



Green manures – Tendencies and development in organic practices in Quebec

COG Eco Farm Days- Cornwall - February 23, 2019

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#### Thanks

- Without naming everyone- many collaborators over last 10 years
- See publications www.cetab.org
- Industrial chair on organic crop protection– NSERC- Anne Weill Ph D.
- Many programmes MAPAQ
- Photos Michel Thibodeau

#### Plan

- Comparing varieties
- Effect of roots
- Practices in field crops
- Practices in horticulture (hay)
- Competition for weeds
- Soil covers & organic no-till
- Complex mixtures
- The Nitrogen question
- Miscellaneous

### Varieties vary very much

- Regrowth after mowing? (Berseem and crimsom clovers, hairy and common vetches)
- Annual ryegrass without flowers
- Ryegrass and alfalfa with good winterkill
- Survival of hairy vetch

### Variety trials

- Coop Novago early/late summer trials
  - Clovers, annual alfalfa, grasses, nonidentified vetches, phacelia
- Jouffray Drillaud= summer /late summer
  - Berseem clover monocut et multicut, l mediterranean alfalfa (winterkill), ryygrass, vetches, forest rye, Avena strigosa



Semis: 13 juillet et 10 août Photo: 5 Septembre



### For market gardeners

- Regrowth after mowing (Berseem, crimson, common vetch)
- Competition with weeds
  - Vigorous start, quick cover
- Quick-growing hairy vetch
- Vetches with good winter survival
- A grass with strong roots and winterkill
- Non-flowering annual ryegrass



#### For field crops

- Legumes with good fall growth that die in the winter
- Cover for no-till
- Berseem? Mediterranean Alfalfa?
- Stronger root systems than 4010 peas

# Effect of roots on soil structure Crimson clover / ryegrass - Peas 4010



# Annual ryegrass (italian)



# Left: sorghum/Sudan Right: ryegrass



# Two month old ryegrass roots



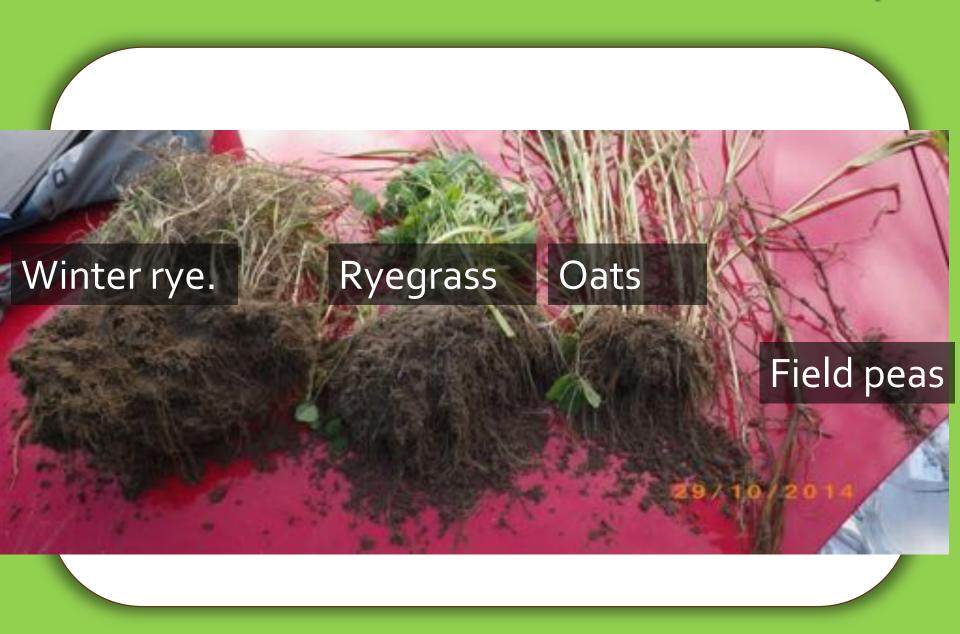


### Questions on annual ryegrass

- Biennial used as annual
- Regrows following year
- First year flowering( alternative?)
- Westerwold supposed to be true annual but abundant regrowth year two



#### Green manure roots end of October 2014



# Winter rye roots





## Field crops

Clover undersown in the furrow allows pre-emergence cultivation with tine weeder v. Hivon, Duval, O'Byrne



#### Sowing in cereal furrow requires precise depth control



#### Red clover sown in the furrow - 2014

In barley crop







# Undersown clover top-seeded with 4010 peas after harvest: easier in light soils



### Sursemis pois 4010 dans trèfle associé





# Mowing double-cut red clover (20 sept) to keep low C/N ratio — otherwise low N availability



# Top-seeding red clover in winter wheat in spring (better in heavy soils)



Trèfle rouge implanté 7 feuilles (photo J-P Hivon)



# Broadcast seeding of red clover in soybeans (Sept 1). Before late canning sweet corn 2019



#### Market gardening- Hay green manure

- Abundant N fixation
- Recycling N, nutrient extraction
- Important production of humus
- Soil structural stability
- Include deep-rooting grasses -fescues, orchard grass, annual ryegrass
- Compete with legumes for N
- Complementary root systems
- Mowing, partial harvest?

## Hay green manure

- Sow with nurse-crop end of summer
- Include hairy vetch
- Up to mid-September
- 1, 2, 3 years
- Strongly reduces hand-weeding costs

# Hay rotation









### Nurse-crop for hay

- Competition for weeds
- Winter rye in Spring (80 k/ha)
- Oats are good –less roots
- Spring rye- early
- **Triticale**
- Forage peas 4010 40-50 kg/ha

#### Relay green manures mowed for weed control

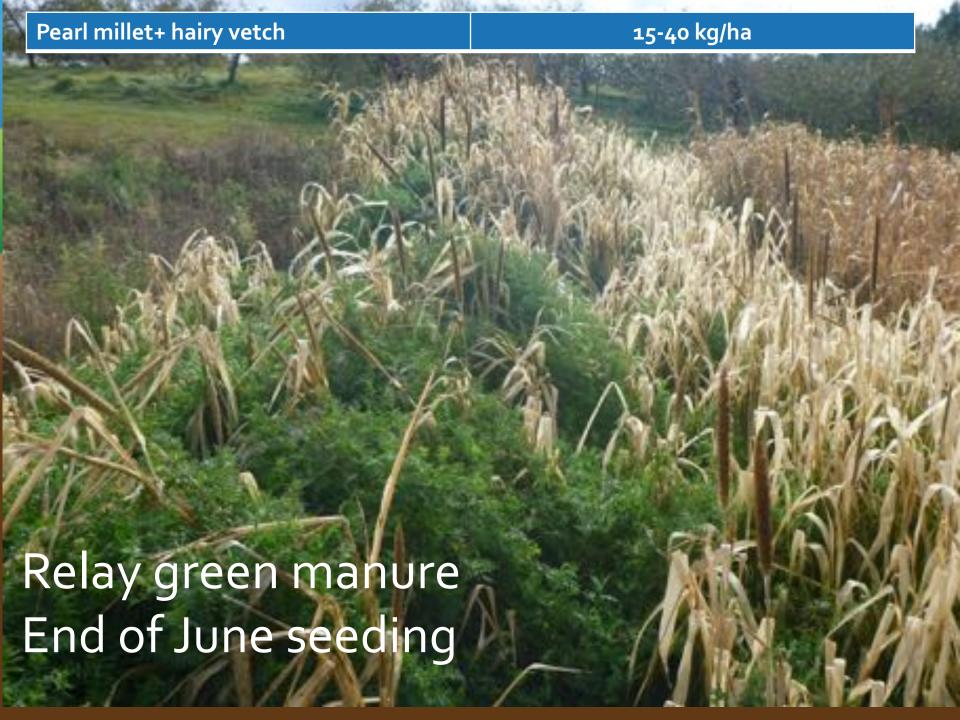
Example: Triticale 30 Peas 4010 30

Hairy vetch 10, Sweet clover 5Red cl. 5, Ladino cl. 4, Dactylis 4, Brome 3 kg/ha



#### Annual and perennial mixes

- Strong green manures few weeds
- Mowing and regrowth were effcient in most cases
- Sometimes weed was stronger than green manures
- More efficient over 2 years with double cut red clover in mixes
- Annual ryegrass was key plant in all annual mixes-very competitive



#### Cut and Carry green manures

- First trials Netherlands
- Mowing and incorporating alfalfa into soil before vegetables just as good as hen manure

## Lucerne (Medicago sativa) or grass-clover as cut-and-carry fertilizers in organic agriculture

Burgt G.J.H.M. van der 1, Eekeren N. van 1, Scholberg J. 2 and Koopmans C. 1

Louis Bolk Institute LBI, Hoofdstraat 24, 3972 LA Driebergen, Netherlands

Table 1. Nitrogen applied in 2009.

Treatment	Applied days until sowing	Fertilizer applied t ha <sup>-1</sup> fresh	N-content kg t <sup>-1</sup> fresh	N applied kg ha <sup>-1</sup>
Control	0.00	0	0	. 0
Lucerne fresh late	10 days	27.0	6.1	165
Luceme silage	36 days	18.2	11.0	200
Poultry manure	36 days	8.2	24.6	202
Grass-clover fresh	36 days	23.3	11.4	266
Lucerne fresh	36 days	24.4	11.1	271

<sup>&</sup>lt;sup>2</sup> Wageningen University, Droevendaalsesteeg 1, 6708 PB Wageningen, Netherlands Corresponding author: g.vanderburgt@louisbolk.nl

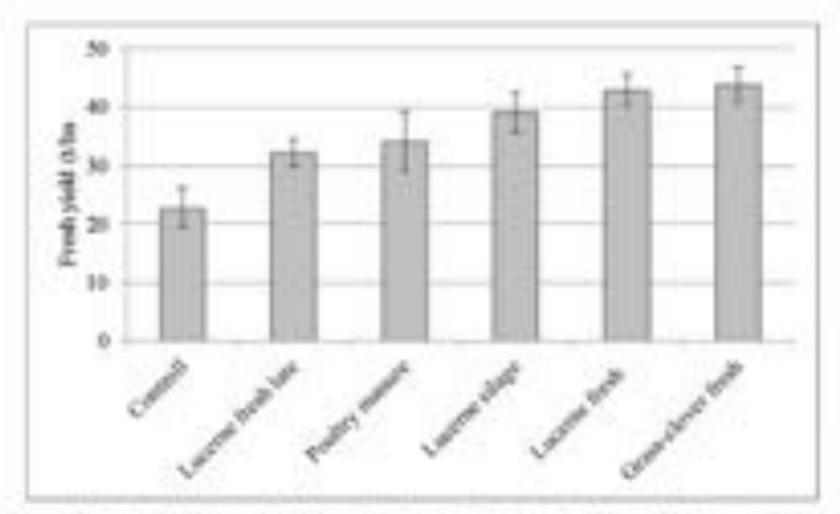


Figure 1. Fresh yield and standard deviation of spinach in 2009 in different fertilizer treatment



#### Organic no-till

- W Heavy residues as soil cover- works well with herbicides
- A lot of organic experimentation
- No conclusions yet
- Weeds are very problematic in no-till
  - Problems with perennial weeds
- Alternating tillage and no-till much easier





### Organic no-till Rodale Hairy vetch before corn



## Roller-crimping fall rye- Rodale



# Wenz Ecodyn – winter wheat after scalping white clover – in Quebec didn't work in spring



## Scalping with Noble Blade- S. Angers



## Rye-vetch on ridge-till



## Michel Thibodeau- Rye/soy, Peas mustard



#### N fixation - Legumes

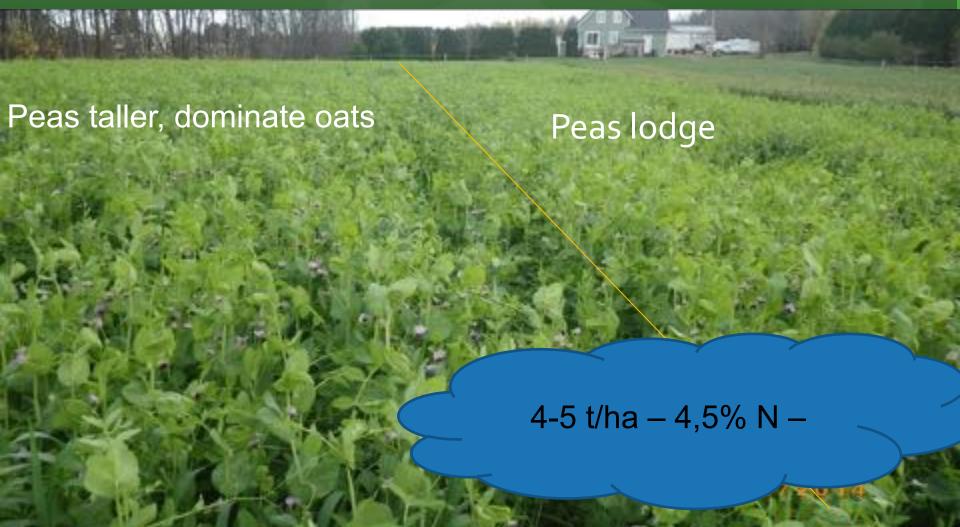
- Peas 4010 end of summer
- SEarly August seeding regularly 200 kg N
- Sometimes 250 kg, even 300 kg
- Many trials field crops and horticulture
- Voir <u>www.cetab.org</u>
- See meta-analysis Anne Vanasse

## Total Nitrogen (Early August seeding)

Species or mix	N (kg/ha)
Oat or spring rye (check)	64
Ryegrass + crimson clover	64
Oat or spring rye + common vetch	124
Oat or spring rye + hairy vetch	111
Forage pea 4010	230
Oat or spring rye + pea 4010	180

#### Oats/peas - Seeded August 7 2014 (essai CETAB+)

Oats peas(4010) 60-100 kg/ha Peas (4010) 160 kg/ha



#### Total N (end of June seeding- 2 cuts)

Mix	N (kg/ha)
Ryegrass + crimson clover– 1.5%N	70
Ryegrass + peas 4010 - 2.9%N	302
Ryegrass + hairy vetch + crimson clover - 4%N	307
Winter rye+ hairy vetch- 4%N (Uncut)	240
Sorghum + common vetch – 2.2 %N	227
Pearl millet + hairy vetch- 2.9%N	260

#### Biomass of undersown double-cut red clover

- Variable with regions (spring grains)
  - Mauricie & Centre du Québec: 1.0 -2.5 t/ha
  - Montérégie: 3.5-4.5 t/ha (lower 2015 & 2016);
- Factors for high biomass
  - Rain in early season
  - Early harvest of grain
  - Mowing after harvest
  - Warm autumn

#### Effect of legumes

- Very hard to determine fertilizer value
- Sometimes low biomass, low N but excellent effect
- Green manure effect much broader than total N
- Biological activity, humification, mineralisation of humus
- Majority of N goes to soil N pool
- Some grow corn without fertilizer/manure
- For more N you need more time for growth





# Since 2005 – Grain corn without fertilizer (Fermes Longprés)

SExcellent results after peas, common vetch,

alfalfa

After clovers – variable because of:

Climate?

Type of clover?

Tilled-in at flowering

Poor results

Even with 4-5 tbiomass

5/2	après vesce	après trèfle(T) ou luzerne (L)
année	rendement (T/ha)	rendement (T/ha)
2005	9,29	8,0 (L)
2006	9,82	9,25 (L)
2007	9,49	9,0 (L)
2008	8,5	7,65 (T)
2009	8,06	6,4 (T)
2010	9,5	7,9 (T)





## Mixtures for biodiversity—First trial 1993



Oats, wheat, peas, sunflowers, corn, phacelia, white lupin, soya, beans, common vetch, hairy vetch, crimson clover



#### Diverse – Subsoiling established green manures



## Soya

Dwarf white clover–
Microclover?
Cashmere Dutch?



## Share your innovations?

