



CETAB⁺

Centre d'expertise et de transfert en
agriculture biologique et de proximité



Permanent Raised Beds for Vegetable Crops

La recherche en bio se cultive à la ferme

Longueuil, 19 septembre 2016

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Yvon Houle, Cégep de Victoriaville

Collaborations & financing

- 🌱 First project PSDAB (MAPAQ)
- 🌱 CETAB+, collaboration IRDA
- 🌱 Second project Innovbio (MAPAQ)
- 🌱 Maryse Leblanc IRDA, collaboration CETAB+
- 🌱 Machinery : Cégep de Victoriaville, IRDA
- 🌱 Photos Anne Weill, D. La France, Ghislain Jutras, P.-A Gilbert , Maryse Leblanc

French project : GAEC Jardins du Temple





White asparagus hiller

Deep cultivator-hiller, 1m80 wheel track



Spring-tine cultivator/hiller



Cultirateau Simon when needed



Innovbio Project , CETAB+ built the machines and made them work



Disk hiller, tillage of green manure and crop residues, bed formation



Deep tiller (Cultibutte) (20 cm deep tillage)

Expensive Wenz Ecodyn tines
Bourgault Tillage Tools sweeps
Soil-lifting action



Flex-tine cultivator, seedbed preparation
Fallow and stale seedbed for weeds



Bed shaping, rolling

Many changes
Wheel-track
1m50
Heavier tractor



Adapted green manure seeder





Yvon Houle,
manure spreader

Heavy residue
Templier uses rototiller



Trial on clover-orchardgrass green manure



Disk hiller

St-Samuel soil

Broccoli 2009

Check plot

Cultibutte (Main tiller)



Flex-tine bed shaper



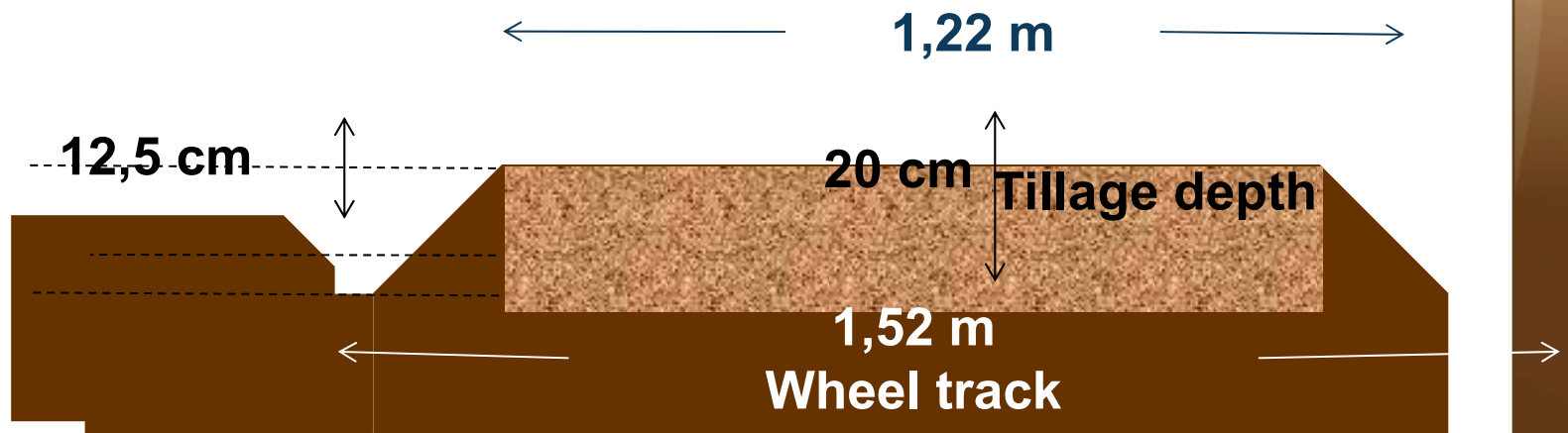
Check plot Comeb rotary hiller
Good capillarity
Practical for planting and seeding
Bad for soil structure



Residues 10 cm deep



Size of raised beds



Soil profile evaluation St-Samuel soil





Permanent bed system

Rotary tillage



2010 Permanent beds - rotary hiller



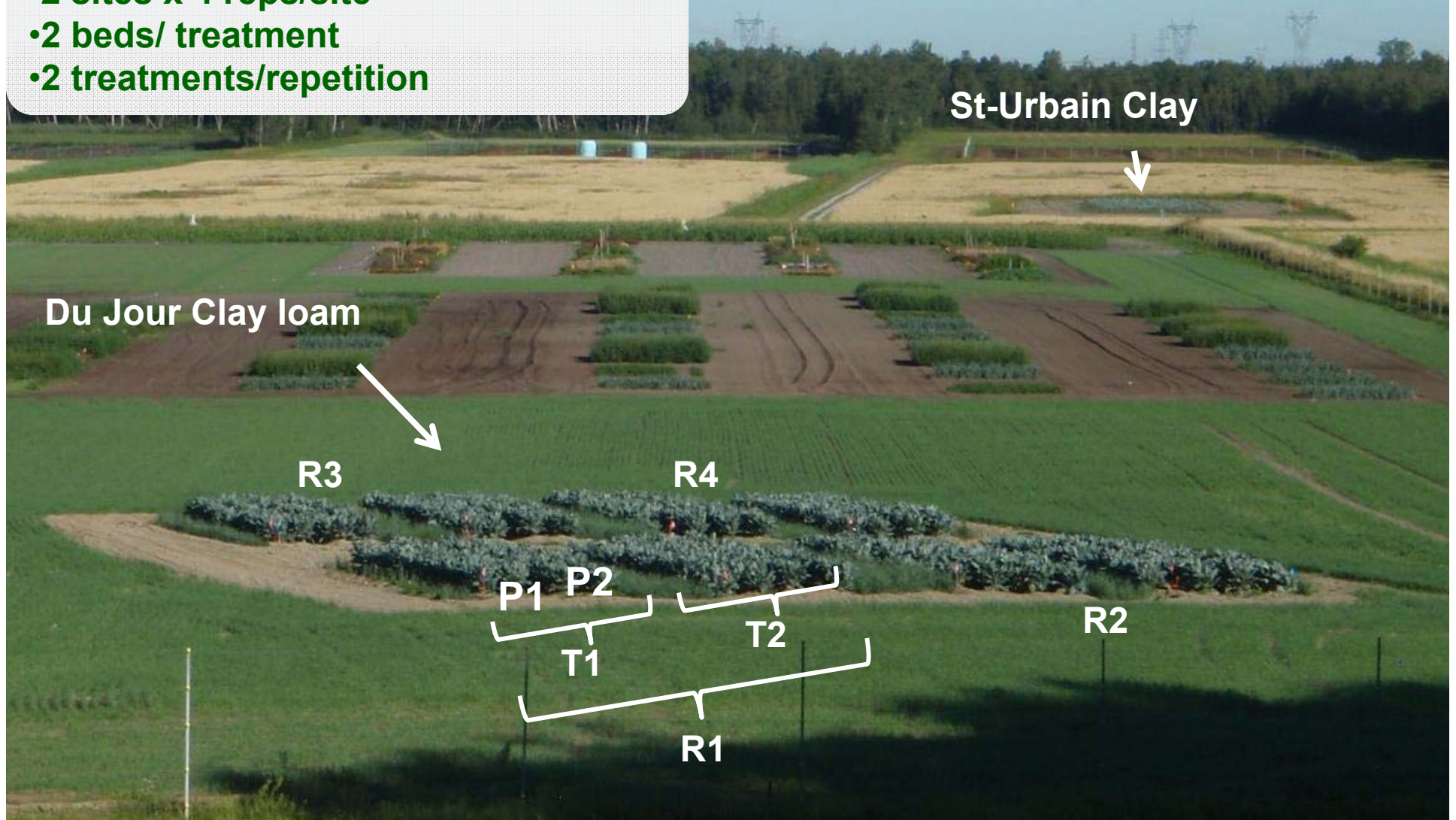
IRDA Research Platform – 2010-2011 and 2012-2014

Scientific validation - Maryse Leblanc
Pierre-Antoine Gilbert, Maxime Lefebvre



Experiment design

- 2 sites x 4 reps/site
- 2 beds/ treatment
- 2 treatments/repetition



Compact soils, need improvement
Tillage, roots, OM, biological activity



Comparing 2 treatments over 5 years

Conventional Tillage (IC)

- Rotary hiller
- Disk harrow
- Flex tine cultivator
- Moldboard plough

Permanent Beds (PP)

- Deep tiller
- Disk hiller
- Flex-tine bed maker

SITE DESCRIPTION

	Sand %	Silt %	Clay %	Texture	pH	M.O. %	P kg/ha	K kg/ha
St-Urbain	2	38	60	Heavy clay	7,4	3,6	187	748
Du Jour	36	28	36	Clay loam	6,0	2,7	140	317

SPRINGTIME

Equipment for conventional tillage



Depth: 20 cm
Speed: 0,5 km/h
Width: 1,5 m

Rotary bedmaker

AUTUMN

Equipment for conventional tillage



Depth: 20 cm
Speed: 3,2 km/h
Width: 3,6 m

Disk harrow



Depth: 15 cm
Speed: 4,8 km/h
Width: 3 m

Flex tine cultivator



Depth: 20 cm
Speed: 3,2 km/h
Width: 1,35 m

Plow

Equipment for permanent beds

spring
AUTuMN



**Deep tiller, Bourgault sweeps, Wenz Eco/Dyn tines
(CETAB⁺, 2010-2012)**

Equipment for permanent beds - IRDA

SPRING
AUTUMN



Chisel bed tiller
(IRDA, 2013-2014)

Equipment for permanent beds - IRDA

**SPRING
AUTUMN**



Disk hiller



**Flex tine
bedmaker**

Both treatments

Fall green manure

2010: Oats 60 kg/ha + peas 80 kg/ha

2011: Oats 160 kg/ha

2012: Oats 160 kg/ha

2013: Oats 160 kg/ha

Cow manure application

20 t/ha

(85% m.o., 4650 mg N/kg, 885 mg P/kg, 3675 mg K/kg)

43 kg N_{available} /ha

23 kg P₂O₅ available /ha

63 kg K₂O_{available} /ha

SOIL PROFILE EVALUATION

Anne Weill



Denis La France



CETAB⁺

St-Urbain soil 2010 soil surface to the right

permanent bed

plowing\ rotary tiller



Du Jour clay loam soil - 2010 soil surface to the right

permanent bed / plowing/rotary tiller



St-Urbain clay soil 2011-

permanent bed / plowing/rotary tiller



Depth 15-20 cm

Du Jour soil Onions 2012 – permanent bed / plowing/rotary tiller



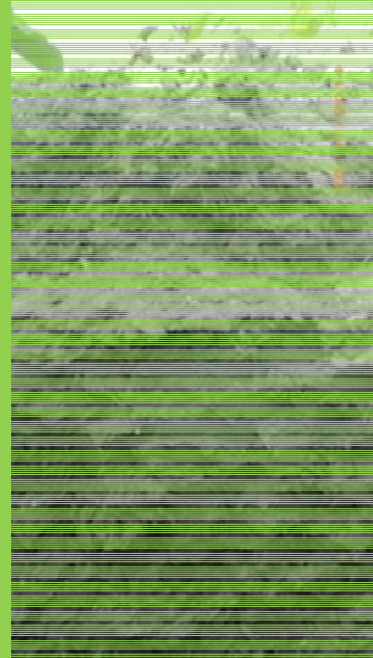
Soil profile 2014

ST-URBAIN

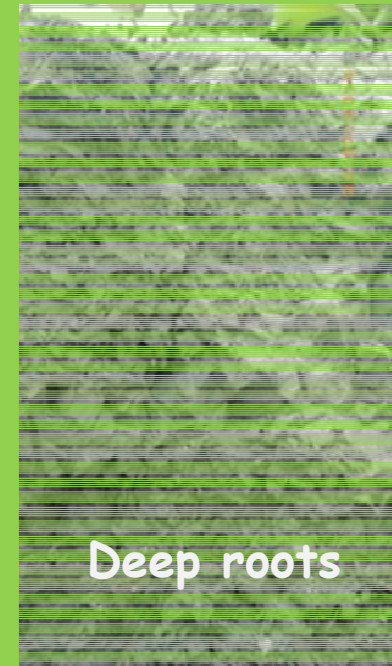
Pan formation
(rotary tiller)

Compact zone

IC



PP



Deep roots



SOIL PROFILE 2014

DU JOUR Pan formation
(rotary tiller)

Hardpan
12-27 cm



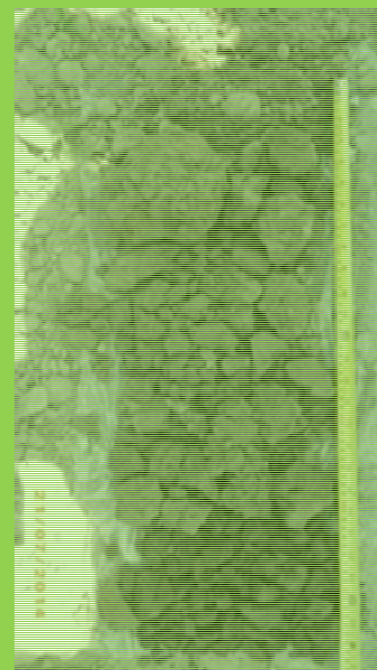
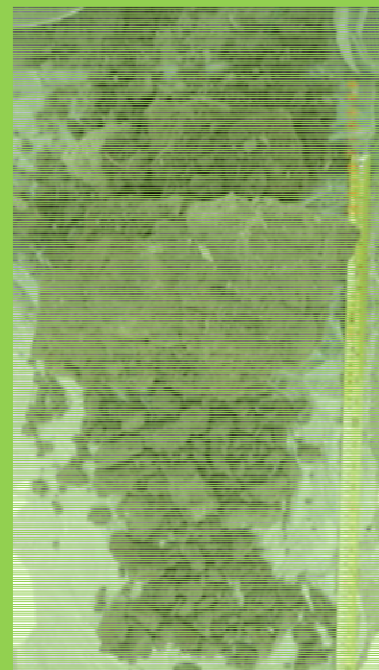
Légume
carencé

IC



Couche
travaillée

PP



EFFECT ON CROP YIELD

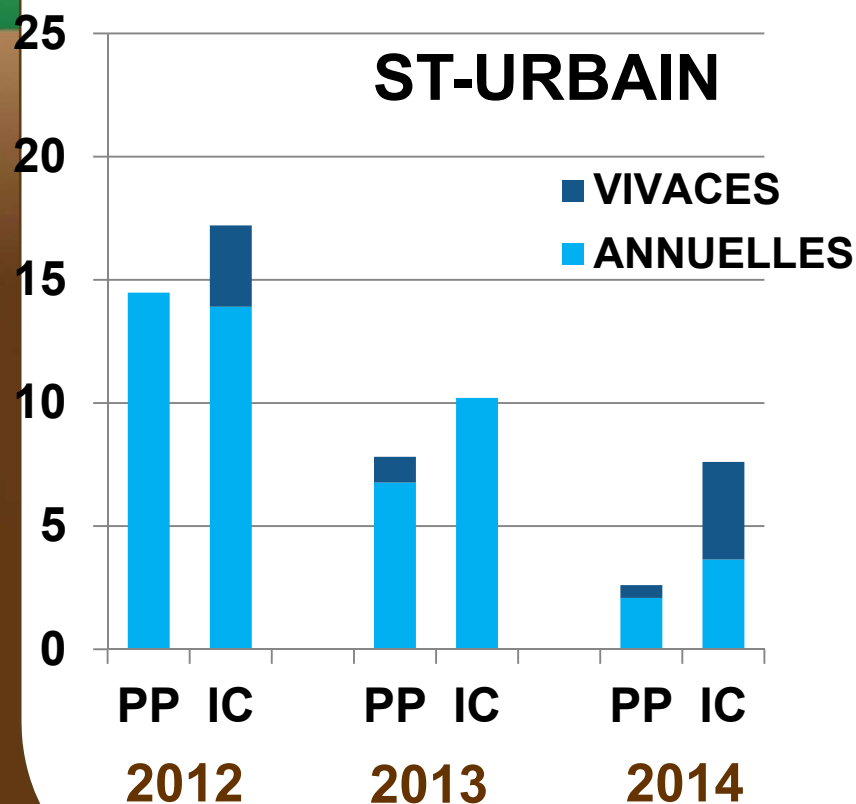
		Yield (t/ha)				
		2010	2011	2012	2013	2014
		Green beans	Broccoli	Spanish onions	Filet beans	Beets
		<i>Strike</i>	<i>Diplomat</i>	<i>Vaquero</i>	<i>Tavera</i>	<i>Chioggia</i>
St-Urbain						
PP		3,2	8,7	40,7	6,9	22,2
IC		3,0	9,9	42,4	5,3	17,7
		ns	ns	ns	*	*
Du Jour						
PP		3,9	10,9	40,1	11,4	14,0
IC		3,5	11,1	46,7	8,1	10,4
		ns	ns	*	***	ns

EFFECT ON WEEDS

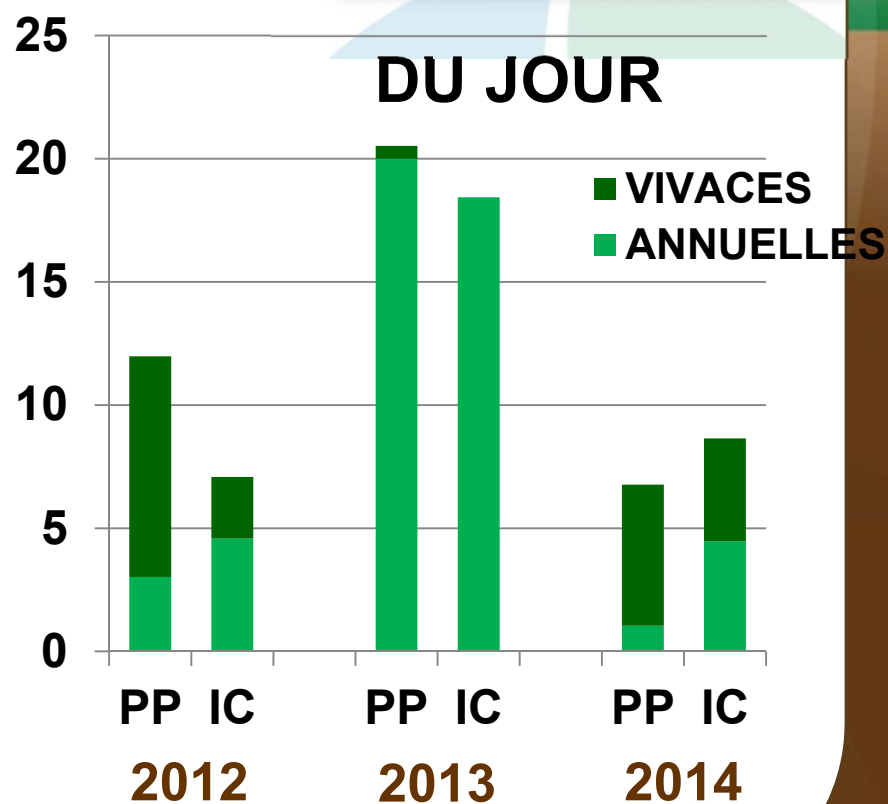


Nbre/m²

ST-URBAIN



DU JOUR



* Biomasse: < 5 g/m²

EARTHWORM POPULATIONS



**Sampling soil cube
30 x 30 x 30 cm**

EARTHWORMS (m³)



	Anecic (deep burrowing)		Endogeic		Total + unknown	
	N ^{bre}	Weight (g)	N ^{bre}	Weight (g)	N ^{bre}	Weight (g)
St-Urbain						
PP	170,1	144,9	134,3	41,7	349,5	188,8
IC	41,7	51,0	4,6	1,0	113,4	54,1
	*	*	*	*	*	*
Du Jour						
PP	53,2	72,5	0,0	0,0	83.3	74,7
IC	54,4	46,8	2,3	0,7	85.6	48,9
	ns	ns	ns	ns	ns	ns

Economic analysis

Cost of tillage

▪ Conventional	2125 \$ / ha
▪ Shop-built equipment	1997 \$ / ha
▪ Farm-built equipment	1103 \$ / ha

 Note : The rotary hiller is a sophisticated implement, but it is costly and works slowly

Economic analysis

Per hectare improvement

- Farm-built equipment 1022 \$ / ha
- Shop-built equipment 877 \$ / ha

 This covers some risk of startup of new system

 According to crops, the farmer can tolerate 2 to 6 % lower yield while he adapts the new system

 Best yields are reached year 4

CONCLUSION

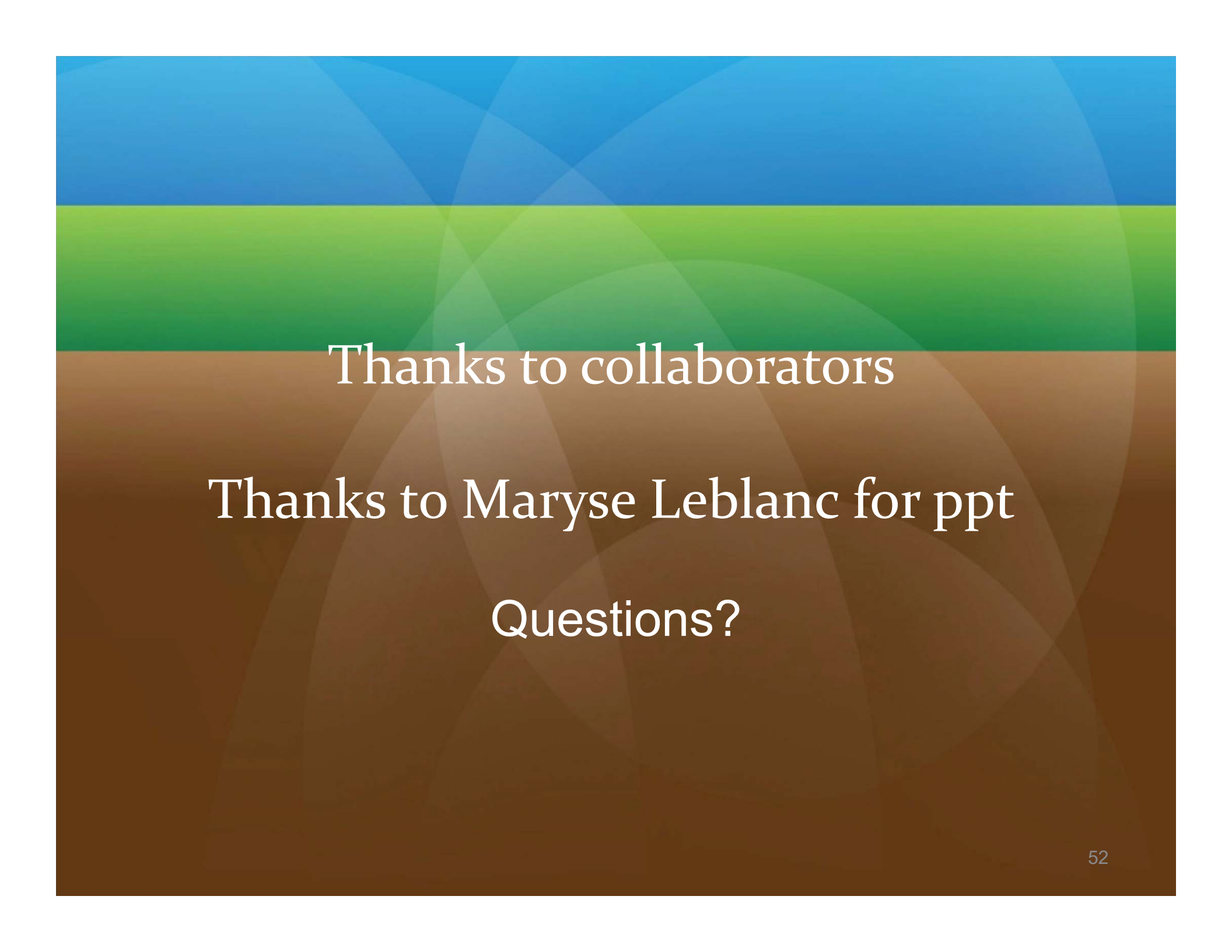
According to results, it is possible:

- **TO TILL WITHOUT PLOWING USING THIS SYSTEM**
- **TO GROW VEGETABLES IN CLAY SOILS**
- **TO IMPROVE SOIL PHYSICAL AND BIOLOGICAL PROPERTIES**
- **TO RAISE CROP PRODUCTIVITY**
- **WITHOUT RAISING WEED PRESSURE**

«You have to adapt the system to your soil and cropping system»

Note

- Soils become structured below tillage depth of sweeps on the deep tiller



Thanks to collaborators

Thanks to Maryse Leblanc for ppt

Questions?