

# Grafted tomatoes and colored



## pepper projects Journée Bio Action - 3

ACORN



November 2015

*Christine Villeneuve, agr.*  
MAPAQ Ste-Martine

# Remerciements



- « Les projets sur **le greffage** ont été réalisés grâce: Programme Innov'Action agroalimentaire, un programme issu de l'accord *Cultivons l'avenir 2* conclu entre le MAPAQ et AAC
- PADAAR , un programme régional du MAPAQ



**Cultivons l'avenir 2**  
Une initiative fédérale-provinciale-territoriale

**Canada**

**Québec**

- ✓ Les Fermes : Potager Mont- Rouge, Maraîchers PA Cousineau, Ferme Régil
- ✓ Catherine Girard, Dura Club
- ✓ Nadia Surdek et Morgane Laperle, PleineTerre
- ✓ Caroline Provost et Steve Lamothe, CRAM
- ✓ Gilles Turcotte, Agrysis

Grafting : joining the top part of one plant (scion= commercial variety) to the root system of another plant (rootstock ex : Maxifort)

2013/2014

4 plots with field tomatoes

2014/2015

1 plot in multi-bay high tunnel CRAM

**Our main objectives for grafting ; getting a different rootstock:**

- 1-Better root system that promotes vegetative growth and enhance plant capacity to produce fruits**
- 2- Control soil diseases pathogens in production system with limited rotation**



Rootstock Maxifort : worldwide reference and popular in Quebec greenhouse

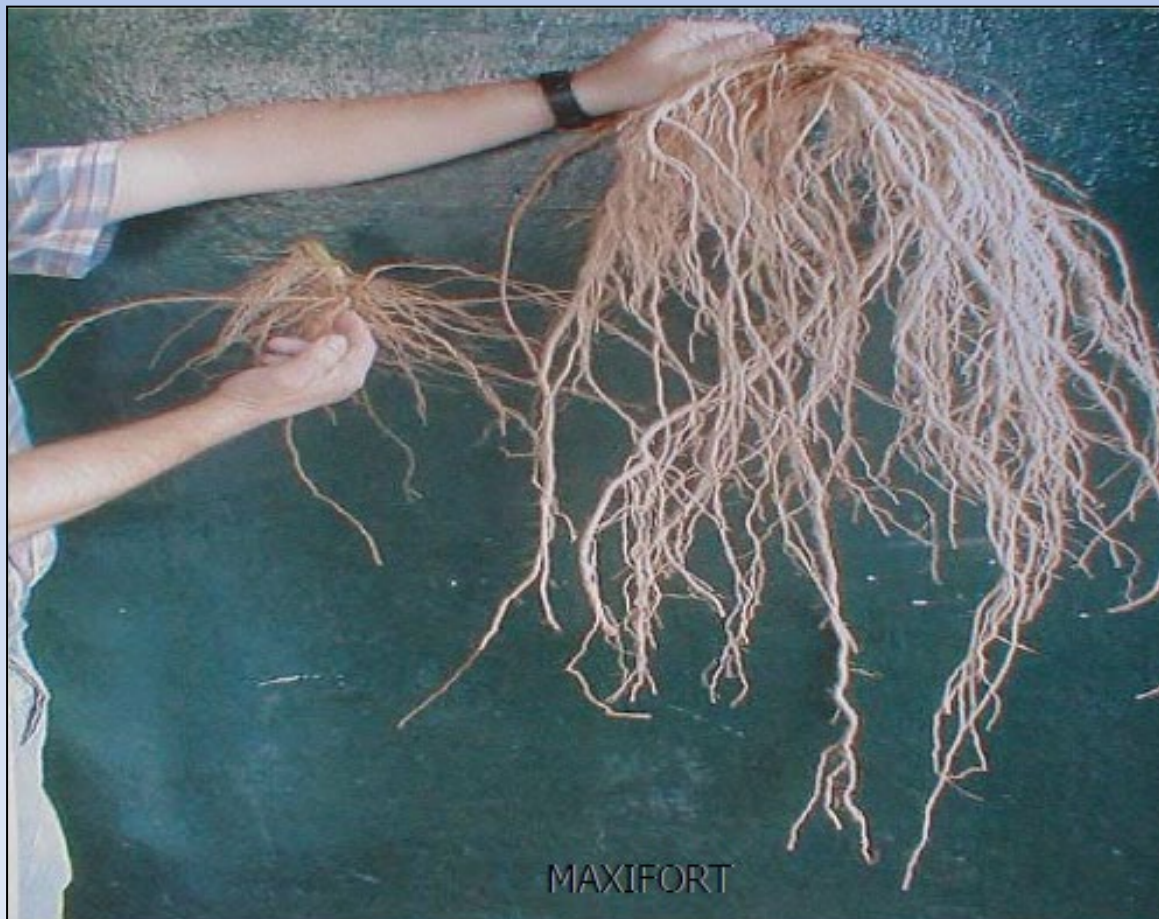
Rootstock	Corky root (Pl)	Fusariose Vasculaire (FOL)	Fusariose racinaire (FORL)	Verticilliose (Va et Vd)
<b>Emperador (RZ)</b>	HR	HR	HR	HR
<b>Maxifort (Monsanto)</b> Tolerate big temperature soil range (cold to warm)	HR	HR	HR	HR
<b>Estamino (EZ)</b>	RI	HR	HR	HR
<b>Arnold (Syngenta)</b>	-	HR	HR	HR

**HR : highly tolerant RI : intermédiaire tolerance**

# The advantages

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- ✓ Better root system → water / Nutrients



## GRAFTING

LECTURE GIVEN BY:

Cathrin Steenhoek  
On August 25<sup>th</sup>, 2003  
In Leamington, Ont

Gilles Turcotte, Agrysis



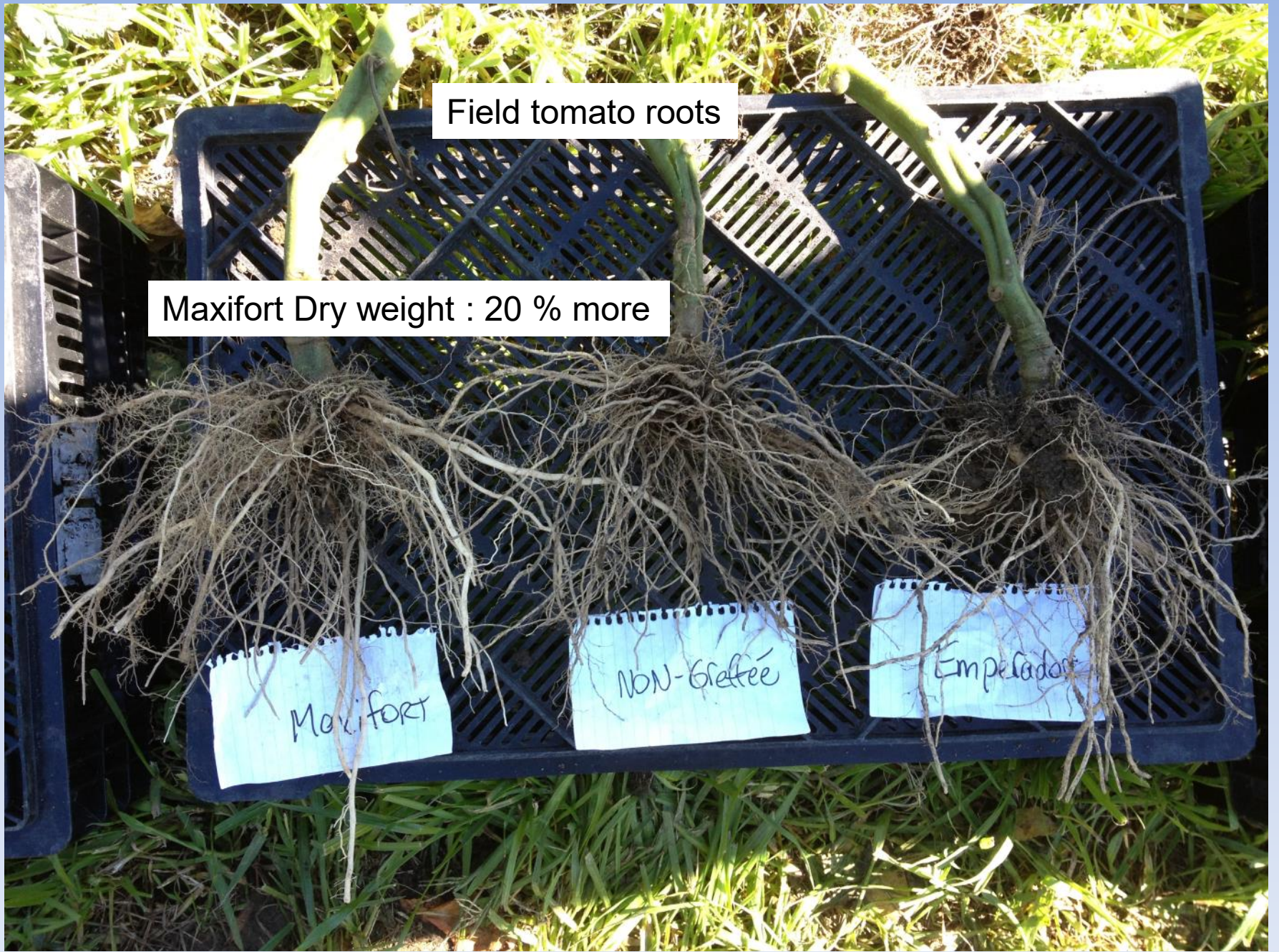
Field tomato roots

Maxifort Dry weight : 20 % more

Maxifort

NON-Greffée

Empelador





Steve Groff, Cedar Meadow Farm



Around 1 ft higher for grafted plants



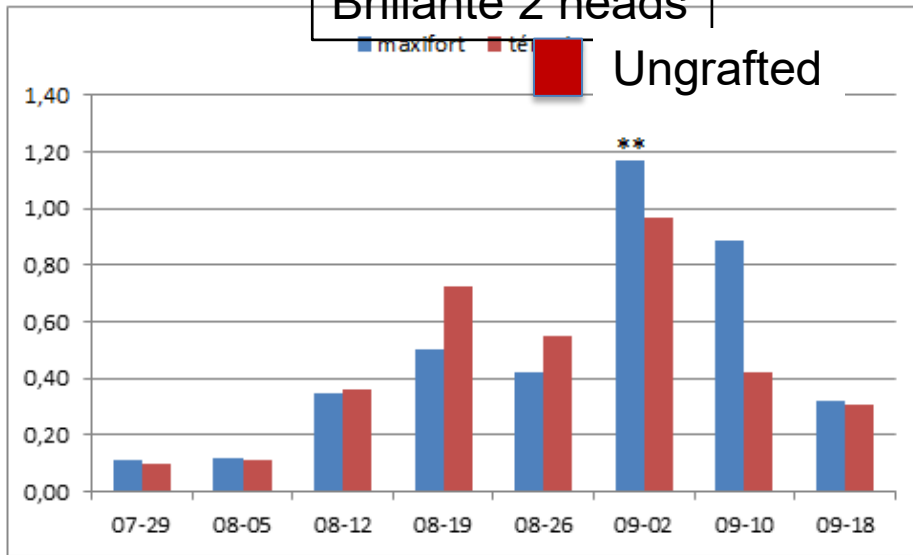


# Effect of grafting field tomato Brillante on Maxifort

Rendement qualité #1 kg/m2			% yield augmen- tation	spacing	training
	ungrafted	grafted			
Ferme A - 2013					
Champ 1	4,5	6,2	38%	18 "	multihead
Champ 2	1,95	3,5	80%	18 "	multihead
Ferme B - 2014					
Champ 1	4,4	4,8	9%	21 "	2 heads
Ferme C - 2014					
Champ 1	7,6	11,5	51%	18 "	multihead

Merci à Nadia Surdek, Pleine Terre  
 Catherine Girard, Dura Club  
 Ferme Régil, Potager Mont Rouge et Maraîchers PA Cousineau

## Brillante 2 heads

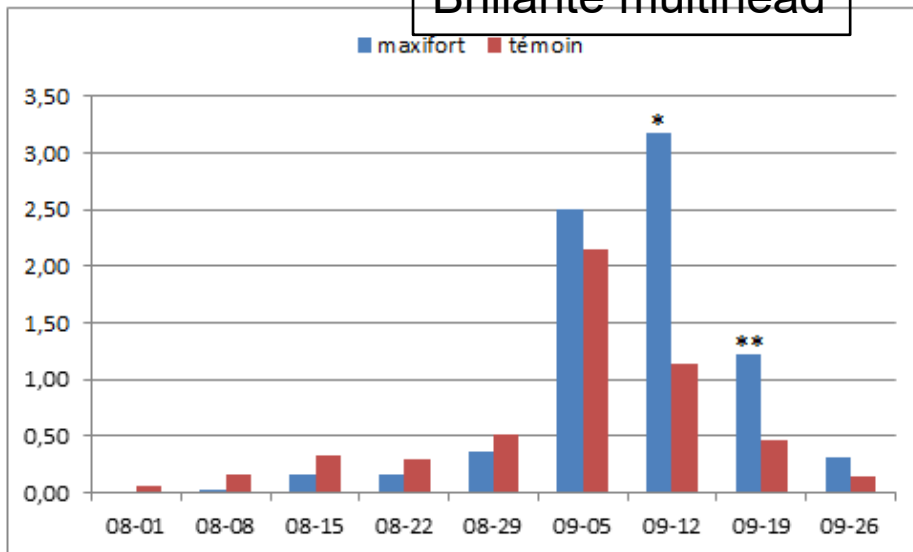


**Figure 1. Rendements hebdomadaires moyens (kg No 1/plant), Site A, 2014.**

\* Anova : intervalle de confiance à 95%

\*\* Anova : intervalle de confiance à 90%

## Brillante multihead



**Figure 2. Rendements hebdomadaires moyens (kg No 1/plant), Site B, 2014.**

\* Anova : intervalle de confiance à 95%

\*\* Anova : intervalle de confiance à 90%

If earliness is important try the training on 2 heads of an appropriate variety.  
Grafting can delay earliness and this is a major issue in short production system: field and high tunnel.

No pruning = vegetative growth  
Grafted plants should be pruned to encourage earliness

# Rentability of grafting field tomato Brillante on Maxifort

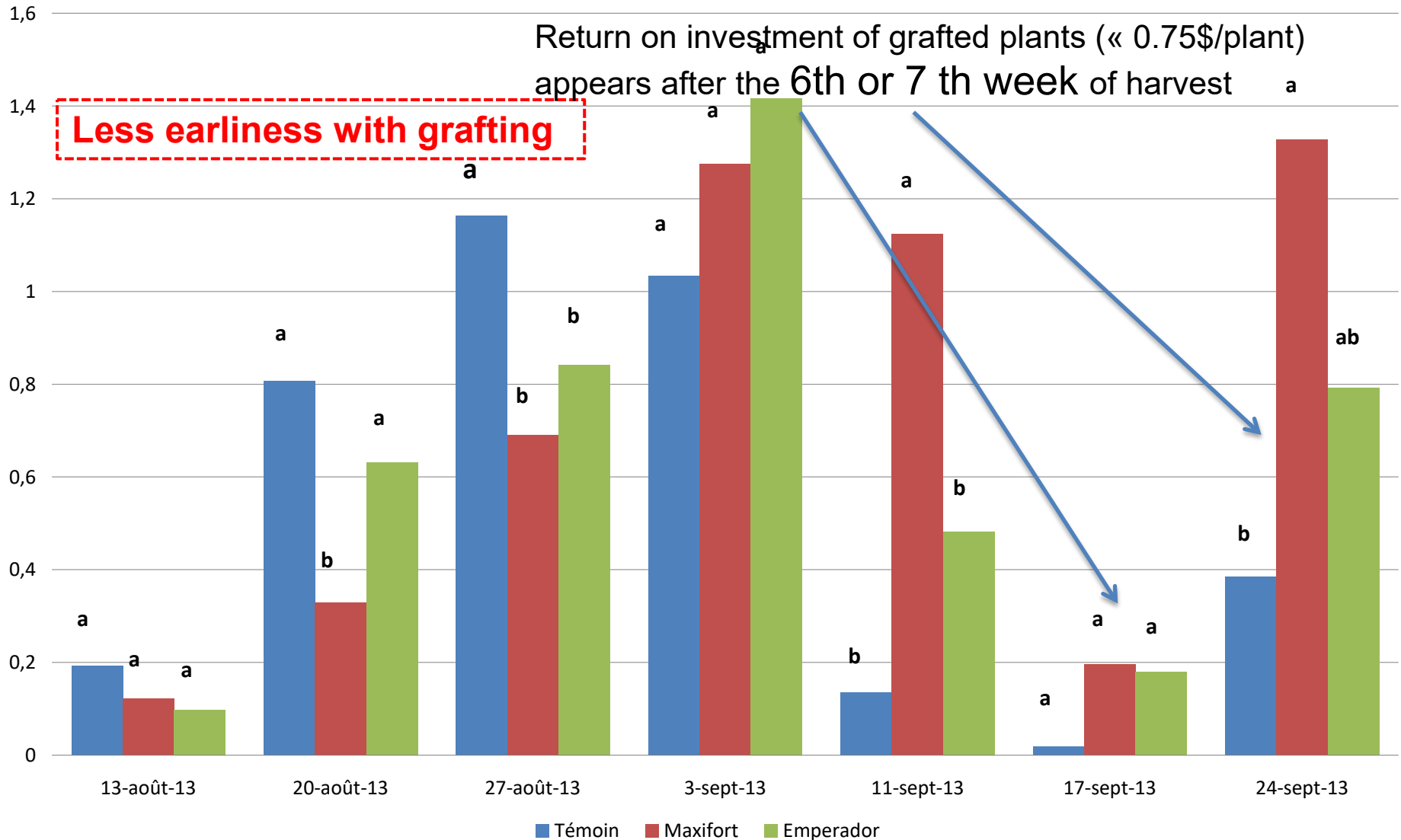
Wholesale Price per 20 lbs of tomatoes  
2014

3 first weeks	16 \$
1 week transition	14 \$
4 last weeks	12 \$

<b>Rendement qualité #1 kg/m2</b>			% yield augmen tation	Net revenu/ ha
	ungrafted	grafted		
<b>Ferme A - 2013</b>				
Champ 1	4,5	6,2	38%	1 040 \$
Champ 2	1,95	3,5	80%	5 454 \$
<b>Ferme B - 2014</b>				
Champ 1	4,4	4,8	9%	no rentabilit
<b>Ferme C - 2014</b>				
Champ 1	7,6	11,5	51%	21 528 \$

# Yield Evolution of Grafted Tomatoes Plants

Ferme A : Summer 2013 same scénario for others farms in 2014



# CRAM – 2014 Grafting project/ Multi-bay High Tunnel « Harnois »

**CRAM**

Centre de recherche  
agroalimentaire de Mirabel

9850, rue de Belle-Rivière, Mirabel, Québec, J7N 2X8

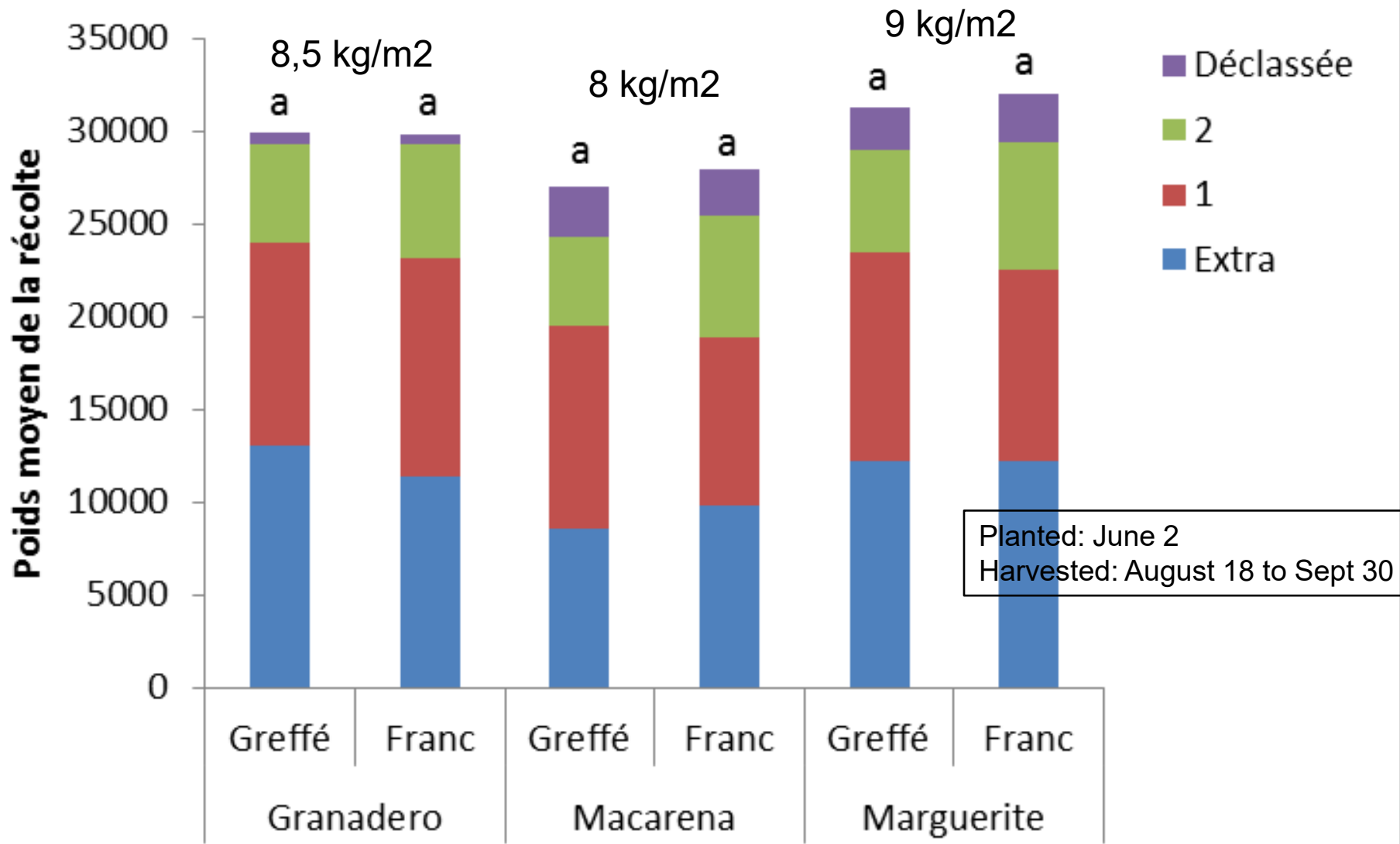




Gilles Turcotte, Agrysis

- Two heads transplants:  
pinch over the first two  
leaves.

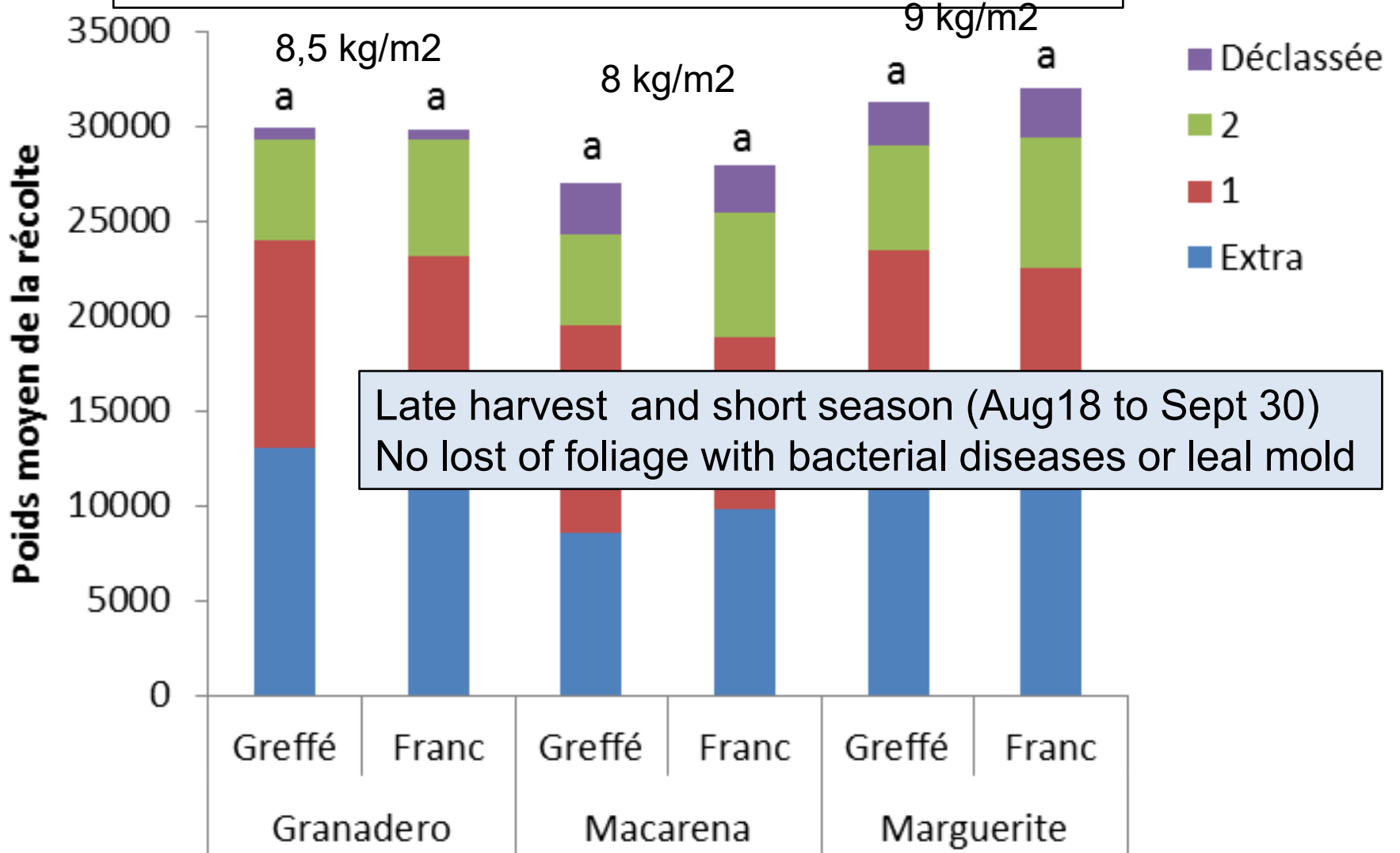
# 2014 : CRAM Effect of grafting 3 tomato varieties in Multi-bay High Tunnel



Extrait rapport : Steve Lamothe, CRAM

45 cm x 152 cm  
2,9 heads/m<sup>2</sup>  
1,5 plants/m<sup>2</sup>

2014 : CRAM Effect of grafting 3 tomatoes varieties in Multibay High tunnel



Extrait rapport : Steve Lamothe, CRAM

45 cm x 152 cm  
2,9 tiges/m²  
1,5 plants/m²



# Rootstocks are not silver bullet against soil pathogens

Brillante on Maxifort 2013  
*Colletotrichum* no rootstock tolerant  
*Verticillium dahliae* (strain?)  
*Pythium* sp (strain



*Brillante / Maxifort / Aug 2013*



*Colletotrichum coccodes* on tomato roots

***Rootstocks are not silver bullet against soil pathogens***



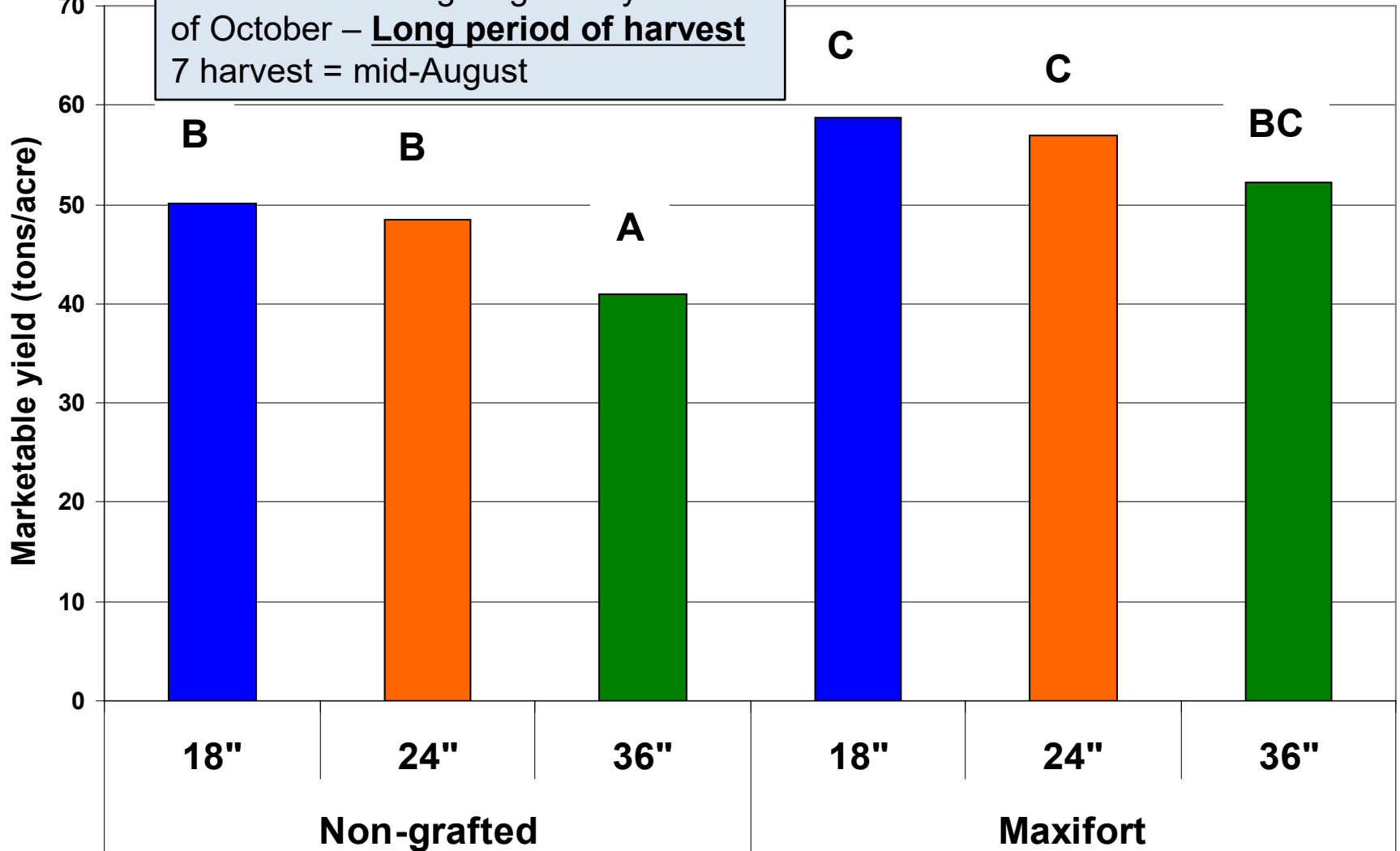
***Colletotrichum, Plectosporium- no rootstock  
Pythium sp (différent race )  
We probably have our local races of soil pathogens, sometimes  
rootstocks work but most of the times are not developed for our  
particularities. It could be different in greenhouses***



**Steve Groff**  
**Cedar Meadow Farm**  
**Holtwood, Pennsylvania**

# Marketable Fruit Weight

Planted around April 20  
Harvest : from begining of July to end of October – **Long period of harvest**  
7 harvest = mid-August

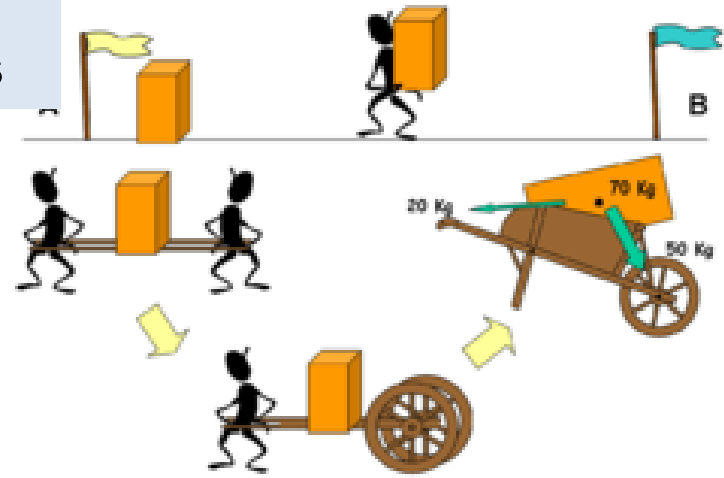


Steve Groff, Cedar Meadow Farm

LSD based on P=0.05

High tunnels have to be moved because of high soilborne disease pressure in tomatoes

Le « détournement de production »



tomate

tomate

tomate

tomate

tomate

Steve Groff  
Cedar Meadow Farm  
Holtwood, Pennsylvania

## You may consider grafting tomatoes in high tunnels if :

- The site is highly contaminated with soil pathogens and has a good biological activity. Most of the times, rootstocks are not adapted to our local strains of pathogens
- Planting and harvest are early and realized on a long period (> 7 weeks)
- Tomatoes varieties are pruned and trained on few heads because grafting delays earliness. Not all varieties are suited to intense pruning.
- The extra need for irrigation and fertilisation should be considered.





## Colored pepper demonstration projects

- Variety trials - 2014
- White plastic mulches in pathways
- Retractable tunnel shelters



Thank you to all collaborators, who inspired the content of this presentation.

- Many agrologists, including Sophie Guimont (Bio Action).
- All the growers that contributed their time and their land.
- Le CETAB (Anne Weill).
- Gilles Turcotte, Consultant Agrysis.
- Morgane Laperle, Pleine Terre.
- The MAPAQ via the PADAAR Regional Program.



More varieties

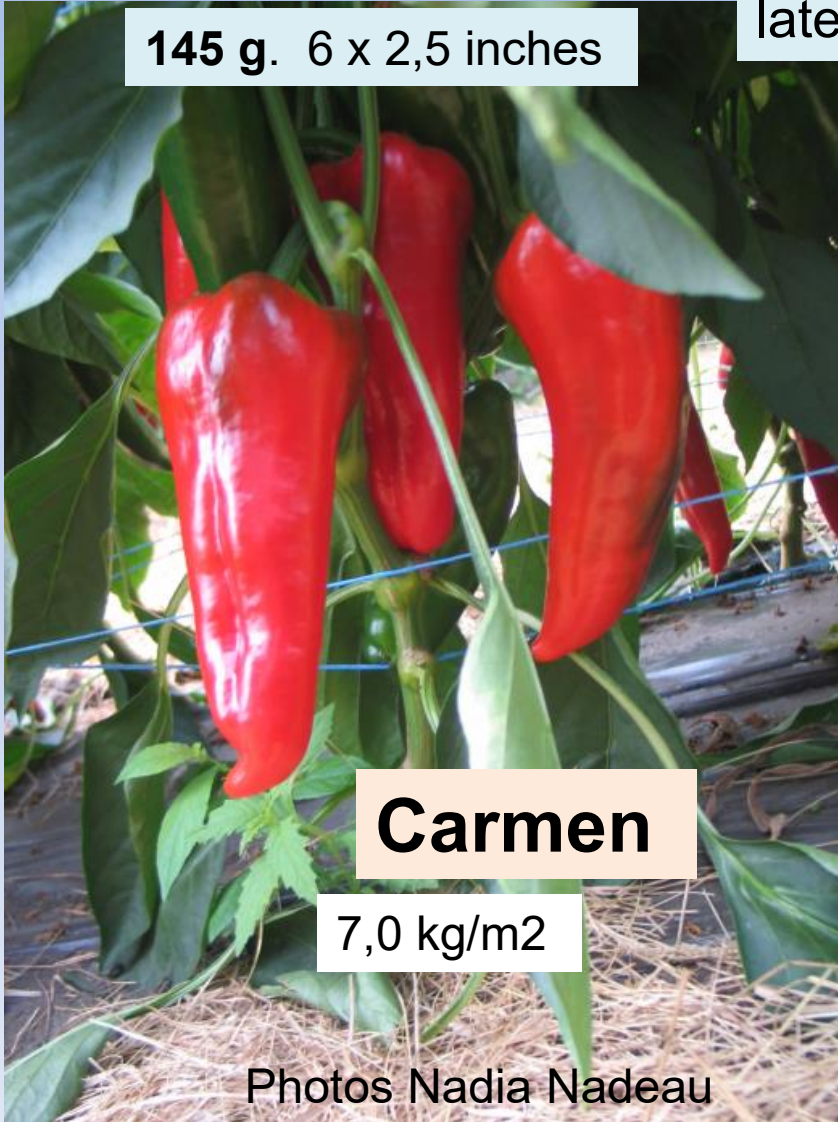


Trials 2013 2014  
High tunnels

Plantation mid-May, Harvest beginning to  
Mid August

Big pepper : **225 g** - harvest 5 -7 days  
later than Carmen .

**145 g.** 6 x 2,5 inches



**Carmen**

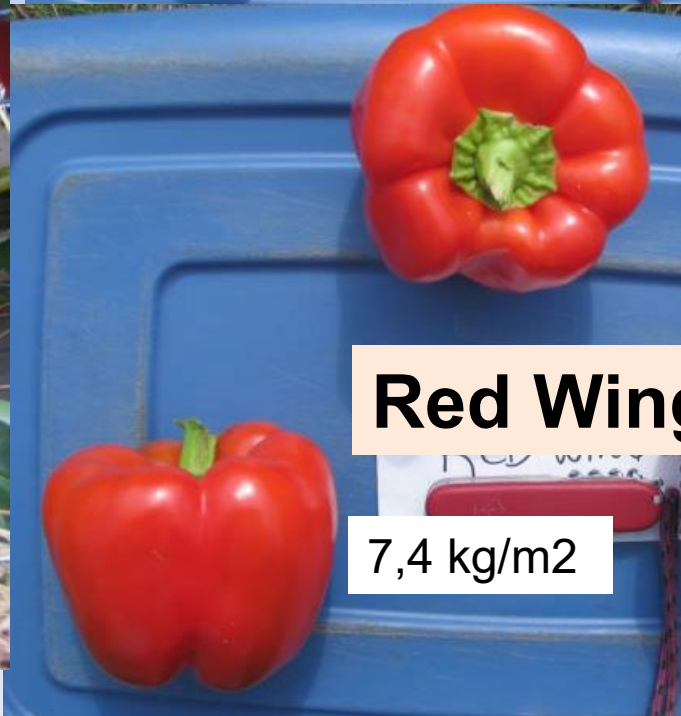
7,0 kg/m<sup>2</sup>

Photos Nadia Nadeau



**Sprinter**

5,8 kg/m<sup>2</sup>



**Red Wing**

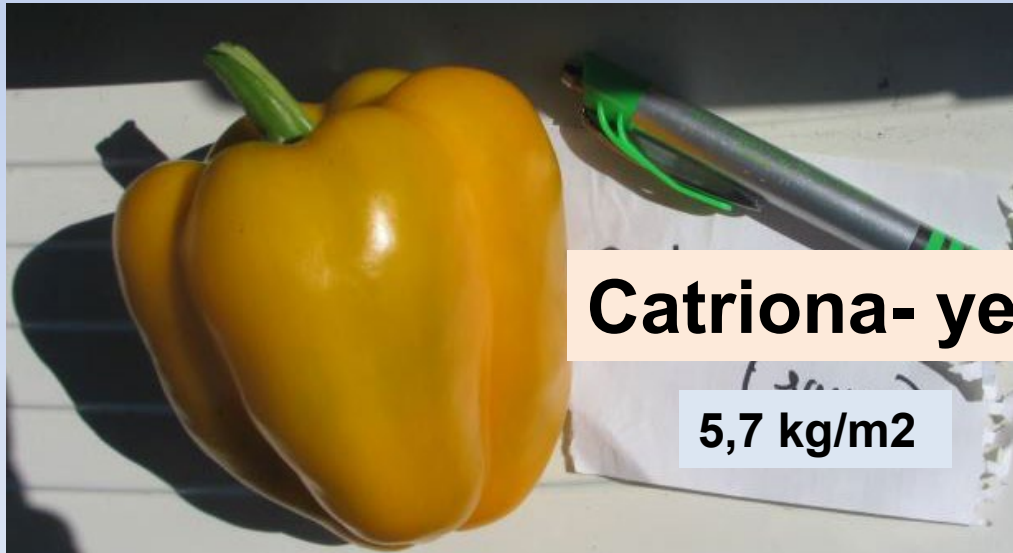
7,4 kg/m<sup>2</sup>

Trials 2013 2014  
High tunnels



**Milena- orange**

3,2 kg/m<sup>2</sup>



**Catriona- yellow**

5,7 kg/m<sup>2</sup>

Varieties trials 2013-  
2014 available

# Mini sweet pepper

Trials 2013 2014  
High tunnels



**Cupid-red**

**Lunch box yellow  
and orange**



Cupid : 5 kg/m<sup>2</sup> same yield as big peppers .  
A lot more fruits: 40 à 60 fruits of 40 g/ plant.

**Doe Hill- orange**



Staking « weaving » productive peppers: 5 ft stakes (1 ft in the soil):  
Carmen, Sprinter, Red wing, les minis sweet Cupid etc.

3-4 plants / 1 stake  
(2/8 or 3/8)  
3-4 levels of UV  
treated (every 8 in)



Photos Nadia Nadeau

Otherwise ...



# White plastic mulches in pathways

2014 :plots small and plastic dirty



Photo Gilles Turcotte

Photo Nadia Nadeau

White plastic mulch (6 mil): The weeds are pushing up the plastic



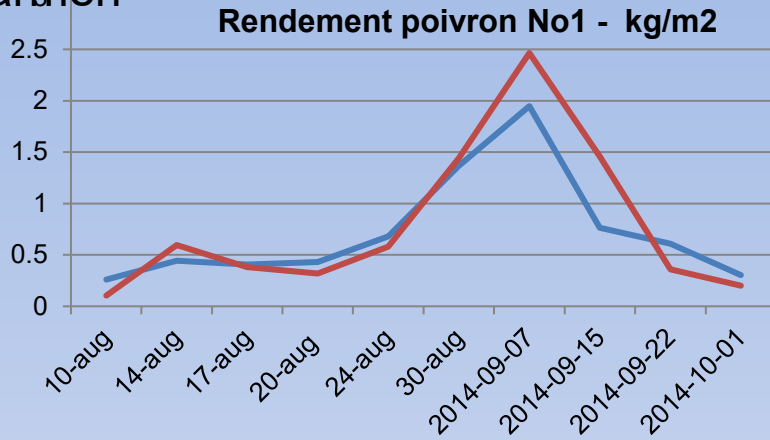
White on black plastic mulch (1mil)



# Results 2014:white plastic mulch

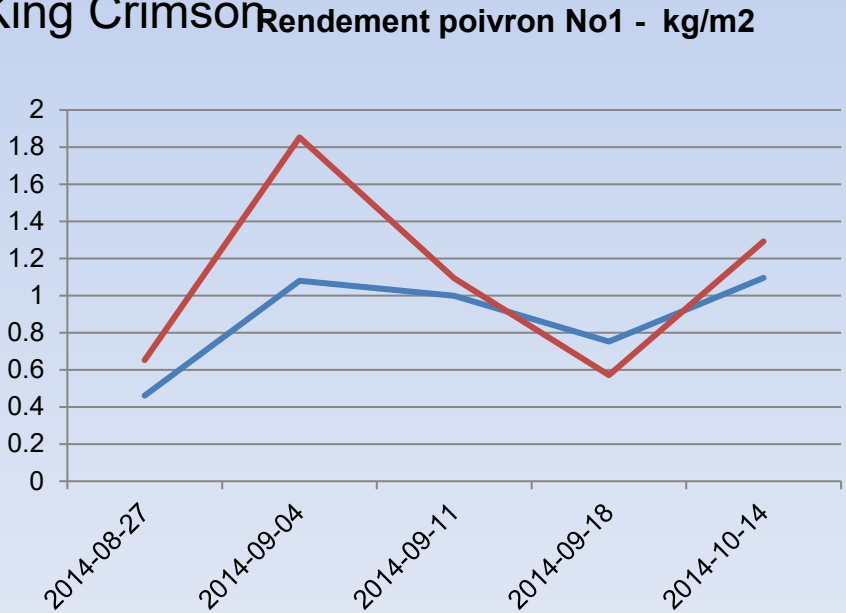
BSL- 21 mai

Carmen

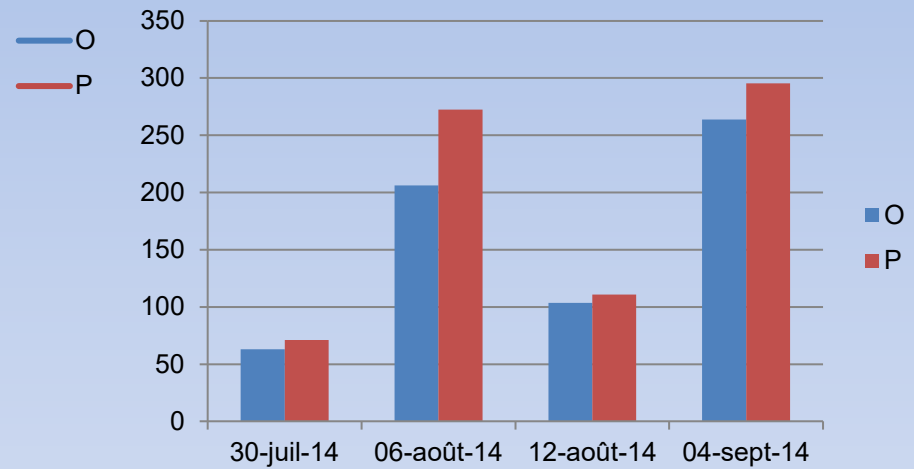


Outaouais- 20 mai

King CRIMSON



**Ceptometer readings : measure photon density usefull for photosynthesis**



Graphiques Anne Weill



# Retractable tunnel shelter

Nadia Surdek, agr.

Adaptation C. Villeneuve, agr.

Temporary (clear or green) perforated mini tunnels are less popular in vegetables. Temperature over 35 C are unfavorable to fruit setting in pepper and tomato promoting vegetative growth. Optimum T° for pepper are 23- 25 C at daytime and 18-20 C at night time.





# Retractable tunnel shelter

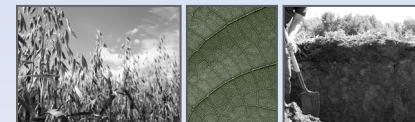


# MICRO-TUNNEL / RETRACTABLE MAIN OBJECTIVES

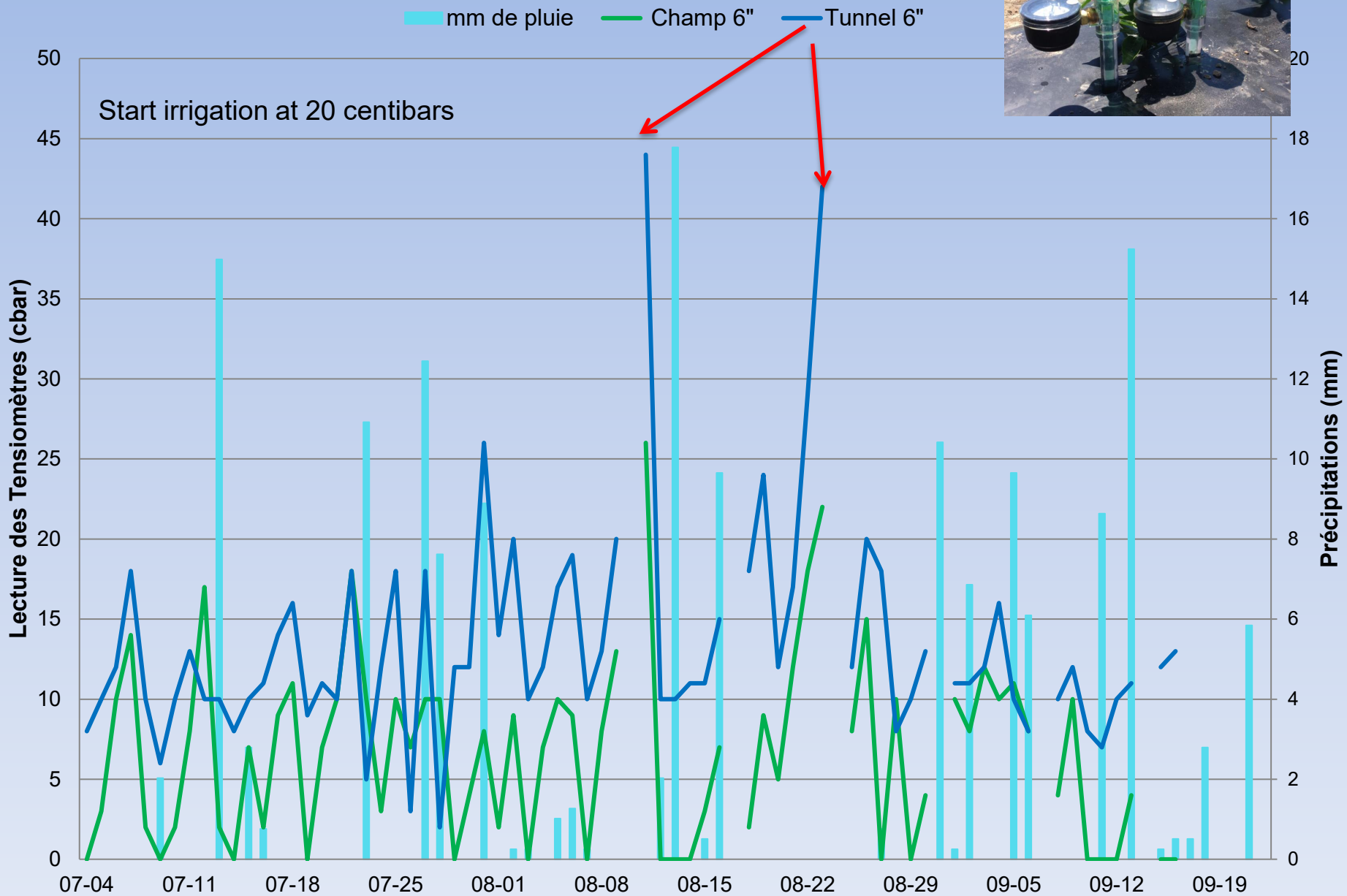
- ✓ 1 ha mini sweet pepper,
- ✓ Lower pesticide applications against bacterial spot
- ✓ Getting higher yields and extend the harvest period
- ✓ Low cost shelter suitable for rotations (0,6 – 1,2 \$/ft2)



Photo: Patrick Bibeau



# Tensiometers



*Température et humidité relative*

	T Moy (-C)	T Min (-C)	T Max (-C)	RH Moy %	RH Min %	RH Max %
<b>JUILLET</b>						
<b>Tunnel</b>	22,6	13,9	33,5	71,9	48,2	92,5
<b>Champ</b>	22,3	13,6	32,5	72,0	44,3	96,4
<b>Diff</b>	0,3	0,3	1,0	-0,1	4,0	-3,9
Most of the time opened in July & Aug.			<b>AOÛT</b>			
<b>Tunnel</b>	22,2	12,7	39,1	76,1	46,3	93,6
<b>Champ</b>	21,9	12,2	37,4	75,1	41,7	98,4
<b>Diff</b>	0,3	0,5	1,6	1,0	4,6	-4,8
Closed sometimes in Sept. & Oct.			<b>SEPTEMBRE</b>			
<b>Tunnel</b>	17,7	7,6	34,5	80,6	54,2	95,3
<b>Champ</b>	16,9	7,4	31,4	78,6	46,4	98,2
<b>Diff</b>	1,3	0,1	5,2	0,4	3,9	-3,0
<b>OCTOBRE</b>						
<b>Tunnel</b>	13,8	5,8	33,3	83,0	50,9	96,6
<b>Champ</b>	12,1	5,0	24,1	82,7	59,1	96,2
<b>Diff</b>	1,5	0,5	8,2	0,6	-5,7	-0,2



Température et humidité relative

RH is always more extreme in the field  
Reflecting rainy & windy conditions

			Max (-C)	RH Moy %	RH Min %	RH Max %
<b>JUILLET</b>						
<b>Tunnel</b>	22,6	13,9	33,5	71,9	48,2	92,5
<b>Champ</b>	22,3	13,6	32,5	72,0	44,3	96,4
<b>Diff</b>	0,3	0,3	1,0	-0,1	4,0	-3,9
<b>AOÛT</b>						
<b>Tunnel</b>	22,2	12,7	39,1	76,1	46,3	93,6
<b>Champ</b>	21,9	12,2	37,4	75,1	41,7	98,4
<b>Diff</b>			1,6	1,0	4,6	-4,8
<b>SEPTEMBRE</b>						
<b>Tunnel</b>	17,7	7,6	34,5	80,6	54,2	95,3
<b>Champ</b>	16,9	7,4	31,4	78,6	46,4	98,2
<b>Diff</b>	1,3	0,1	5,2	0,4	3,9	-3,0
<b>OCTOBRE</b>						
<b>Tunnel</b>	13,8	5,8	33,3	83,0	50,9	96,6
<b>Champ</b>	12,1	5,0	24,1	82,7	59,1	96,2
<b>Diff</b>	1,5	0,5	8,2	0,6	-5,7	-0,2

RH average is higher in tunnel

# 2014 COLD SPELL

	TUNNEL		FIELD	
Sept 18-19	7		12	
	0,2 °C	86,8% HR	-0,8 °C	91,6% HR
	0	-1		



**Sept 24**

	TUNNEL		FIELD	
<b>Oct 12</b>	0		6	
	0,8 °C	94,4% HR	-0,3 °C	95,8% HR
			0	-1
<b>Oct 12-13</b>	15		22	
	-0,2 °C	86,7% HR	-1,9 °C	88,4 % HR
	0	-1,5	0	-3
<b>Oct 20</b>	11		12	
	-1,3 °C	95% HR	-1,9 °C	95,5 %HR
	0	-2	0	-3

October 20



## Bacterial Diseases

Plants in tunnel still get some bacteria diseases but 1 month later and at mid September: Pathogen pressure in tunnel = pressure in field

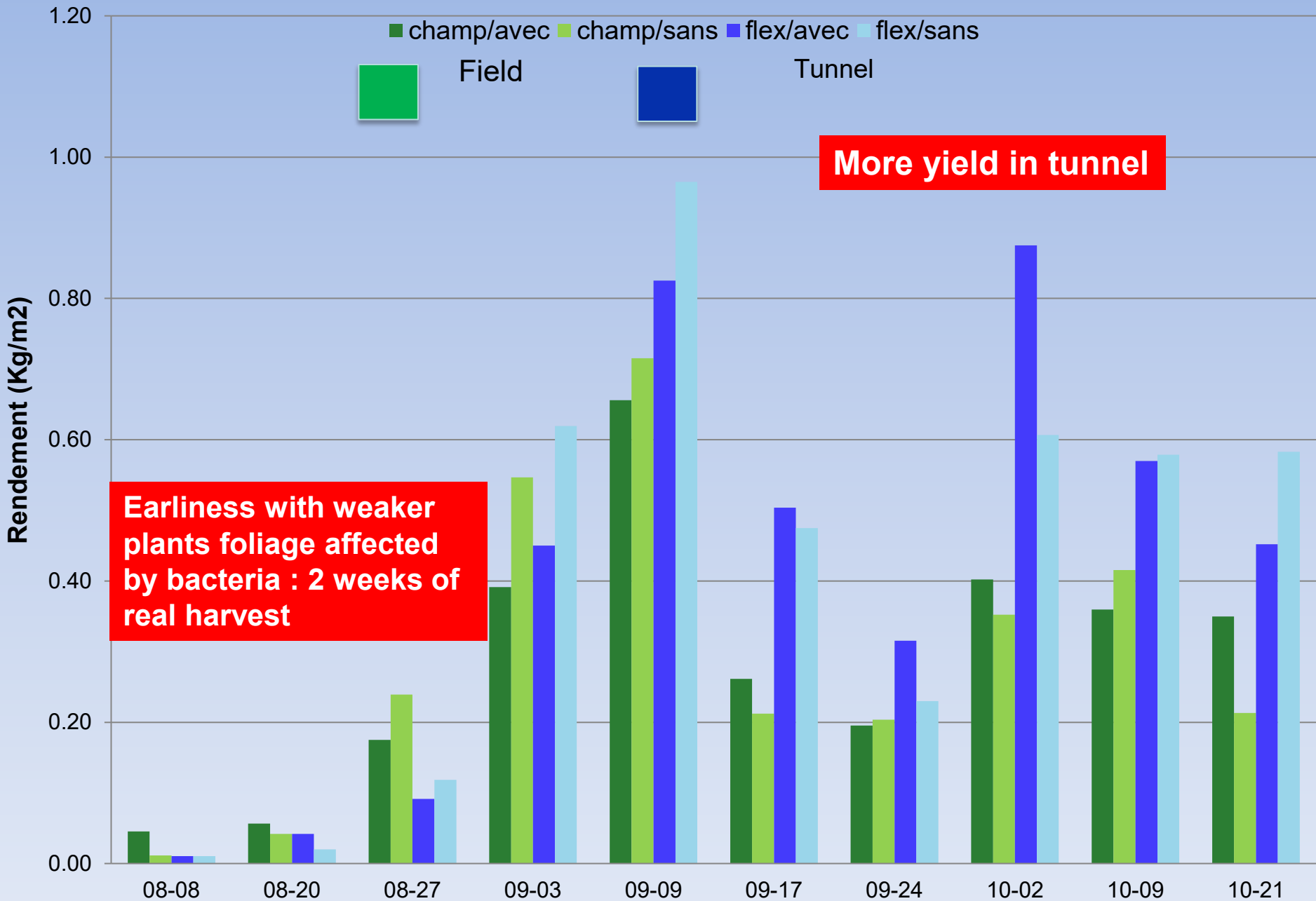
% of foliar surface	Disease Incidence
0	0
1-25	1
26-50	2
50-75	3
76 et +	4



RH average is higher in tunnel starting from August

	15 juil	25 juil	8 août	20 août	27 août	3 sept	9 sept	17 sept
Field/with	0,06	1,06	0,94	1,39	2,00	1,28	1,06	1,22
Field/without	0,00	0,94	1,22	1,17	1,61	1,72	1,17	1,17
flex/with	0,00	0,11	0,28	0,28	1,00	1,17	1,11	1,06
flex/without	0,00	0,06	0,28	0,17	1,00	1,06	1,00	1,17

# Weekly harvest mini sweet pepper -2014



## Mini Poivron - Lunch Box orange – Saison 2014

Étiquettes de lignes	Somme de RDT no1 (Kg/ m2)	Somme de RDT commercialisable (Kg/ m2)	Somme de rdt brute kg/m2
Champ/avec Kocide	1.7	2.3	3.2
Champ/sans Kocide	1.3	2.0	3.2
Tunnel/avec Kocide	2.5	3.1	4.6
Tunnel /sans Kocide	2.5	3.1	4.8

In the tunnel there is no difference if you apply Kocide or not  
In the field : yield increase about 30 % with Kocide applications

## Mini Poivron - Lunch Box orange – Saison 2014

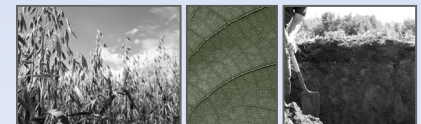
<b>Étiquettes de lignes</b>	<b>Somme de RDT no1 (Kg/ m2)</b>	<b>Somme de RDT commercialisable (Kg/ m2)</b>	<b>Somme de rdt brute kg/m2</b>
Champ/avec Kocide	1.7	2.3	3.2
Champ/sans Kocide	1.3	2.0	3.2
Tunnel/avec Kocide	2.5	3.1	4.6
Tunnel /sans Kocide	2.5	3.1	4.8

# CONCLUSION : GROWER IS NOT CONVINCED

- ✓ 1 ha to deal with opening and closing of plastic
- ✓ Adapt the harvester ...
- ✓ Try with small scales growers
- ✓ Try with other crops (melons, snap beans...)



*Photo: Patrick Bibeau*





A floating row cover ?





Floating row cover

6 rows wide



Novagryl P- 19 Dubois



Gro Guard- Récoltech

# Remerciements

« Ces travaux ont été réalisés grâce à une aide financière du Programme Innov'Action agroalimentaire, un programme issu de l'accord *Cultivons l'avenir 2* conclu entre le ministère de l'Agriculture, des Pêcheries et de l'Alimentation, et Agriculture et Agroalimentaire Canada. »



**Cultivons l'avenir 2**  
Une initiative fédérale-provinciale-territoriale

**Canada**

**Québec**

- ✓ Patrick Bibeau, grower
- ✓ Farm employees Carlos et Edgar
- ✓ Christine Villeneuve, MAPAQ
- ✓ Morgane Laperle, PleineTerre
- ✓ Caroline Provost, CRAM