

# Management and Agronomic Benefits of Rotational Crops in Controlling Wireworm

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# A Closer Look at Rotational Crops

- Effect on controlling wireworm
- Effect on total yield
- Effect on controlling other diseases/pests
- Cost of Production
- Different ways to manage/incorporate
- Experience from growers



# A couple of preliminary statements

- Use of biofumigant/rotational crops has not been shown to be the “silver bullet” in control of wireworm.
- Can serve as a part of an **IPM approach**, along with tillage practices, insecticide use, and variety selection.



# A couple of preliminary statements

- Whether you choose to incorporate biofumigant crops into your rotation and how you manage them will be based on:
  - Severity of wireworm in your fields (Measure It!)
  - Effectiveness of insecticide
  - Soil health and soil structure
  - Pressure from other diseases/pests (Vert, nematodes, etc)



# A couple of preliminary statements

- This presentation will not recommend a simple Best Management Practice (BMP) for all producers; rather, it will present options for you to consider adapting for your farm, based on previous research and experience working with biofumigant crops by Island potato farmers.



# Effect on Controlling Wireworm

Research by Dr. Noronha (2007-2010)

Crop Preceding Potatoes	Total Yield cwt/acre	Marketable Yield cwt/acre
Barley	417	265
Brown Mustard	402	397
Buckwheat	405	379

No insecticide used

Marketable Yield for Processing used as standard

Double Crop of Mustard/Buckwheat for two years in this study

No Sig. Diff. for Total Yield

Sig. Diff for Marketable Yield for Processing



# Effect on Controlling Wireworm

- It is theorized that mustard and buckwheat are less-preferred host crops for click beetles to lay eggs.
- **Root mass** of brown mustard **exudes chemicals** that may impact wireworms.
- Action of biofumigant gases plus tillage destroys eggs and neonate wireworm larvae.



# Effect on Total Yield

Research by Dr. Ganga – Cavendish Farms (2013)

Crop Preceding Potatoes	Total Yield cwt/acre
Barley	256
Treated Wheat	277
Untreated Wheat	319
Mustard (Caliente 199)	340
Mustard + Nemat	351
Buckwheat	386

Study showed **significant reductions in holes/tuber and in the percentage of non-marketable tubers** in the plots when Mustard and Buckwheat were grown before potatoes.





# Effect on Other Diseases/Pests

- Dr. Bob Larkin, USDA, Maine (2004-2012)
- Compared 5 different type of potato rotations, including:
  - **SQ - Status Quo (2yr):**  
Potato / Barley (Clover underseed)
  - **SC - Soil Conserving (3yr):**  
Potato / Barley (Timothy underseed) / Timothy  
Limited Tillage, Mulched Straw and Timothy
  - **DS - Disease Suppressive (3yr):**  
Potato / Mustard (rapeseed cover) / Sudangrass (rye cover)



# Effect on Other Diseases/Pests

- After two full rotations (6 years):
  - DS rotation was **not significantly different for Total Soil Carbon** versus SC and SQ
  - DS rotation **yielded approximately 35 cwt/ac more total yield** than SC and SQ (sig. diff)
  - DS rotation **showed reduction in incidence of both black scurf (Rhizoctonia) and common scab** when compared with the SC and SQ rotations (sig. diff)



# Effect on Other Diseases/Pests

- Both Brown Mustard and Caliente Mustard blends contain **glucosinalates**.
- In the presence of moisture, these breakdown to form a gas that kills bad actors in soil.
- It is believed that this may have a beneficial effect in combatting:
  - *Verticillium*
  - Root lesion nematodes
  - Rhizoctonia
  - Common Scab



# Cost of Production

- Variable Cost Breakdown presented last year by Dr. Ganga

Variable Cost	Buckwheat	Caliente Mustard	Brown Mustard	
Seed	50	60	24.50	
Fertilizer	40	40	40	
Planting	12	12	12	
Herbicide	12	12	12	
Mulching/ Incorporation	27	18	18	
<b>Total</b>	<b>\$141.00</b>	<b>\$142.00</b>	<b>\$106.50</b>	



# Cost of Production

- Variable Cost Breakdown presented last year by Dr. Ganga

Variable Cost	Buckwheat	Caliente Mustard	Brown Mustard	Forage Mix
Seed	50	60	24.50	??
Fertilizer	40	40	40	??
Planting	12	12	12	??
Herbicide	12	12	12	??
Mulching/ Incorporation	27	18	18	??
<b>Total</b>	<b>\$141.00</b>	<b>\$142.00</b>	<b>\$106.50</b>	<b>??</b>



# Cost of Production

- While it is very likely that green manure crops like mustard and buckwheat have higher per acre production costs than forage crops like clover and ryegrass, it is important to acknowledge that there are **still costs associated with growing forage crops.**
- **The key consideration:** will the benefits associated with biofumigant/disease suppression green manure crops outweigh the additional cost to grow them.



# Cost of Production

- Variable cost estimates by another grower for growing brown mustard also was in the \$115-\$120 per acre range, not including spring tillage.
- If you are growing a legume/grass crop in rotation and not selling a hay crop, incorporating a biofumigant crop may hold benefits.
- Suit fertilizer application to crop needs.



# Different Management Techniques

- A number of Island farmers are already incorporating biofumigant/green manure crops into rotations in a number of different ways:
  - Double cropping
  - Plant mustard in early season, incorporate in mid-summer, follow with cover crop
  - Fallow land until early summer, then plant mustard, incorporate in early fall.
  - Plant mustard early in season, clip/mulch multiple times during growing season before seed formation, fall incorporation





# Different Management Techniques



# Grower Experiences

## Klondike Farms, Wilmot Valley

- Using mustard off and on for 5 years
- Only incorporated one year. Other years:
  - Clipped through the growing season
  - Underseeded barley with brown mustard (2 years)
- When using as green manure, planted in early/mid June and incorporated in late July with Lemken.



# Grower Experiences

## Klondike Farms, Wilmot Valley

- Centennial brown mustard: Seeding rate 10-12 lbs/ac
- Fertilizer: 200 lbs/ac of 22:11:11
- Results:
  - *Verticillium* populations appear to be lower in soil samples following brown mustard
  - Saw fewer weeds the next year (in potatoes) where we incorporated versus where we clipped... virtually no weeds!



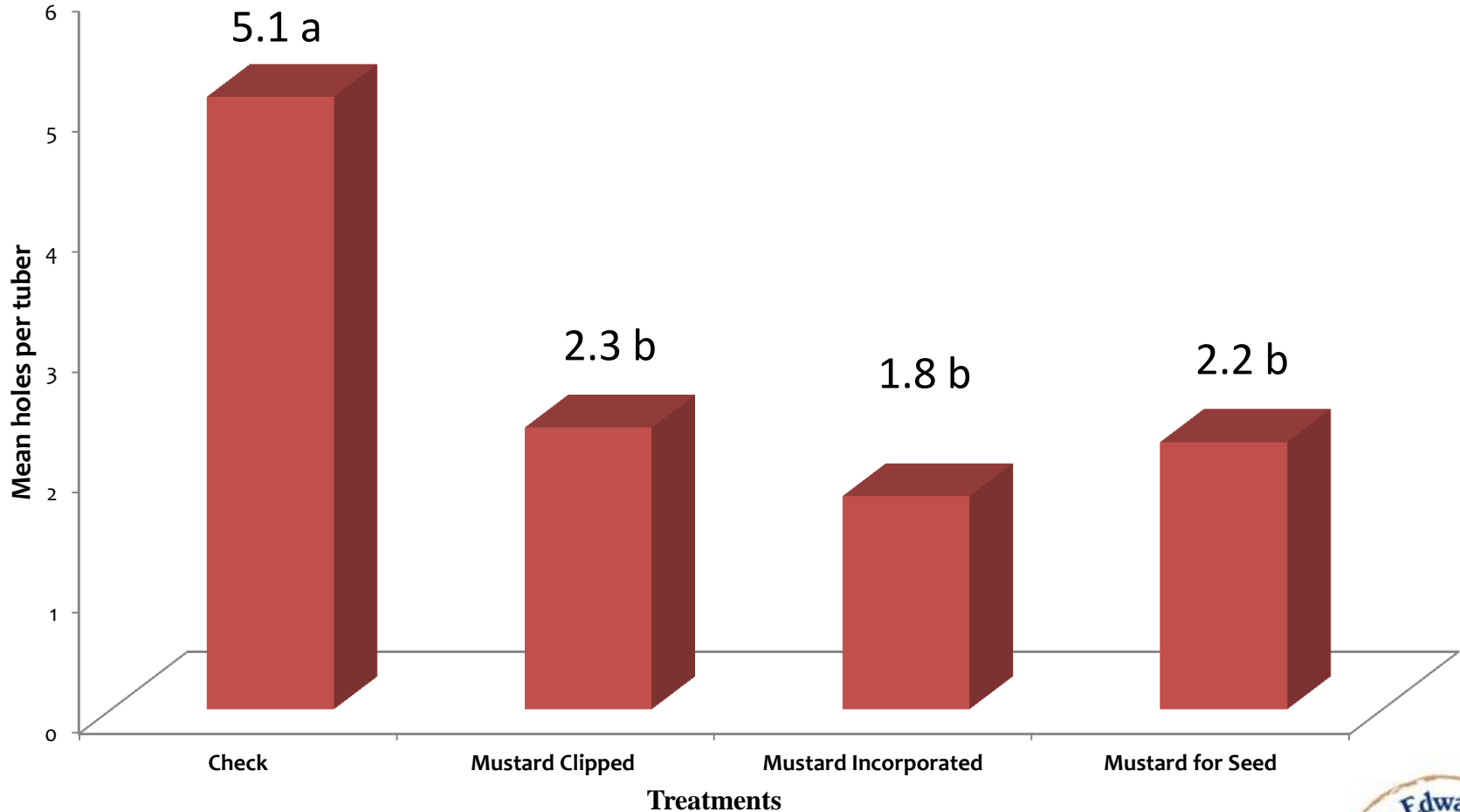
# Grower Experiences

## Klondike Farms, Wilmot Valley

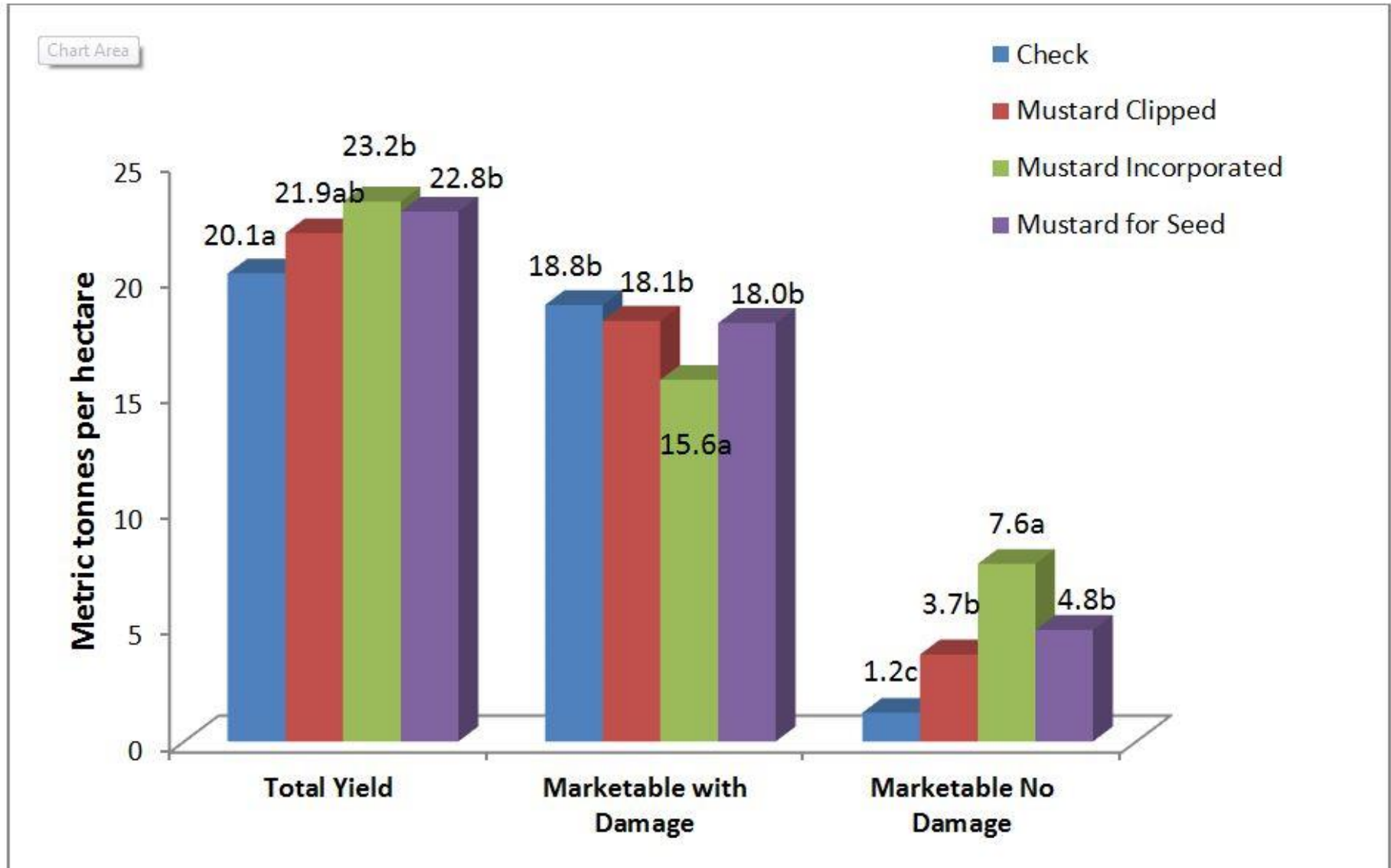
- Project with Dr. Noronha, AAFC
  - Large field
  - 4 Treatments:
    - Control
    - Mustard clipped through the season, worked the next spring
    - Mustard incorporated that summer
    - Mustard left to grow for seed, harvested the seed.
  - Measured # of holes/tuber as well as marketable yield.



# Grower Experiences



# Grower Experiences



# Grower Experiences

## GW & R Visser & Sons, Orwell

- Working with mustard the past two years on a trial basis
- Traditional rotation has included potatoes, winter wheat, soybeans and spring wheat.
- Estimate Mustard to cost approx \$191/acre, including:
  - Fertilizer (product + application) = \$75
  - Seed (product + application) = \$66
  - Pre-plant tillage = \$15
  - Mowing & Incorporation = \$35



# Grower Experiences

## GW & R Visser & Sons, Orwell

- 2014
  - Seeded buckwheat in mid-June
  - Incorporated buckwheat in mid-July
  - Re-seeded with brown mustard (Centennial)
  - Mulched with flail mower and incorporated with discs and mulch finisher in mid-September





# Grower Experiences

## GW & R Visser & Sons, Orwell

- 2015
  - Seeded mustard in mid-July
  - Mulched and incorporated with Karat in mid-Sept
  - Followed with mulch finisher 2 weeks later
  - Last year, the season was quite late in starting. In a normal year, we would like to seed and incorporate earlier, so that we are working soil at time eggs are hatching
  - Theory behind the 2<sup>nd</sup> tillage was to take out late hatched eggs and to take another rip at small wireworms



# Grower Experiences

## GW & R Visser & Sons, Orwell

- Planted a few of these green seeds at home to see if they would grow... they did not.
- Incorporating while seeds are still green should avoid issues with mustard regrowing as a weed.



# Grower Experiences

## GW & R Visser & Sons, Orwell

- 2015 Split Field trial with Cavendish Farms:

	Wheat	Buckwheat	Mustard
% Weight with Zero Holes	62.8%	67.7%	69.4%
% Marketable Weight with Holes	35.8%	30.6%	29.3%
% Unmarketable Weight	1.4%	1.8%	1.4%
Average # of early holes/tuber	0.08	0.11	0.08
Average # of late holes/tuber	0.60	0.42	0.38
Average # of total holes/tuber	0.67	0.52	0.46

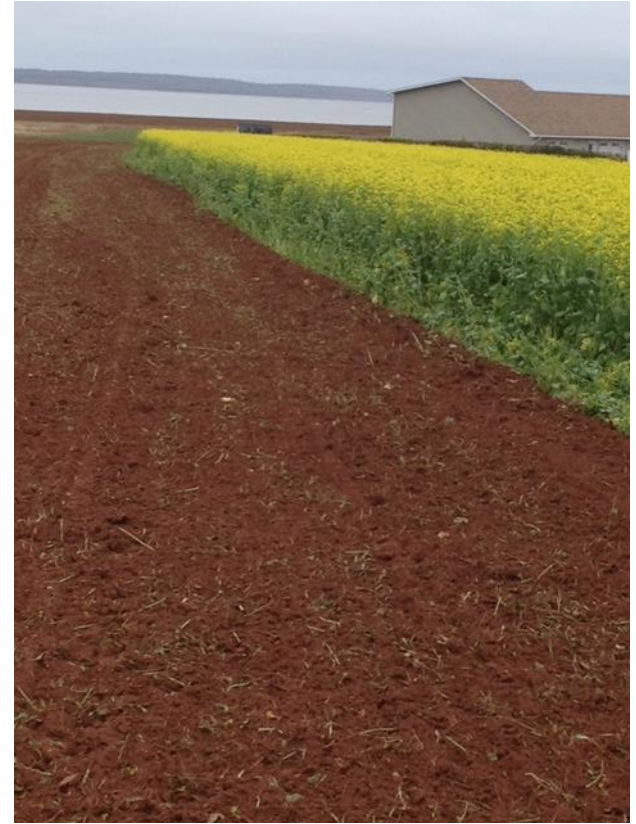
No sig. diff in yield, but best crop value on potatoes following mustard.



# Grower Experiences

## GW & R Visser & Sons, Orwell

- In 2016, we plan to look at the effect of two years of back to back mustard vs 1 year mustard vs control
- Also want to look effect of leaving land fallow (1 yr and 2 yr)



# Summary

- Biofumigant/Green Manure crops like mustard and buckwheat appear to be having an effect for some growers.
- There is a lot more to learn about how to best manage these crops.
- There is **flexibility** to incorporate these crops into your rotations depending on wireworm pressure, rotation specifics, other soil health/pest considerations
- These crops are used in other countries to combat *Verticillium*, nematodes, scab, etc.



# Special Thanks to Contributors

- Dr. Christine Noronha, AAFC
- Dr. Zenaida Ganga, Cavendish Farms
- Klondike Farms (John Hogg)
- Gerrit Visser & Sons (William Visser)
- Brian Beaton and Angela Hughes, PEIDAF
  
- All members of the PEI Wireworm Research Working Group.



# Summary

- **Phased-in Approach**...what about trying your hardest affected fields first?
- If you are interested in measuring effectiveness, **leave a check strip!**
- **If interested in doing a trial**, reach out to me or one of the researchers on the Wireworm Research Working Group.



# Thank You and Questions



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