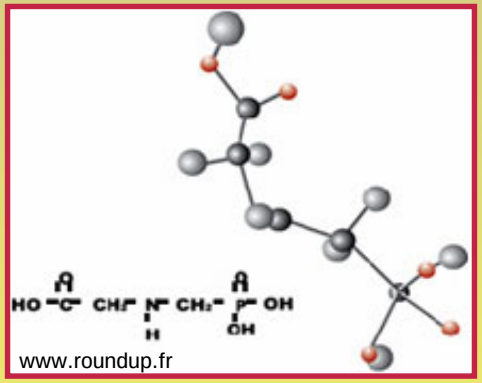
Effect of glyphosate on fusarium head blight in wheat and barley under different soil tillages



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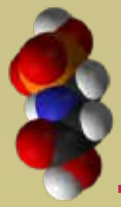
National Fusarium Head Blight Forum
December 7th – 9th 2014
St. Louis, Missouri

Introduction

- Fusarium head blight (FHB) : important disease in wheat and barley
  - Wet conditions in Eastern Canada
- Principal pathogen associated with FHB : *Fusarium graminearum*
  - Production of deoxynivalenol (DON)
- Surveys conducted by Fernandez *et al.* (2005, 2007)
  - Glyphosate application the year before wheat or barley crops
    → higher FHB levels



Objective

To determine the effect of glyphosate, used on soybean as the previous crop, on FHB intensity in wheat and barley and on *F. graminearum* inoculum production under three different soil tillages: mouldboard plow, spring tillage and direct drilling

Material and methods

- Six trials
  - Two cereal species : wheat and barley
  - Three soil tillages: mouldboard plow (MP), spring tillage (ST) and direct drilling (DD)
- Two experimental stations
  - Saint-Augustin-de-Desmaures (Quebec City area) = 2800 degree-days
  - Saint-Mathieu-de-Beloeil (Montreal area) = 3270 degree-days
- Experimental design: split-plot
  - Main plots: two different herbicide treatments (glyphosate, no glyphosate) implanted the first year on Roundup Ready™ soybean
  - Subplots: three wheat and three barley cultivars with distinct FHB resistance levels, implanted the second year

Material and methods

- In each main plot: two Petri plates facing the ground containing a *Fusarium*-selective medium
- Daily collecting of Petri plates for approximately five weeks (beginning around June 15th)
- Transferring of the strains on an identification medium for *Fusarium* spp.
- Identification and counting of colony-forming units (CFU)

Results and discussion

FHB index and *Fusarium*-damaged kernels (FDK) – wheat, 2007/2008

Saint-Augustin-de-Desmaures

		Herbicide			
Variable	Soil tillage	Glyphosate		No glyphosate	
FHB index	MP	3.1	a	2.9	a
	ST	6.4	a	6.3	a
	DD	3.5	a	3.6	a
FDK	MP	6.7	a	8.0	a
	ST	8.5	a	8.2	a
	DD	7.3	a	8.7	a

Saint-Mathieu-de-Beloeil

		Herbicide			
Variable	Soil tillage	Glyphosate		No glyphosate	
FHB index	MP	12.1	a	12.1	a
	ST	8.3	a	8.1	a
	DD	6.7	a	6.2	a
FDK	MP	15.0	b	17.6	a
	ST	16.6	a	16.0	a
	DD	10.1	a	10.7	a

MP = mouldboard plow; ST = spring tillage; DD = direct drilling.

Results and discussion

DON content (ppm) – 2007/2008

Saint-Augustin-de-Desmaures

Trial	Soil tillage	Herbicide			
		Glyphosate		No glyphosate	
Wheat	MP	2.2	a	2.4	a
	ST	1.5	a	1.6	a
	DD	2.4	a	2.6	a
Barley	MP	0.8	a	1.0	a
	ST	0.9	a	0.6	a
	DD	Interaction herbicide x cultivar			

Saint-Mathieu-de-Beloeil

Trial	Soil tillage	Herbicide			
		Glyphosate		No glyphosate	
Wheat	MP	9.0	a	9.1	a
	ST	8.3	a	8.1	a
	DD	6.2	a	6.5	a
Barley	MP	5.2	a	5.2	a
	ST	4.1	a	5.4	a
	DD	3.2	a	3.3	a

MP = mouldboard plow; ST = spring tillage; DD = direct drilling.

Results and discussion

DON content (ppm) – interaction herbicide x cultivar in barley-DD trial (Saint-Augustin; 2007 / 2008)

	Herbicide			
Cultivar	Glyphosate		No glyphosate	
Oceanik	0.36	b	0.48	ab
Raquel	0.65	a	0.36	b
Perseis	0.46	ab	0.53	ab

Results and discussion

- Herbicide effect on FHB index, FDK and DON content in wheat grains:
  - No significant effect on FHB index and DON content, whatever the trial considered
  - A significant effect on FDK (MP trial at Saint-Mathieu): higher value for the no glyphosate treatment
- Herbicide effect on DON content in barley grains:
  - No significant effect, but a herbicide x cultivar interaction for DD trial at Saint-Augustin: higher DON content in Raquel with glyphosate treatment
  - Linked to the *F. graminearum* inoculum production?

Results and discussion

Daily mean number of *F. graminearum* (CFU day^{-1}) – 2007/2008

Saint-Augustin-de-Desmaures

Trial	Soil tillage	Herbicide			
		Glyphosate		No glyphosate	
Wheat	MP	Interaction herbicide x year			
	ST	0.53	a	0.43	a
	DD	Interaction herbicide x year			
Barley	MP	0.70	a	0.96	a
	ST	0.44	a	0.44	a
	DD	0.37	a	0.26	a

Saint-Mathieu-de-Beloeil

Trial	Soil tillage	Herbicide			
		Glyphosate		No glyphosate	
Wheat	MP	1.63	a	1.61	a
	ST	1.08	b	1.44	a
	DD	1.11	a	0.97	a
Barley	MP	1.22	a	1.00	a
	ST	0.57	a	0.91	a
	DD	0.85	a	0.68	b

MP = mouldboard plow; ST = spring tillage; DD = direct drilling.

Results and discussion

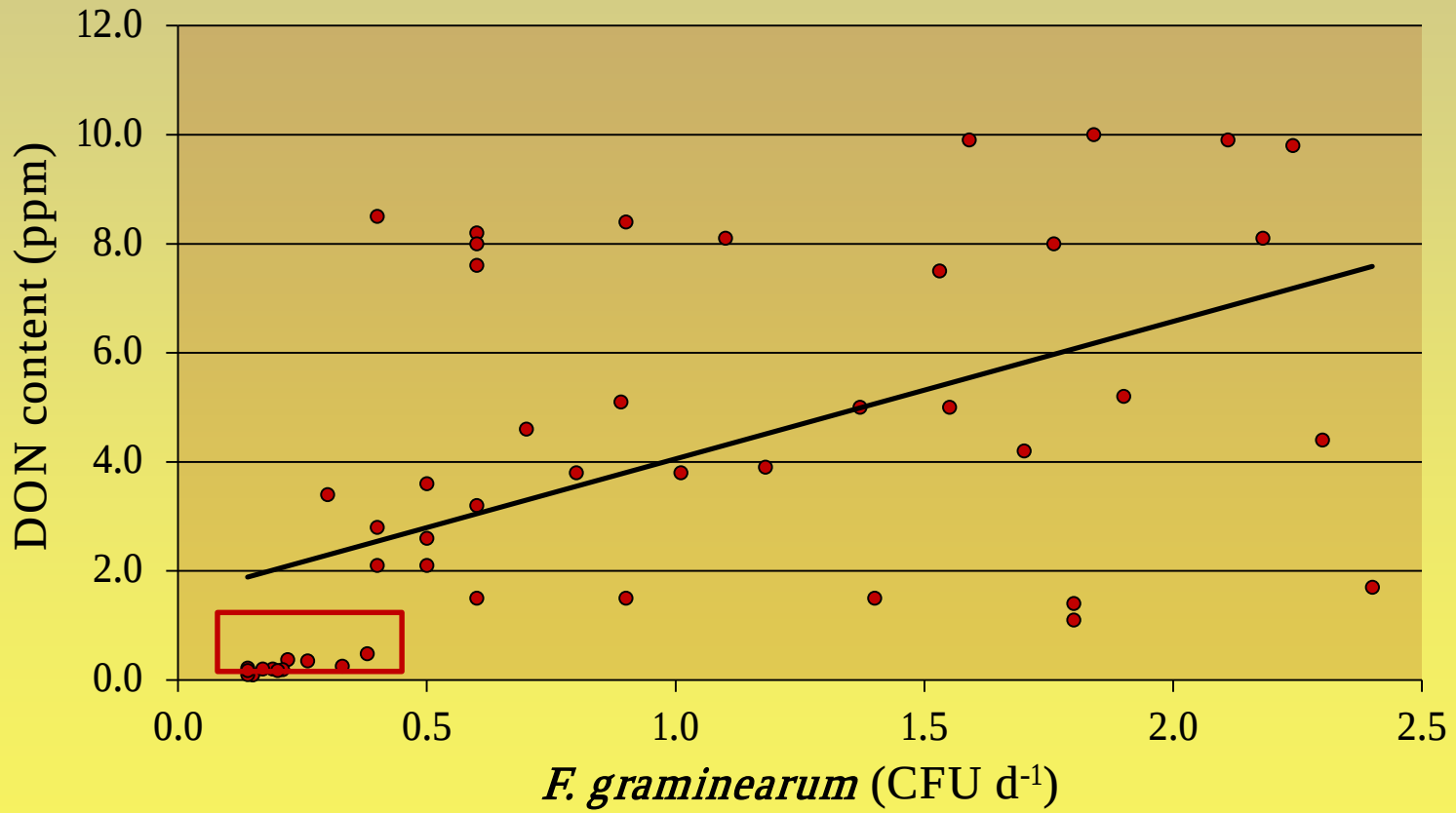
Daily mean number of *F. graminearum* CFU
Interaction herbicide x year in wheat-MP and wheat-DD trials (Saint-Augustin)

		Herbicide			
Soil tillage	Year	Glyphosate		No glyphosate	
MP	2007	0.23	a	0.21	a
	2008	1.69	b	2.22	a
DD	2007	0.15	a	0.14	a
	2008	0.77	a	1.84	a

MP = mouldboard plow; DD = direct drilling.

Results and discussion

Relationship between the daily mean number of *F. graminearum* CFU coming from crop residues during the critical period of infection and DON content



Results and discussion

- Herbicide effect on *F. graminearum* inoculum production
  - A significant effect for only 2 of 12 trials (wheat-ST and barley-DD trial at Saint-Mathieu): higher value with glyphosate treatment only in barley-DD trial
  - No significant effect on the barley-DD trial at Saint-Augustin, despite a significant effect of glyphosate on DON content in Raquel cultivar
  - Herbicide x year interactions: a significant effect of no glyphosate treatment in only one trial (wheat-MP, 2008)
- Relationship between *F. graminearum* inoculum production and DON content
  - Significant, but weak relationship
  - When smallest DON content values removed : relationship no more significant

Conclusions

- Globally, there is no significant effect of glyphosate on FHB intensity and *F. graminearum* inoculum production under Quebec conditions, whatever the soil tillage or the cereal species

- Precipitations may have caused leaching of glyphosate out of the soybean residues, but this hypothesis can't be confirmed since glyphosate residue level was not quantified

- Herbicide effect, if present, is reduced by the prevalence of factors more associated with the development of the disease : weather conditions, previous crop susceptibility or cultivar susceptibility

Acknowledgments

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MAPAQ

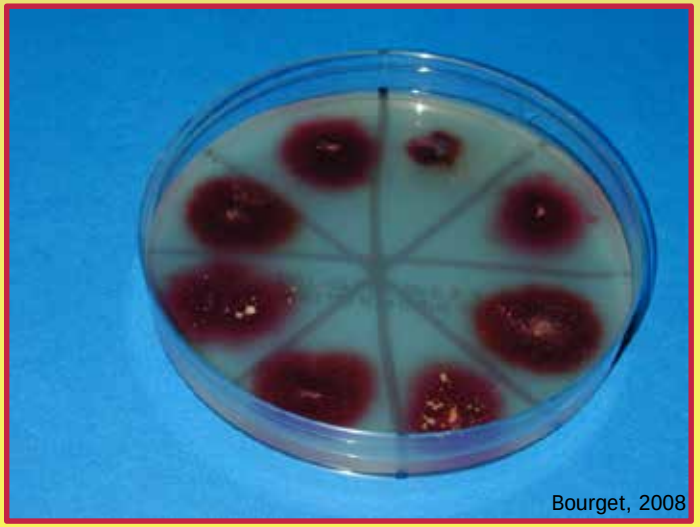
NSERC

US Wheat and Barley Scab Initiative

Thank you for your attention!


Bérubé, 2009


Bérubé, 2008


Bourget, 2008

Other results

DON content (ppm) – Saint-Mathieu-de-Beloeil, 2008

		Cultivar					
Cereal	Soil tillage	AC Barrie		Orleans		SS Fundy	
Wheat	MP	5.2	b	5.5	b	13.6	a
	ST	5.5	b	6.6	b	12.9	a
	DD	5.2	b	5.6	b	12.6	a
		Oceanik		Raquel		Perseis	
Barley	MP	1.6	c	2.2	b	2.6	a
	ST	2.3	c	3.4	b	4.0	a
	DD	1.6	c	3.0	b	3.4	a

MP = mouldboard plow; ST = spring tillage; DD = direct drilling.

$P = < 0{,}001$