combine)
Jopp			
Miami	**10.0**	**12.8**	**11.3**
Lenca	**15.9**	**15.4**	**12.2**
Hulless Oats	-	15.0	13.8
Oats	-	10.8	10.2

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Mixed Crop Trials

- Yields
  - Monocrop pea 3 - 4 t/ha
  - Oat and barley monocrops were between 2-2.5 t/ha
  - Mixed crop > cereal monocrops
- Peas had 20-25% protein
- All mixed crops contained >14% protein
  - Increased protein 2.5% above hulless oats alone
- <20% peas in stand to prevent lodging
- Timely finger-weeding can be effective

OACC

Preliminary Small Plot Protein Trial 2006

Crop	Yield (kg/ha)	% Peas	Est. Protein Yield (kg/ha)	Sites
Peas + Oats	2328	26	377	5
Peas + Barley	2477	32	447	5
Peas + Oats + Barley	2530	26	416	5
Faba bean	2767	-	692	4
White Lupin	1933	-	735	2
Soybean	1464	-	586	3
Bernard & Brookside Sites Only				
Peas + Oats	3184	38	572	
Peas + Barley	2828	46	580	
Peas+Oats+Barley	3043	38	570	
Faba bean	2197	-	549	
White Lupin	1933	-	734	
Soybean	2179	-	872	

Field Scale Lupin, Soybean, Mixed Crop (& Faba Bean)

June 27th, all planted on May 18, 2006

Small plot protein crop trials in 2006 (2 site average)

Crop	Targeted Plant Density (seeds m^{-2})*	Average Yield (kg/ha)	% Peas	Est. Protein Yield (kg ha^{-1})**
Peas + Oats	60+300	3184	38	572
Peas + Barley	60+300	2828	46	580
Peas+Oats+Barley	60+150+150	3043	38	570
Faba bean	44	2197	-	549
Lupin	50	1933	-	734
Soybean	55	2179	-	872

*Assumed germination rate was 75% for cereals and peas, 70% for faba bean, 60% for lupins, 80% for soybean.
** The actual seeding rate was adjusted for germination to meet the target density. Here we have assumed 11% protein for cereals and 25% protein for peas in the mixed crop, 40% for soybean, 38% for white lupin and 25% for faba bean.

Soybean, Faba bean, Lupin, Peas

- Advantages
  - Soybean
    - Commonly grown, lots of varieties, easy to handle, well-developed market, high protein
  - White lupins
    - High protein, no roasting, some more competitive than soybean
  - Faba bean
    - High yielding, competitive under good conditions
  - Peas
    - Early maturing, easily grown in mixes, commonly available in west
- Disadvantages
  - Soybean:
    - Poor weed competitor, late maturing, needs roasting for pigs and poultry, low growing
  - lupins:
    - Disease and yield issues, seed not readily available
  - Faba bean:
    - Late maturity, lower protein, harvest challenges, seed not readily available
  - Peas
    - Susceptible to lodging and harvest problems, lower protein, no varieties for Maritimes

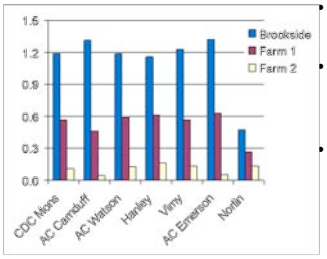
2006 & 2007 Soybean Variety Trial Results grown under Organic Conditions

Variety	Yield (kg ha)		Yield kg/ha		Yield kg/ha	
	2006 Site A&B 15-cm	2006 Site B&C 30-cm	2007 Site PEI 15 cm	2007 Site PEI 45 cm	2007 Site NS 15 cm	2007 Site NS 45 cm
OAC Prudence[1]	2097 bc	2370 bc	2412	2936	476	868
Bicentennial[3]	n/a	n/a	2802	2813	1347	1897
Ugo[1]	1583 cd	1442 e	2483	2772	1014	1347
OAC Atwood[1]	1199 d	1249 e	1507	1283	160	344
Barren[1]	1827 cd	1399 e	1787	2292	431	725
AC Glengarry[2]	2379 ab	2829 ab	n/a	n/a	n/a	n/a
OAC Champion[1]	2685 a	2975 a	2526	2711	1476	1863
NK S08-80[1]	2057 bc	2184 cd	1386	2156	1518	1334
Toki[3]	n/a	n/a	3357	2884	1935	2008
NK S03W4[3]	n/a	n/a	2037	2940	1963	2298

[1]Variety in 2006 & 2007 trial. [2] Variety only in 2006 trial. [3]Variety only in 2007 trial
a-e Yield values within the same column and followed by the same letter are not statistically different.
Note: Yields for the two row spacings should not be compared because they were measured at different sites

Flax Variety Trial
7 varieties chosen

2005 Flax Yield (t ha^{-1})



- 2005: overall average (0.1 - 1.3 t ha^{-1})
- 2006: overall average 457 kg ha^{-1} (0.2 -0.9 t ha^{-1})
- Lower yields & quality observed on farms were due to low fertility soils, drought, harvesting problems and tine weeding losses

Table 3. Oil quality assessment for three flax cultivars in 2005

		Hanley	Vimy	AC Emerson
Oil Content (%)	Original[a]	39.9	40.7	41.9
	Brookside	41.9	42.4	42.8
	Farm A	41.0	41.9	41.9
	Farm B	38.2	38.4	37.1
ALA (% of all FA)	Original[a]	62.3	56.8	62.8
	Brookside	62.2	59.1	63.1
	Farm A	59.8	56.7	61.5
	Farm B	56.0	53.2	56.0
Free Fatty Acid[b]	Original[a]	0.40	0.62	0.39
	Brookside	0.72	0.85	0.57
	Farm A	2.75	0.83	1.42
	Farm B	1.17	0.83	1.26

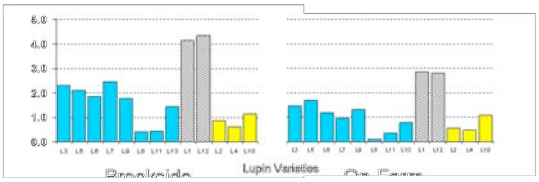
Flax Agronomy

- Seeding rates 600 seeds m^{-2}
  - ~ 6 g per 1000 seeds, varies by variety
- Early May seeding produces higher yields
  - Late seeding allows early season weed control
- Shallow seeding 1 cm – 2.5 cm

- **Conventional**: rec. 50 kg/ha N (but will make weeds more competitive)
- **Conventional**: dessicant used to prevent late season tillering and encourage dry down
- **Organic**: seed early into clean field or use false seed bed technique and seed late in May (esp. if soil P is low)
- Tine harrow (finger weed) when crop is 5 cm to 7.5 cm tall, try to avoid burying plants

Lupin Variety Trials

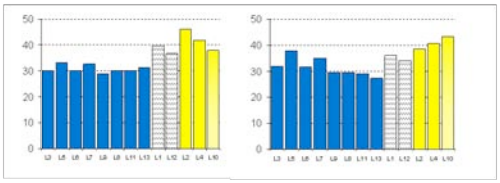
Lupin Yield (in t ha^{-1})



* reported at 13% moisture content

- Highest yield was obtained for both white and several blue varieties

Lupin Protein Content (% dry basis)



- Protein yield was 1.5 t ha^{-1} for white lupins and <0.8 t ha^{-1} for yellow and blue lupins

Potential for Lupin Production

- Disease, heat stress and wireworm limited establishment, flower development and seed filling for some varieties
- White lupins severely affected by anthracnose disease under stress and high humidity
  - Anthracnose is a seed borne disease, make sure you get clean seed, don't plant too heavy, store seed for an extra year, try heat/chilling treatments
- White lupins were the latest maturing (~140 days), while some blue lupin varieties matured in <110 days, but had low yield

On-Farm Establishment Rates of Mixed Crops in 2004

	Oats	Oats in Mix	Peas in Mix
Seeding Rate (seeds/m2)	409	190	42
	Establishment Rate (%)		
Farm 1	53	72	54
Farm 2	30	55	66
Farm 3	27	50	87
Farm 4	23	72	47

Stand Counts in 39 Maritime Fields

	# sites	Plants/m^2	range
barley	2	219	195-243
hulless oats	11	239	114-333
oats	1	153	-
red fife	1	249	-
soybean	6	52	29-81
wheat	7	365	207-516
mixed crop*	11	260	126-341

* average when present 54 peas (24%), 151 oats, 78 barley

2007 Crop Establishment

	Barley	Hulless Oats	Wheat
Number of fields	6	11	4
Seed TKW (g)	**45**	**32**	**38**
	44 - 45	29 - 36	38 - 38
Seeding Density (seeds/m^2)	**260**	**556**	**470**
	200 - 320	452 - 655	296 - 644
June Crop Density (plants/m^2)	**228**	**281**	**300**
	182 - 251	191 - 393	233 - 393
Establishment Rate (%)	**84**	**51**	**68**
	76 - 91	31 - 77	52 - 81
Heads/m^2	253	254	364
	203 - 331	145 - 333	274 - 471
Yield (kg/ha)	**2537**	**1977**	**2859**
	1754-3819	880–3553	1488-4553

Seed Treament Experiments

- **Seed Quality Testing:**

  2006 2007

  ☑ ☐ – Germination (Barley & Oat, 14 samples)

  ☐ ☐ – Purity (Barley & Oat, 14 samples)

- **Vigour Testing of Seed Samples:**

  2006? 2007

  ☐ ☐ – Cold Test (CT)

  ☐ ☐ – Seedling Growth Test (SG)

  ☐ ☐ – Accelerated Aging Test (AA)

How can a forage crop be used on organic farms?

(without removing for sale)

Mulching Experiment

- MB
  - Wheat yields when 3.9 and 5.2 t/ha alfalfa mulch applied equivalent to 20 and 60 kg/ha of fertilizer N
  - At equivalent yields, grain protein with mulch was higher than with fertilizer
  - Highest mulch rate provided higher N uptake & yield in second crop than fertilizer N
  - Weed problems at low rates
- NS
  - High rates smother crop, encourage weeds
  - Low rate (1 t/ha) had yield and economic benefit

OACC project update:

Seeding Rate Experiments –
Nova Scotia and Canada wide results

ACORN Conference – February 26, 2005
Roxanne Beavers, MSc Candidate
Dr. Andy Hammermeister, OACC

- Recommended seeding rate for organic wheat - 1.25 x conventional
- Little research performed in organic farming systems - different than conventional!
- Is higher seeding rate necessary?

Why increase seed rate?

- Higher crop density can buffer losses from pests, mechanical weeding, or poor emergence
- Weed control - denser stand may suppress weeds with faster growth, taller stand, denser canopy, better root distribution

Risks

- May not result in a yield increase as the crop can compensate for low density by tillering
- Lodging possible
- Cost of extra seed
- Quality problems?

Study Objective

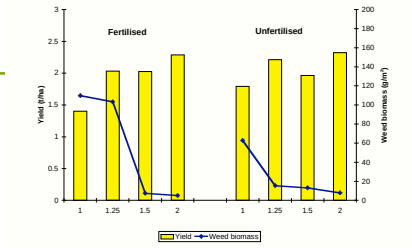
- To determine whether increasing the **seeding rate** of spring wheat is an effective means of **weed control in organic systems** which can be applied without negatively affecting yield and quality
- Part 1 - seeding rate and fertility in NS
- Part 2 - seeding rate at different farms across Canada

Plot Scale: Design

- Replicated plot trial looking at wheat-weed competition in detail
  - Four different seed rates (1x conventional, 1.25x, 1.5x and 2x) plus a non-seeded control
  - Two fertility levels
- Repeated for 2 seasons at OACC research site

Plot Scale: Results

- Increasing seeding rate resulted in higher yield at the double rate, mainly due to more mainstems.
- Weed biomass was reduced in the high seeding rates, and the effect was stronger in the fertilised plots, which had stronger weed competition.
- There was no effect of seeding rate on quality parameters



- At high seeding rates,
  - Yield increased
  - Weed biomass decreased (more so in the fertilised plots)

Farm Scale: Methods

- Trial replicated in 25 fields over 2 years
- Spring wheat seeded at 4 rates: 1x, 1.25x, 1.5x, 2x
- Measuring:
  - Wheat and weed density
  - Weed biomass
  - Wheat yield
  - Thousand kernel weight
  - Test weight
  - Grain protein content

Regional 1x Rates

Prairies South	Prairies North and Atlantic	Ontario and Quebec
89 kg/ha	118 kg/ha	150 kg/ha
80 lb/ac	105 lb/ac	134 lb/ac
1.3 bu/ac	1.75 bu/ac	2.2 bu/ac
264 seeds/m^2	348 seeds/m^2	443 seeds/m^2

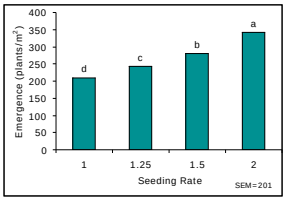
South includes Brown and Dry Dark Brown Soil zones
North includes Moist Dark Brown, Grey and Black zones

Clearwater, Manitoba

Parrsboro, Nova Scotia

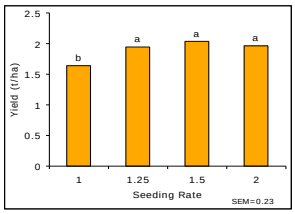
Farm Scale: Emergence

- Wheat plant density increased with seeding rate, but establishment rate declined



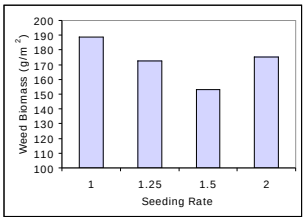
Farm Scale: Yield

- Yield was lowest at the 1X rate
- No difference observed between the three higher rates



Farm Scale: Weeds

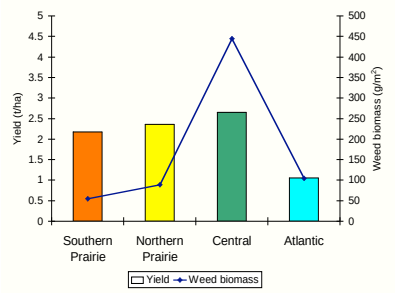
- No statistical difference observed in weed biomass between the treatments
- More analysis - by region



Farm Scale: Results

- Differences between sites greater than between rates - environment and management and cultivars all different
- Two variable years out west - drought in 2003 and frost in 2004
- No differences in test weight or TKW between rates
- Protein content still to come

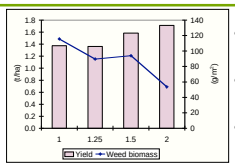
Differences between regions?



Why so variable?

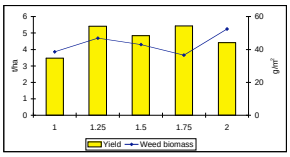
- Weed species - grasses vs. broadleaf
- Soil type & fertility
- Weather
- Cultivation practices

Late Notukeu Farm, Swift Current SK



- Base rate = 90 lbs/ac (101 kg/ha)
- Chart summarizes results from 3 fields
- Major weeds - Lamb's quarters, stinkweed, wild oat
- Increase in yield and decrease in weed biomass at high seeding rates

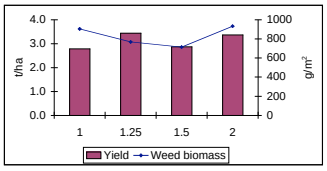
St. Peter's Abbey, SK



- Base rate = 94 lbs/ac (105 kg/ha)
- Few weeds - Canada thistle, wild oat
- High yield, slight decline in weeds, except at 2X

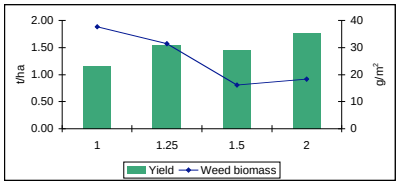
Carruthers Farm, Embrun ON

- Base rate = 130 lb/ac (146 kg/ha)
- Higher weed pressure - crabgrass, pigweed
- Yield increased slightly, effect on weeds inconsistent



OACC Research Site, Brookside NS

- Base rate = 120 lb/ac (134 kg/ha)
- Yield increased and weed biomass declined at higher rates
- Major weeds - lamb's quarters, vetch



Overall:

- At some sites, increasing seeding rate reduced weed biomass; at others there was no effect
- Increasing seeding rate by 25% had positive effect on yield
- Regional differences dominated
- Further analysis:
  - Look at regions separately
  - Effect of weed species and time of emergence
  - Effect of
- Completed report - May 2005

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Trial Participants

Fred Dollar – Winsloe, PEI
Andrew Kernohan - Parrsboro, NS
Serge Giard - St. Hugues, QC
François Bertrand - St. Alban, QC
Robert Guilford - Clearwater, MB
John Finnie - Kenton, MB
Bruce Duncan - Almonte, ON
Stewart Carruthers - Embrun, ON
Marlyn O'Connor- Mountain, ON
Martin Meinert - Swift Current, SK
Marc Loiselle - Vonda, SK
Dave Montgomery - Morse, SK
Kirby McCuaig - Eastend, SK
Nelson Collinge - Eston, SK
Norman Bromm, Tisdale, SK
Kim Tomlin - Gronlid, SK
St. Peter's Abbey, SK
Danny Rempel - Hodgeville, SK
Bruce Wagner - Weyburn, SK

Trial Cooperators

Sponsors: NSERC, Western Ag Innovations

Researchers:
Jennifer Bromm, Dr. Brenda Frick (OACC, University of Saskatchewan)

Collaborators:
Dr. Wendy Asbil
(University of Guelph – Kemptville)
Dr. Martin Entz
(University of Manitoba)
Dr. Steve Shirtliffe
(University of Saskatchewan)
Sophie Boudreau
(Club Agri-Avenir)

Weds and Grains Research

Andy Hammermeister PhD, PAg
Organic Agriculture Centre of Canada,
Nova Scotia Agricultural College

Weed Surveys

Maritime Weed Survey 2006

- 43 organically managed grain and pulse fields across the Maritimes sampled in July 2006
- Ten quadrats were sampled on each farm
- Averaged over all sites, the mean weed density in organic farm fields was 328 plants m^{-2}
- Broadleaf weeds made up 66% of weeds
- Remaining 33% were grassy weeds

Most common weeds...

Weed Species	Distribution - % of farms -	Pop'n Density - plants m^{-2} -
Lamb's quarters	93%	33.0
Chickweed/ Stitchwort	91%	25.7
Grasses (may include couch grass)	81%	104.4
Plantain	79%	24.9
Hemp nettle	67%	11.7
Dandelion	65%	6.7
Cudweed	58%	45.8
Corn spurry	56%	77.8
Shepherd's purse	56%	14.4

	%of farms	Density (plants/m2)
Wood sorrel *(Oxalis stricta)*	49%	8.3
Vetch *(Vicia* spp.)	47%	8.1
Daisy (*Chrysanthemum leucanthemum)*	40%	32.7
Couch grass *(Elytrigia repens)*	37%	62.2
Buttercup *(Ranunculus* spp.)	35%	6.2
Thistle *(Cirsium* spp.)	33%	4.8
Smartweed *(Polygonum lapathifolium)*	33%	2.3
Wild radish *(Raphanus raphanistrum)*	30%	14.9
Buckwheat *(Polygonum convolvulus)*	30%	2.4
Goldenrod *(Solidago* spp.)	21%	20.5
Yarrow *(Achillea millefolium)*	19%	4.9
Sheep sorrel *(Rumex acetosella)*	19%	2.8
White cockle *(Silene pratensis)*	19%	3.9
Redroot pigweed *(Amaranthus retroflexus)*	16%	31.0
Black medick *(Medicago lupulina)*	16%	4.0
Stinkweed *(Thlapsi arvense)*	16%	1.2
Bindweed *(Convolvulus arvensis)*	16%	8.5
Other broadleaf weeds (occurring <4 sites)	60%	19.9

Potato and Barley Yield Response to Wild Radish

Andrew Hammermeister and Kate Punnett
Organic Agriculture Centre of Canada
Funded by: PEI Dept. Agric. Fisheries Aqua.

OACC Nova Scotia Agricultural College

Wild Radish

Plant produces >2000 seeds; survive 60 years in the soil (3 plants:7000 seeds/m^2, 70 mil seeds/ha)

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Economics of Weeds

- **Economic injury level (EIL):**
  = Cost of pest damage = cost of control
- **Economic threshold (ET)**: level of pest population where a control is required to prevent the pest from reaching (EIL)
- What are the EIL and ET for wild radish in organic potato and barley production?
- Preliminary exploration…

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Best Organic Management Practices (BOMPs)

Stale seedbed technique	$11
Increasing seeding rate	$13
Pre-emergent fingerweeding	$11
Post-emergent fingerweeding	$11
Total	$46/ha

Methods

- **Organic barley fields**
  - Weed species biomass and barley yield determined in each quadrat
  - Field 1: 60 quadrats sampled (low fertility)
  - Field 2: 30 quadrats sampled (following sod)
- **Organic potato fields**
  - Field A: Snowden potatoes, high fertility
  - Field B: Gold rush potatoes, medium fertility
  - 30 quadrats in each field; weed species biomass and potato total, No 1., and Small yields

BOMP Trial – Farm 1

Results

- BOMPs reduced wild radish density in August
- Higher seeding rate reduced wild radish fresh weight in August
- No significant yield difference although slightly higher at high seeding rate (overall crop density & yield was low)

Conclusions

- Need a systems approach
  - pre-emergent fingerweeding reduces weed population
  - higher seeding rates reduces competitiveness of the weeds

BOMP Trial: Farm 2

Results

- BOMP reduced wild radish competition but no yield benefit as wild radish was a minor weed.
- Couchgrass (quackgrass) was the major weed
  - Every gram of weeds/m^2 reduced yield 1.68 kg/ha
  - Average 198 grams couchgrass/m^2
  - Estimated yield reduction of **332 kg/ha**
  - **Loss of $83/ha**
    (assuming price of $250/metric tonne)

Conclusion

- Need a system to manage all weeds

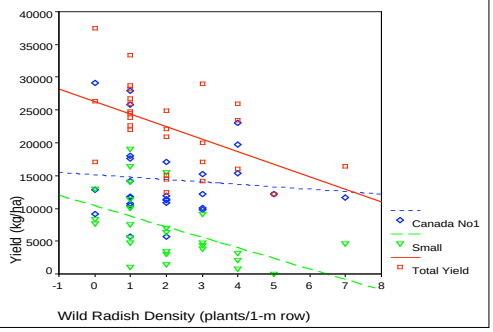
Wild Radish Economics in Grains Example: Barley in 1 field

- Yield, if no wild radish: 1281 kg/ha (24 bu/ac)
- Yield reduction: **10.6 kg/ha (0.2 bu/ac)** for every wild radish plant/m^2 in August (average for field)
- Example:
  - Ave. wild radish density: **3.4 plants/m^2**
  - Estimated yield reduction: **36 kg/ha**
  - Estimated $ loss: **$9/ha ($3.6/ac)** (assuming grain price of $250/metric tonne)

Wild Radish in Potatoes: Farm A

- Each wild radish plant large but population small
- Yield of Canada No1, no wild radish: 15.5 t/ha (wild radish did not affect No1 yield)
- Yield of Small potatoes, no wild radish: 10.4 t/ha
- Yield reduction of Small potatoes: 1.6 t/ha for every wild radish plant/m of row in August (average for field)

Potato Yields in Response to Wild Radish Density (Farm A)



Wild Radish in Potatoes: Farm A

Example:

- Average wild radish density: 2 plants/m of row
- Estimated yield reduction of Small potatoes: 3.2 t/ha (29 cwt/ac)
- Estimated economic loss of Small potatoes: $2381/ha ($963/ac) assuming potato price of $0.36/lb

Wild Radish in Potatoes: Farm B

- Each wild radish plant smaller, but higher population
- Yield of Canada No1, no wild radish: 19.8 t/ha (82% of total yield)
- Wild radish did affect No1 yield as well as small potatoes
- Yield reduction of No1 potatoes: 0.425 t/ha (3.74 cwt/ac) for every wild radish plant/m of row in August (average for field)
- Example:
  - Average wild radish density: 7.7 plants/m of row
  - Estimated yield reduction of No1 potatoes: 3.3 t/ha (29 cwt/ac)
  - Estimated economic loss of No1 potatoes: $2618/ha ($1068/ac) assuming potato price of $0.36/lb

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Lamb's Quarters in Potatoes: Farm A

- Lamb's quarters affected No1 and Small grades
- Yield reduction for every wild radish plant/m of row in August (average for field):
  - No1: 0.9 t/ha (8 cwt/ac)
  - Small: 0.547 t/ha (4.9 cwt/ac)
- Ave. lamb's quarters density: 2.4 plants/m of row
- Estimated yield reduction of No1 & Small potatoes: 3.5 t/ha (31 cwt/ac)
  - Estimated economic loss: $2863/ha ($1169/ac) assuming potato price of $0.36/lb

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Managing Wild Radish

Wild Radish: must improve competitive advantage of crop:

1. Reduce population: stale seed bed, pre- and post-emergent weeding
2. Increase seeding rate

Economic threshold will be affected by soil fertility, and other weeds

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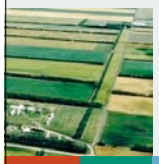
Management of Colorado Potato Beetle in Organic Potato Production

Influence of Fertilization

G. Boiteau[1], D.H.Lynch[2] and R.C. Martin[2]

[1]Agriculture and Agri-Food Canada
[2]Nova Scotia Agricultural College



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Principles of Insect Pest Management in Organic Systems:

- ecologically sound crop production and pest control practices specified by international and national organic production standards
- multiple and varied production and control tactics
- preventive rather than curative solutions

Insect Pest Management Strategies for Organic Crops

Priority 1	Cultural practices compatible with natural processes	Crop rotation Soil management Plant resistance Field isolation
Priority 2	Vegetation management	Enhance natural enemies
Priority 3	Biological control	Inundative releases Inoculative releases
Priority 4	Approved insecticides	Biological origin Mineral origin

Adapted from Wyss et al 2005

Fertilization and Insect Performance

Conventional production:

- Fertilization promotes insect growth by improving the nutritional quality of plants (Bentz et al. 1995).
- Key factor in the generation of pest outbreaks - 75% of 175 studies (Jansson and Smilowitz 1985).
- Synthetic fertilizers reduce natural plant insect defense.

Organic production:

- Healthy soil produces healthy, insect resistant plants (e.g. to Phelan 2004).

Research Objective

Overall objective:

- Determine the relation between fertilizer rates and the abundance of the Colorado potato beetle in an organically produced potato crop.

Experimental Field Setup

Abundance of Colorado potato beetle monitored on:

- Organic potato plots treated with organic fertilizer:
  - zero
  - low (150 kg N/ha)
  - high (300 kg N/ha)
- Conventional potato plots with inorganic fertilizer
  - (150 kg N/ha)

Fertilizer and CPB Abundance

Fertilizer treatments in the organic plots had no significant effect on CPB abundance.

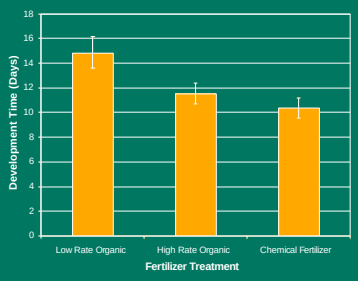
Significant interaction of fertilizer with time on larval abundance.

Experimental Laboratory Setup

- Groups of 5 neonate larvae – field collected
- Terminal leaflets from plants that had received:
  - low organic fertilizer (150 kg N/ha)
  - high organic fertilizer (300 kg N/ha)
  - chemical fertilizer (150 kg N/ha)
- Small ventilated cages
- Mortality and instar of the larvae recorded daily
- Five replicates for each fertilizer treatment

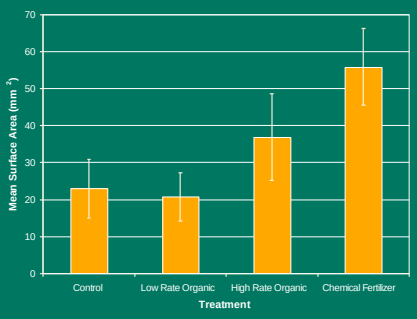
Development Time – CPB larvae

A 22% longer larval development time on plants treated with low fertilizer rate than on plants with high rate was the most significant effect Development time represents the number of days required to develop from first larval instar to the end of the third larval instar.



Leaf Consumption by Adult CPB

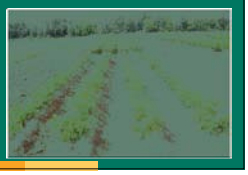
Summer adults spent less time feeding and consumed two to five times less foliage on organic potato than on inorganically fertilized and conventionally produced plants.



Summary

Effect of increased fertilization:

- No increase in CPB abundance
- Peak abundance of larvae shifted forward in time
- Development time increased
- Summer CPB feeding level increased



Conclusion

- Fertilization practices are unlikely to act as a key trigger of CPB pest outbreaks.
- Avoidance of high fertilizer rates may make a secondary contribution to the management of CPB populations.

Acknowledgements

- Envirem Technologies, Fredericton
- NB Department of Agriculture and Aquaculture
- Organic Agriculture Centre of Canada
- Canada Research Chairs Program
- C. Berthélémé, P. MacKinley, K. Nelson and Y. Yu
- PRC Research Farm staff.

Canada

Alternative Methods For CPB Control

- Objective
  - Evaluate the efficacy of
    - Intercropping tansy, flax, marigold, horseradish, and bush beans
    - Commercial plant extract sprays: Hot Pepper Wax™, Garlic Barrier AG®, and Neemix 4.5®
- Participants
  - NSAC – T. Moreau*, P. Warman, J. Hoyle

CPB Control

- Neemix was most effective in reducing CPB numbers and provided a yield benefit
- Intercropping (at a low density) proved ineffective

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Insect Ecology:
Dispersal of the Colorado Potato Beetle

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Insect Ecology:
Dispersal of the Colorado Potato Beetle

Canada

Invasive Insect Pest

Colorado potato beetle:

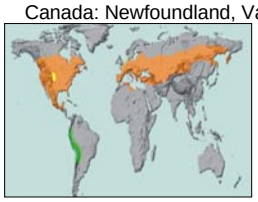
- Entered Canada late 19th century
- Entered Russia mid 20th century
- Distribution increasing globally

Regulated Insect Pest

European Union: UK Ireland, Cyprus and southern parts of Sweden and Finland.

Australia

Canada: Newfoundland, Vancouver Island



Insect Ecology Laboratory

Objectives:

1 - Understanding insect dispersal to

a) reduce field colonization in areas where it is established

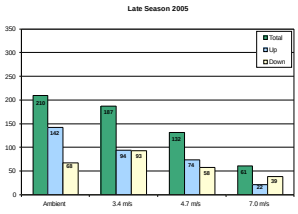
b) reduce risk of invasion in areas where it is not established

2 - Development of tools to monitor and track the insect pest.

Project 1: Impact of wind on flight take-off by CPB

Wind Exposed Flight Activity Cages

- The results show the limiting effect of increasing wind speeds on CPB dispersal by flight
- Wind exposure could prevent dispersal between farms or fields.



Project 2: Monitoring population in flight

- "Harp trap "
- Interception trap monitoring the abundance of Colorado potato beetles in flight within and outside potato fields.

Project 3: Impact of the landscape on CPB dispersal

Field scale

Regional scale

Portable harmonic radar tracking

Developed for Colorado potato beetle

Being adapted for

Plum curculio

Corn rootworm

Brown spruce longhorn beetle