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

# Efficient and effective control of Canada thistle, sow thistle and coltsfoot

January 30th, 2016  
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Agriculture, Pêcheries  
et Alimentation

Québec 









# Outline

1. Introduction
2. On farm trials – spring fallow
  - Sow thistle
  - Canada thistle
  - Coltsfoot
3. Key elements to a spring fallow
  - Role of timing
  - Role of a competitive crop and cultivation
4. Other cultural practices
  - Tillage
  - Hay



# 1. Introduction

## Canada thistle, sow thistle

- Major problem for cash crop organic farms with no hay in the rotation
- Weed density keeps increasing

## Coltsfoot

- Less important
- Very aggressive – harder to eliminate

## Weeds hard to control because:

- Deep root system
- Produce seeds (mainly Canada and sow T.)





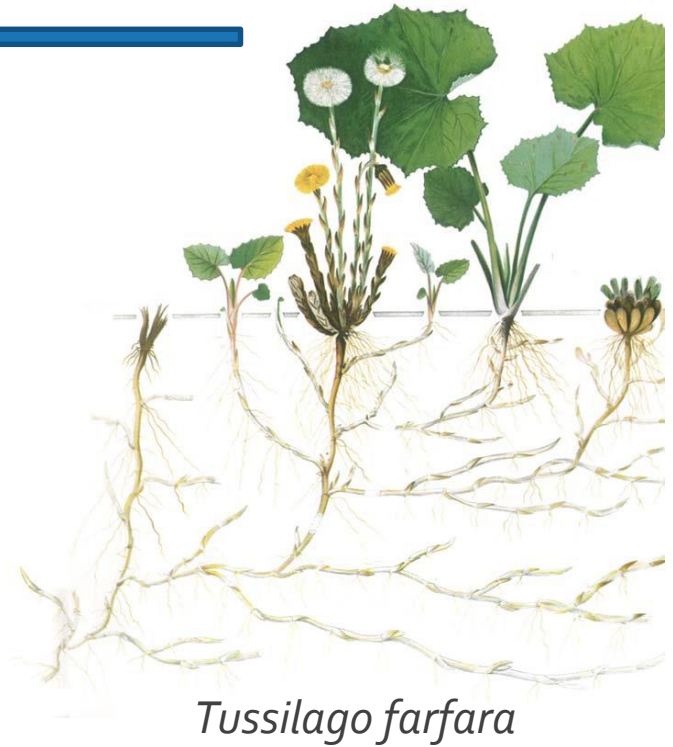
# Roots



*Cirsium arvense*



*Sonchus arvensis*



*Tussilago farfara*

(Ramussen, 2006)



# Strategies for control

## Exhaust the plant: full summer fallow

- Expansive:
  - Cost of the fallow
  - 3t/ha of soybean at 1000\$/ha on 20ha = 60 000\$ (similar for corn)

## Hay in the rotation

- Good for the soil – expansive
  - Hay = low revenue
  - 3t/ha of soybean at 1000\$/ha on 20ha = 60 000\$
  - Often 2 years







# More economical strategies

- 🌱 Summer fallow after cereals
  - Could work for Canada T. – to be verified in Qc
  - Organic farmers want to avoid doing a fallow after cereals because they grow green manures for the corn planted the next year
  
- 🌱 Trials : Summer fallow +green manure
  - brings N to corn the following year
  - Good results
  - Still expansive...
  
- 🌱 Trials: Spring fallow followed by late seeded soybean





# Spring fallow

- 🌱 2 to 3 destructions in the spring
- 🌱 Destruction with C-tine harrow or other tool with sweeps
  - 🌱 Working depth: 5-10 cm
  - 🌱 Use sweeps that overlap
  - 🌱 Efficacy of sweeps varies with type







# Always check if weed was properly destroyed



This may happen when Canada T. elongation has started



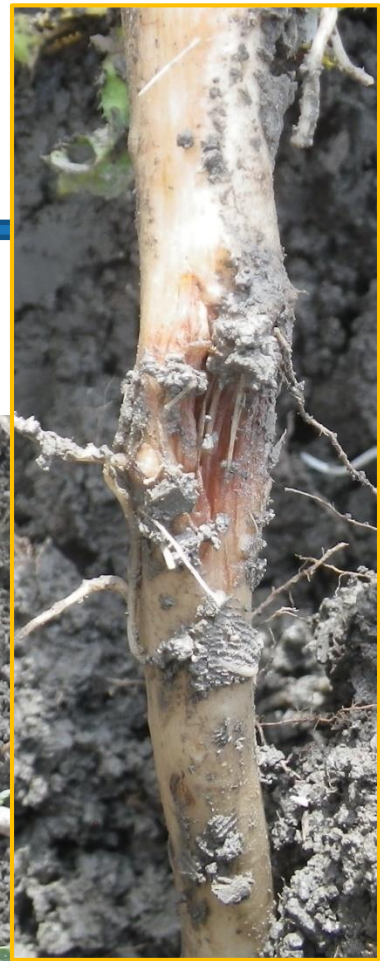
Photo: Thomas Dewavrin





# Canada T. stems can very difficult to destroy

- After 7 leaves stage, the stem becomes too fibrous
- Tools displace the stem without cutting it







# Destroy the weed when reserves in roots are low



	Reserves minimum at :	Date – Montreal area
Canada T.	6-8 leaves <sup>1</sup> Begin elong. <sup>2</sup>	May 10-15 May 20-25
Sow T.	5-7 leaves <sup>3</sup> Begin elong. <sup>2</sup>	June 1-5 June 10-20
Coltsfoot	2-4 leaves (before 6 leaves) <sup>2,4</sup>	June 1-5

1. Graglia et al. (2005)

2. Rasmussen (2006)

3. Vanhala et al. (2006)

4. Gharsallah, unpublished data







# Different phenotypes can give different results











## Beware of seedling

Summer fallow with pea green manure

- Plants from rhizome: from 220 to 0 pl/m<sup>2</sup>
- New seedling in Aug. and Oct.: 70 and 7,5 pl/m<sup>2</sup>
- Seedlings can establish under a thick canopy: they may survive with no fall tillage







# Two research models

## Classical and action research

🌱 Highlights of 5 years of data

🌱 Classical randomized designs:

- Randomized complete block design or completely randomized design
- Statistical analysis:
  - Kruskal Wallis non parametric test; Mean followed by different letters are significantly different at the level 0,05;
  - ANOVA if population can be normalised

🌱 Farm adapted design:

- Field separated in two (paired samples) when differences are visually evident (not due to chance!)







# Outline

1. Introduction
2. **On farm trials - spring fallow (4 out of 10 trials)**
  - 2.1 **Sow thistle**
  - 2.2 **Canada thistle**
  - 2.3 **Coltsfoot**
3. Key elements to a spring fallow
  - 3.1 Role of timing
  - 3.2 Role of a competitive crop and cultivation
  - 3.3 Role of row spacing and cultivation
4. Other cultural practices
  - 4.1 Effect of tillage
  - 4.2 Effect of hay



# Sow thistle farm trial 1 (2013)

2 spring passes  
0,1 pl/m<sup>2</sup>

1 late spring pass  
3,9 pl/m<sup>2</sup>

Difference sign. at level 0,05  
in summer 13 and 14

Treatment 2013	Harrowing date	Date seeding
1 pass (1P)	June 19	June 19
2 passes (2P)	May 9, June 19	June 19





# Conclusion – farm trial 1

## Spring fallow

- Only one late destruction when sow thistle is advanced: not effective
- Two destructions = effective
- This conclusion is valid with cultivated soybean after fallow





# Canada thistle and sow thistle – farm trial 2 (2012)

Treatment 2012	Harrowing date	Date seeding 6" soybeans
2 passes (2P)	June 17 and 22	June 22
3 passes (3P)	May 18 June 17 and 22	June 22



Before treatments  
Sow.T. 65 pl/m<sup>2</sup>  
Canada.T. 72 pl/m<sup>2</sup>

Report at  
[cetab.org](http://cetab.org)





# Results - september 2013



3 Passes

3 Passes

S.T. 0 pl/m<sup>2</sup>

C.T. 3 pl/m<sup>2</sup>



2 Passes

2 Passes

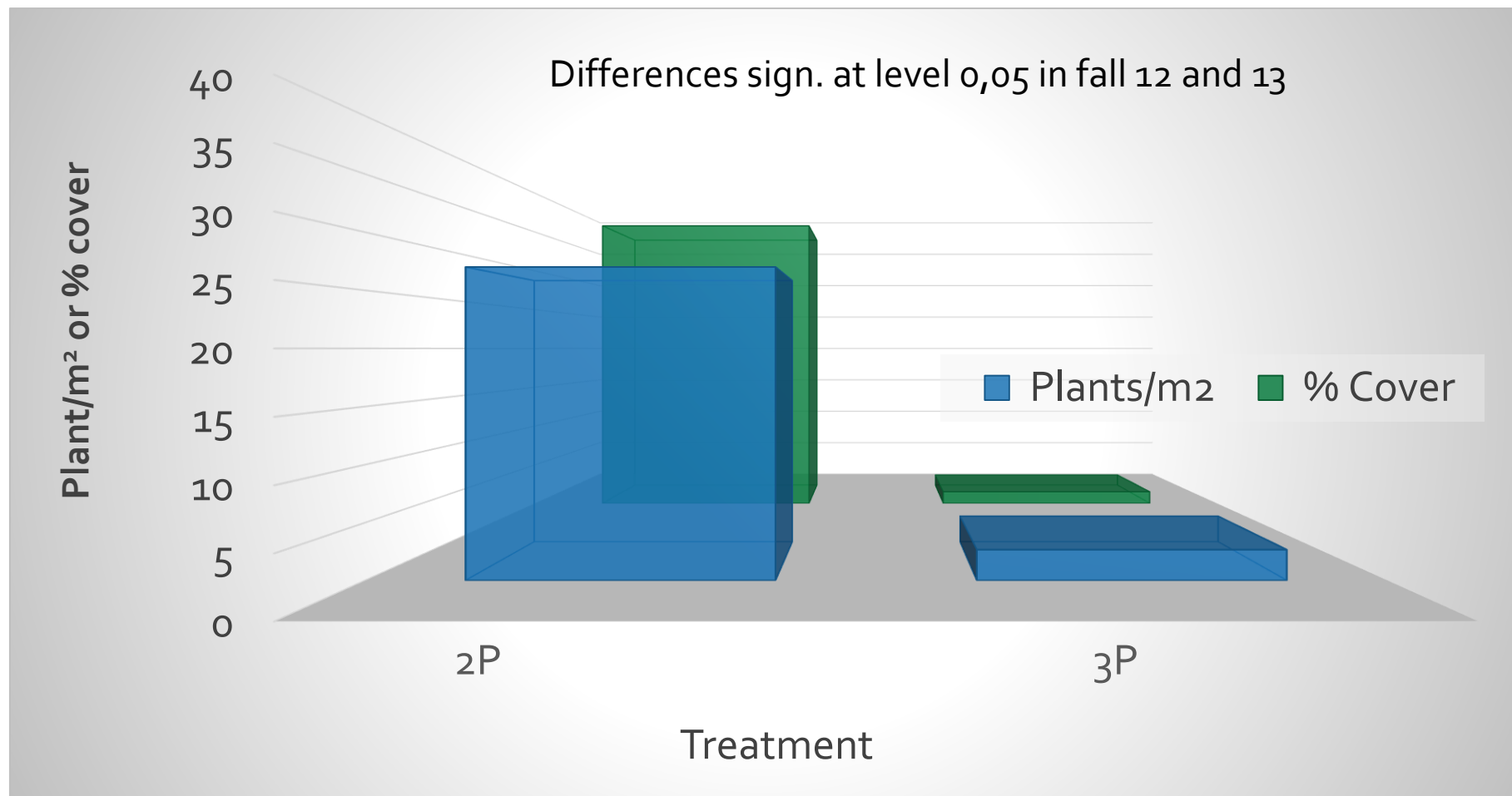
S.T. 0 pl/m<sup>2</sup>

C.T. 27 pl/m<sup>2</sup>

Difference sign. at level 0,05  
in fall 12 and 13



# Treatment effect on C. thistle density and % cover - results in sept. 2013



Sow thistle: 65 pl/m<sup>2</sup> to 0 pl/m<sup>2</sup> with 2P or 3P





# Conclusion – farm trial 2

- 🌱 Canada thistle
  - Excellent control with 3 destructions
- 🌱 Sow thistle
  - Excellent control with 2 destructions or 3 destructions
- 🌱 Good results with narrow row soybean
  - with no mechanical weeding



# Canada thistle farm trial 3 (2013)

Desperate situation!

22 pl/m<sup>2</sup>

Find the crop!

Treatment 2013	Harrowing date	Date seeding
1 pass (1P)	May 9	May 10
2 passes (2P)	May 9, June 5	June 5





# Corn on August 6, 2013

1P – seeding in may

Corn 0 t/ha

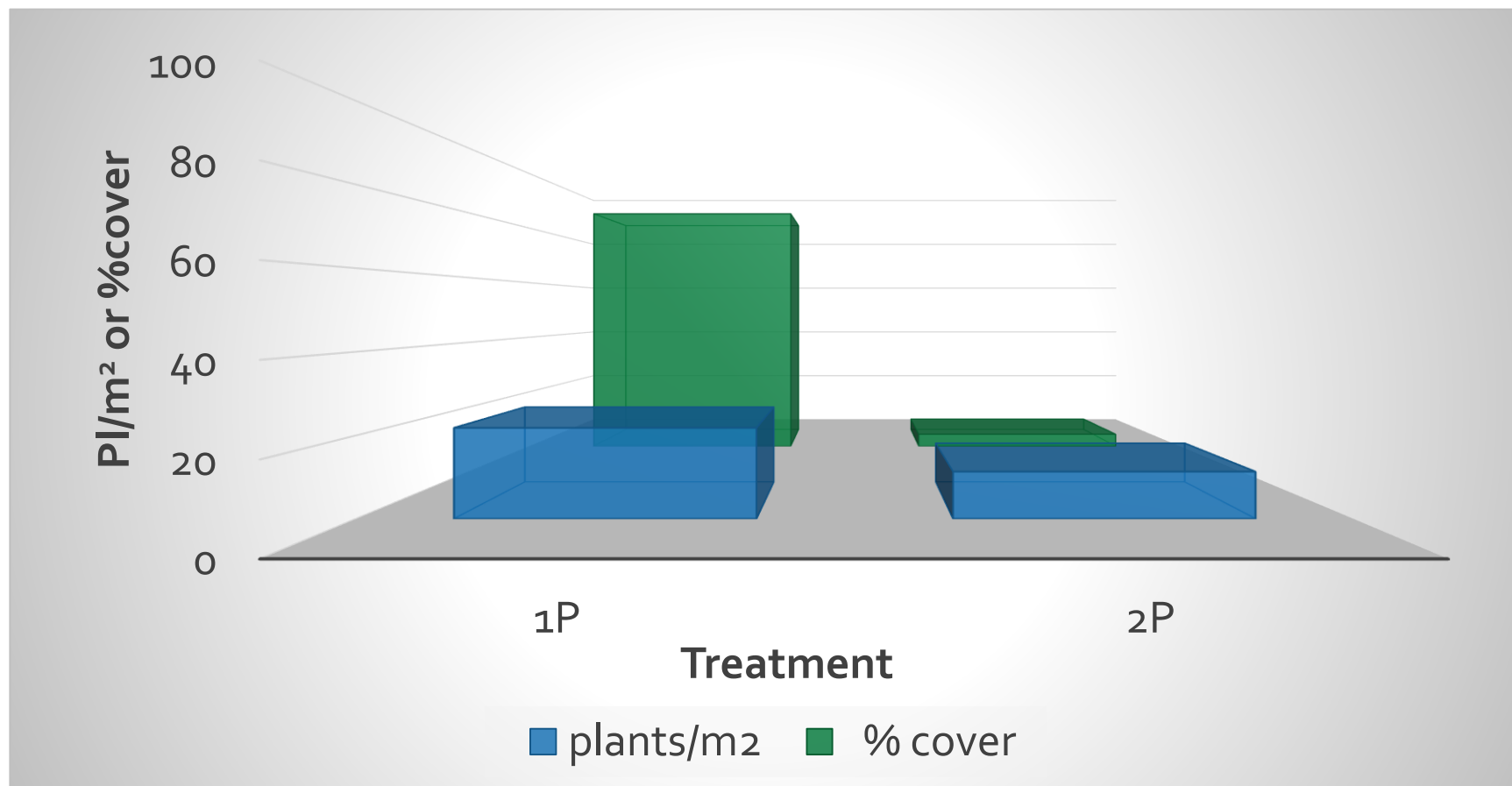
2P – seeding in june

Corn 9 t/ha





# Treatment effect on C. Thistle density and % cover – results Aug. 2013



Differences sign. at level 0,05



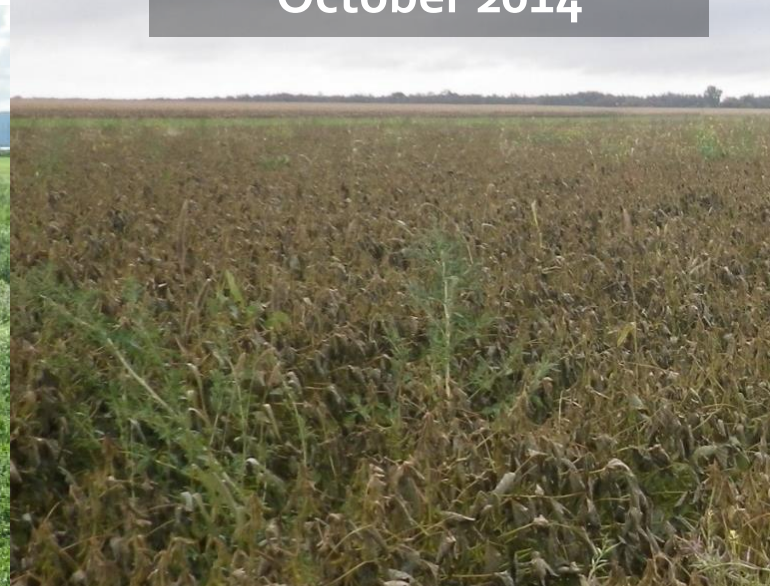


2014: 2<sup>nd</sup> spring fallow; soybean seeded June 12  
Thistle nearly eliminated

June 2013



October 2014





# Conclusion – farm trial 3

## First spring fallow

- Weed density was reduced
- Delaying planting give a very large competitive advantage to the corn
- In addition, mustard was controlled

## Second spring fallow

- Reinforced the effect of the first fallow
- Thistle is not a problem anymore (but not eliminated)





# Canada thistle and coltsfoot – farm trial 4 (2013)

## 1. Canada thistle



Treatment	Harrowing date 2013	Seeding date
3 Passes	May 10 and 17; June 19	June 20



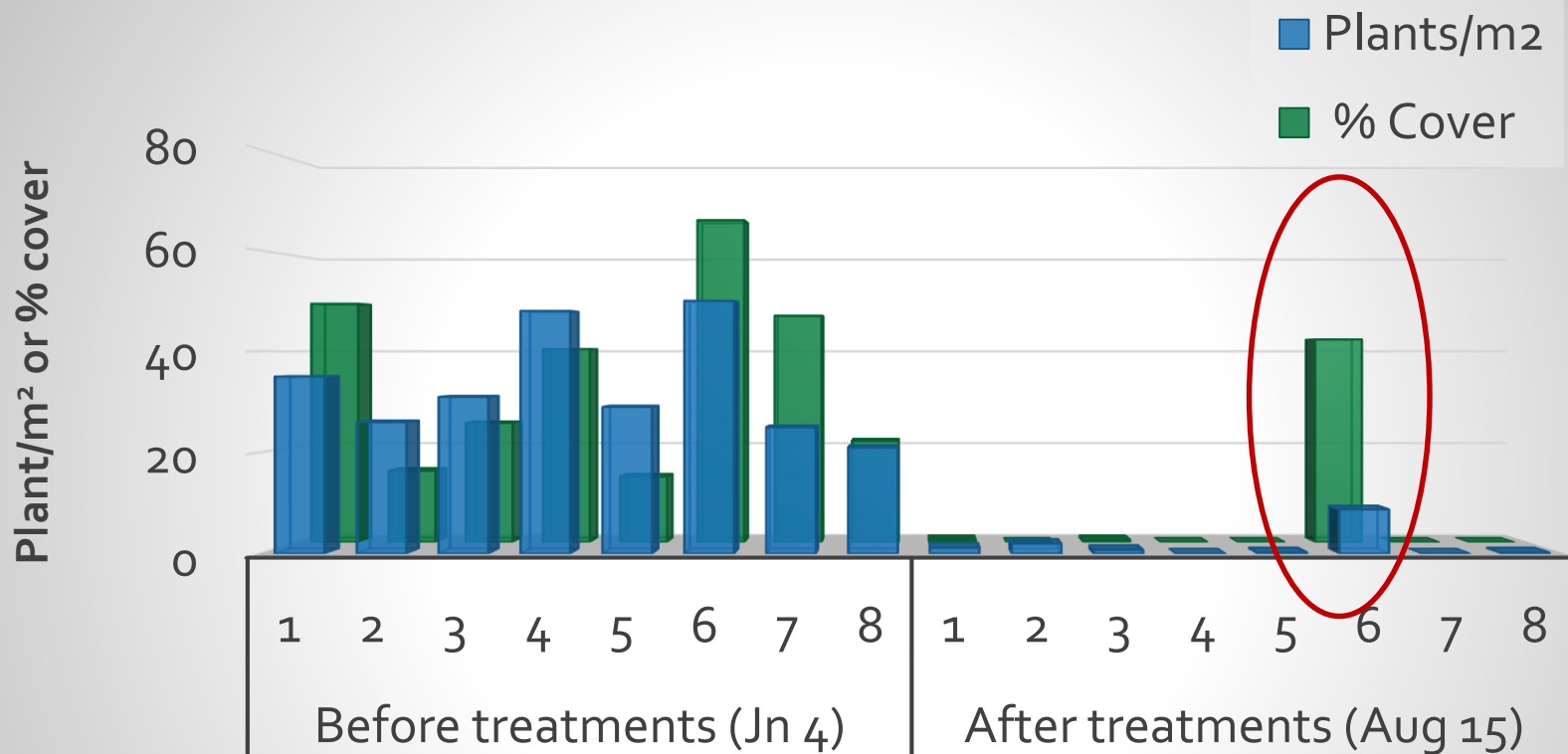
Aug. 2013: thistle nearly absent







# Treatment effect on C. thistle density and % cover for 8 replicates – results 2013



One rep is different; why?



July 15, 2014 – no Canada thistle  
except one spot



The one spot....







## 2. Coltsfoot



June 2013:  
107 plants/m<sup>2</sup>; 33% cover

Aug 2013, July 2014:  
Disappeared

04/06/2013



# Conclusion – farm trial 4



## Canada thistle and coltsfoot

- Excellent control with 3 destructions
- 2 destructions would probably have worked (timing)



## Not true for one rep. Why ???????

- Older stand? Ditch was in this area before?
- ?





# Coltsfoot– farm trial 5 (2014)

190 pl/m<sup>2</sup> (8 reps)



Report will be  
posted at  
[cetab.org](http://cetab.org)

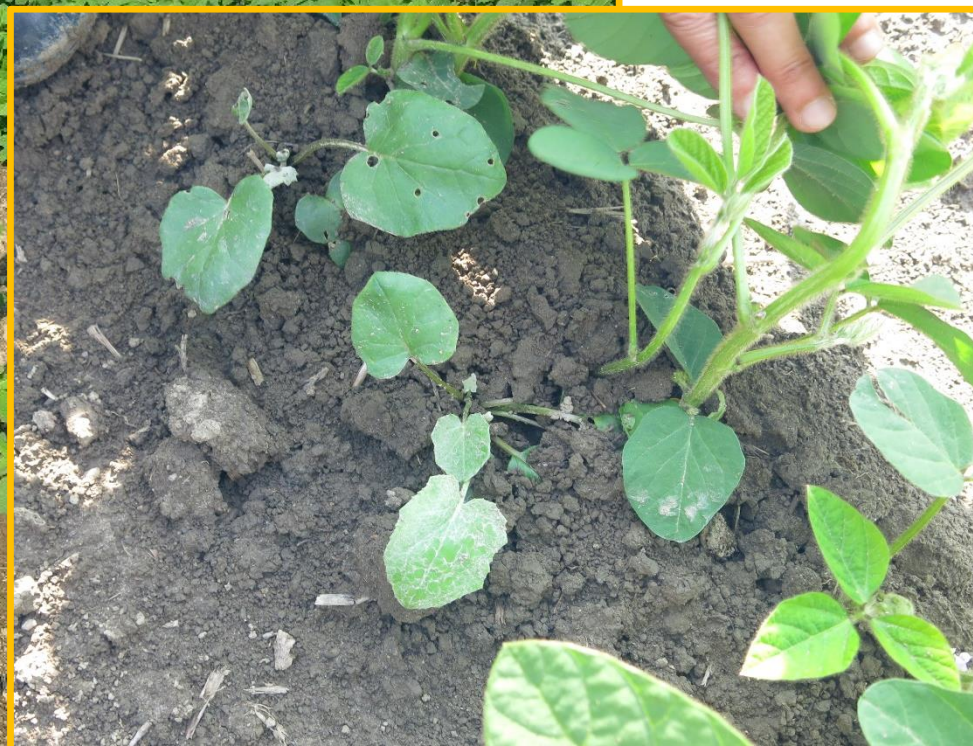
Treatment 2014	Harrowing date 2014	Date seeding
2 passes (2P)	June 11, June 23	June 23
3 passes (3P)	May 30, June 11, June 23	June 23





July 29

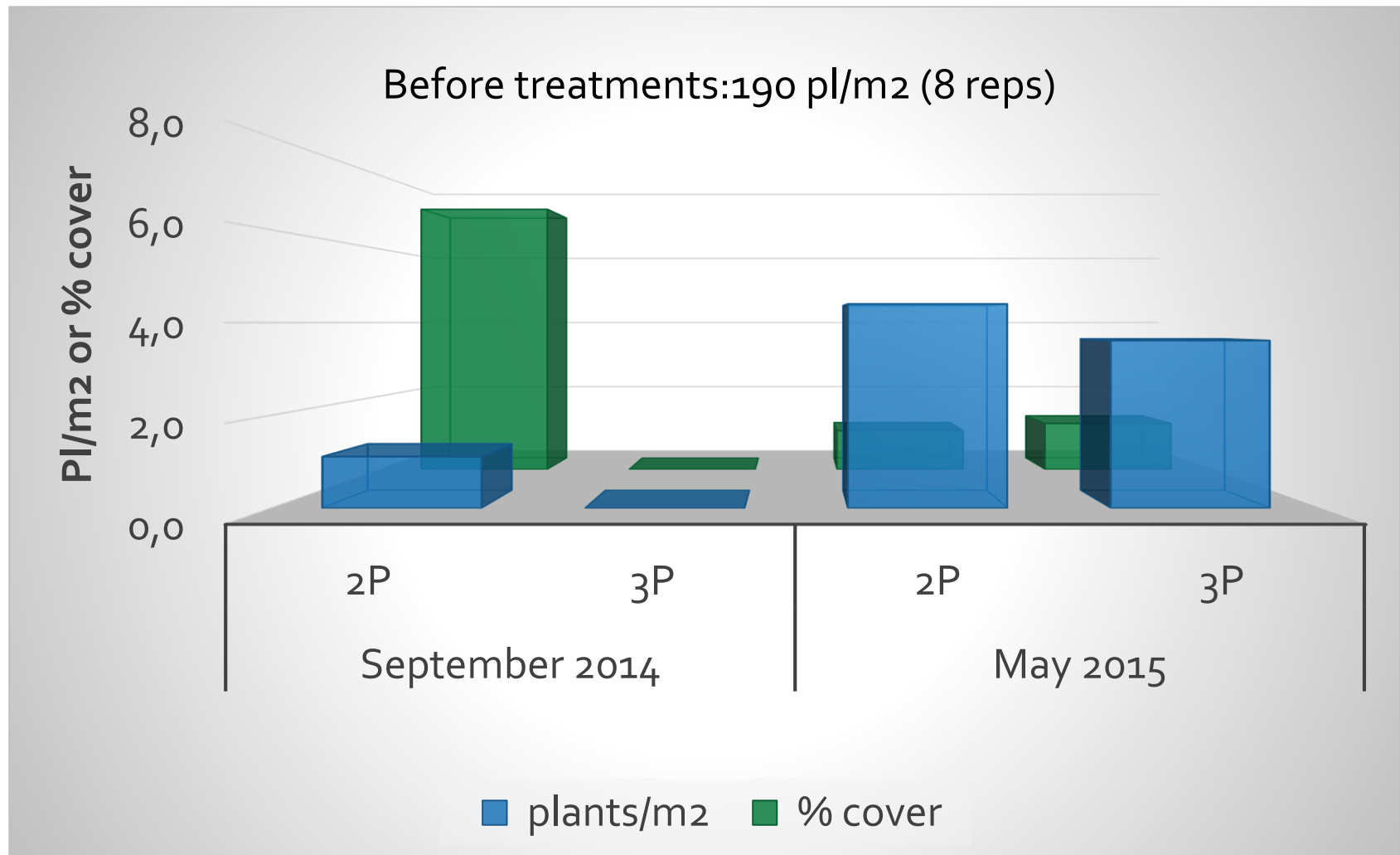
0,5 pl/m<sup>2</sup> (8 reps)







# Treatment effect on coltsfoot density and % cover in the fall 2014 and spring 2015



Differences NOT sign. at level 0,05 except % cover in Sept. 2014



# Conclusion – farm trial 5



## Coltsfoot

- Excellent control with 2 or 3 destructions



## Sow thistle was also present in large quantities

- Excellent control with 3 destructions (from 192 pl/m<sup>2</sup> to 0 pl/m<sup>2</sup> in fall 15 and spring 15)
- No observation made for 2 destructions – would probably have worked as well



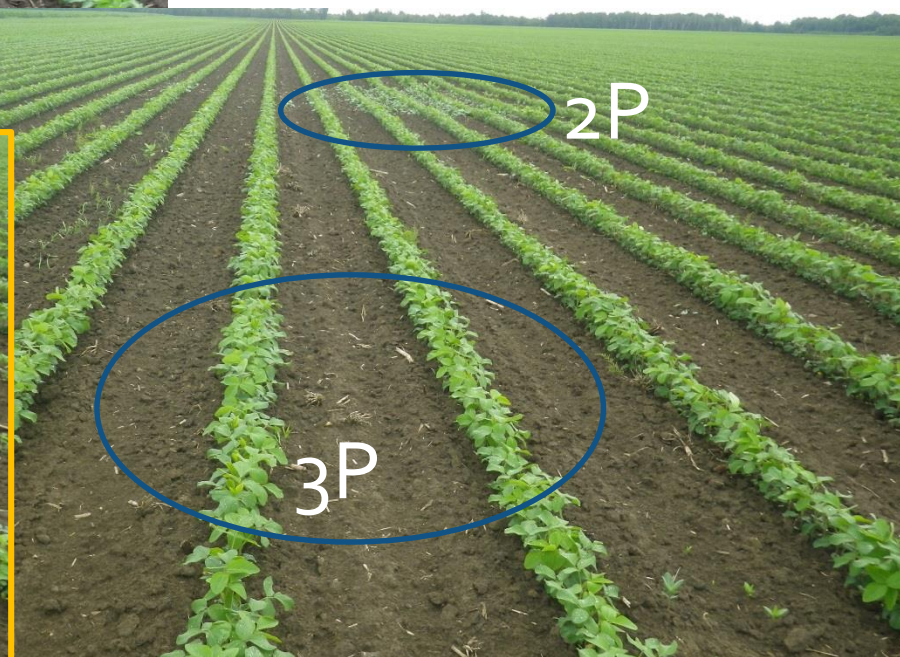
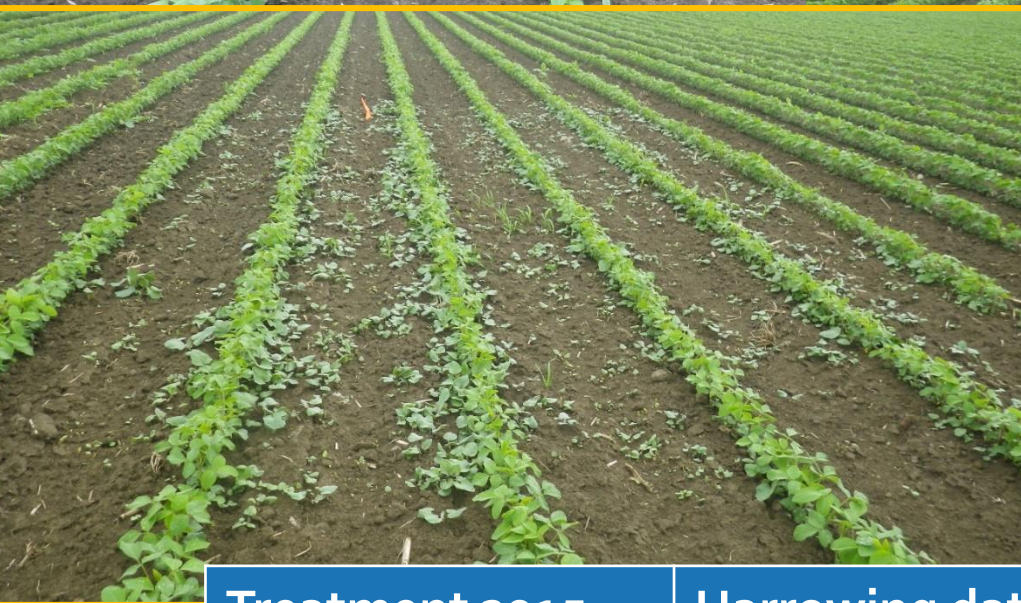


# Coltsfoot

## farm trial 6 (2015)



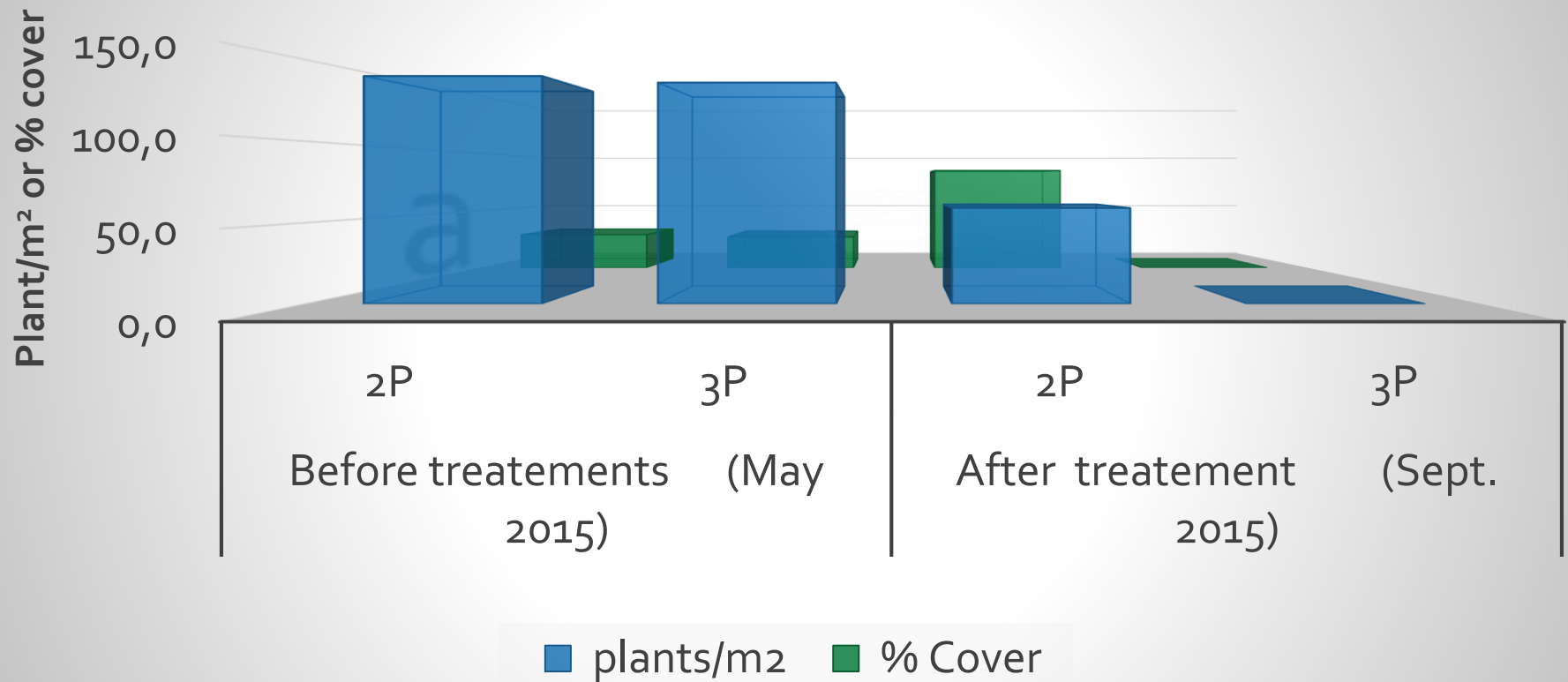
Before treat.  
138 pl/m<sup>2</sup> (8 reps)



Treatment 2015	Harrowing date	Date seeding
2 passes (2P)	May 17, June 28	June 28
3 passes (3P)	May 17, June 3, June 28	June 28



# Treatment effect on coltsfoot density and % cover in the spring and fall 1025



Differences due to treatment sign. at level 0,05





# Conclusion – farm trial 6



## Coltsfoot

- Excellent control with 3 destructions
- 2 destructions: the interval was probably too long and the weed had time to accumulate energy



Timing and weed stage = important



# It did not always work!

🌱 Spring fallow and soybeans with **short intervals** between destructions

- Spring fallow = 4 harrowing
- Dates: May 22, 25; June 3, 9 (**very short intervals**)
- Soybean seeded on June 9 *and cultivated*



# Effect of cultivated soybean on area covered with *C. thistle*

15/5/2014 9:54:08 am

Grey: thistle 2014  
55 pl/m<sup>2</sup>

Red: thistle 2015  
24 pl/m<sup>2</sup>



Thistle decreased but not enough  
Timing?

© 2015 Google

Google



# It did not always work!

🌱 Spring fallow and millet with **short intervals** between destructions

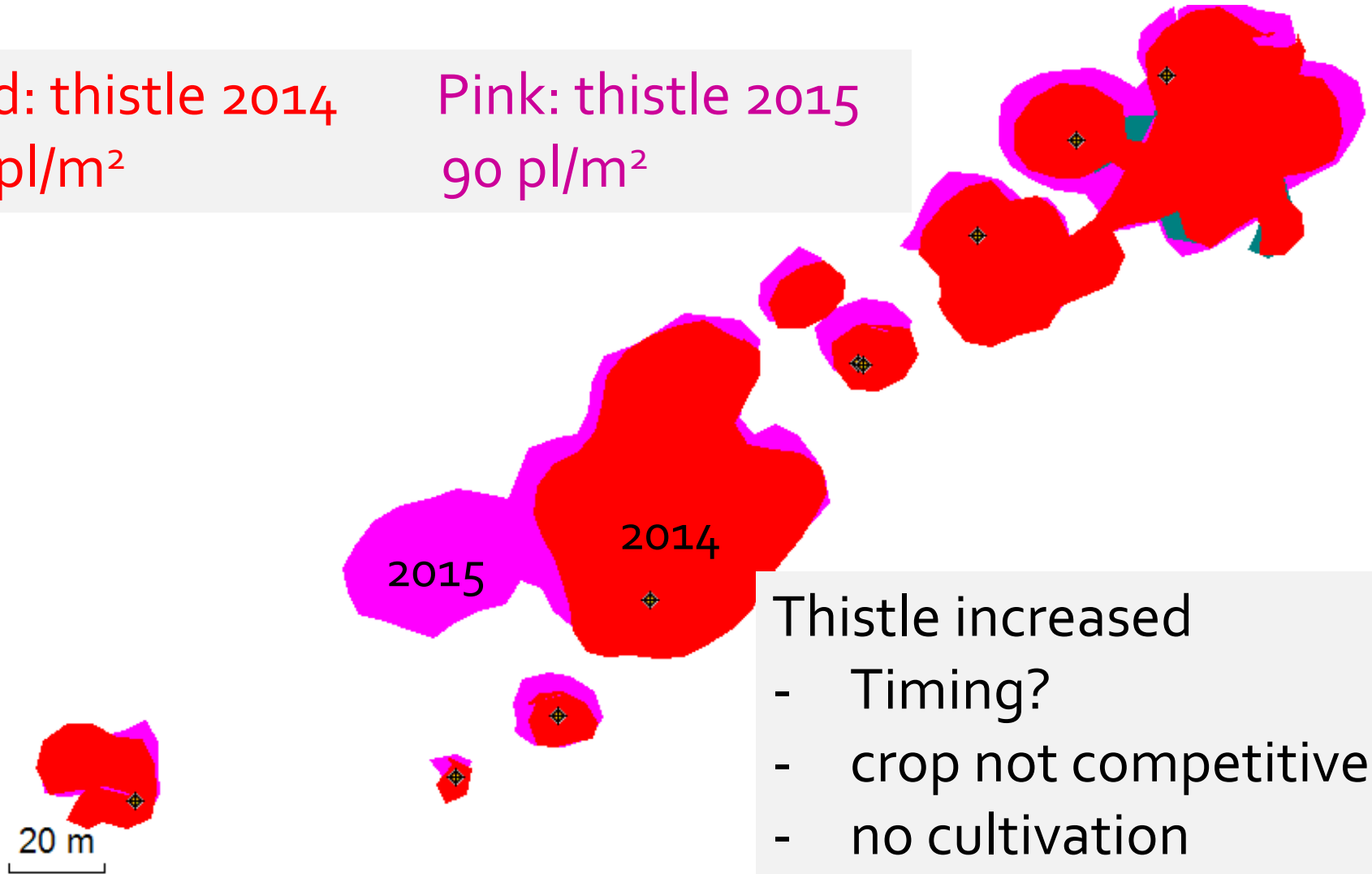
- Spring fallow (5 harrowing)
- Dates: May 22, 25; June 3, 11, 21
- Millet seeded on June 21
  - **slow start**
  - **NOT cultivated**



# Effect of non cultivated millet on area covered with C. thislte

Red: thistle 2014  
51 pl/m<sup>2</sup>

Pink: thistle 2015  
90 pl/m<sup>2</sup>



Thistle increased

- Timing?
- crop not competitive
- no cultivation





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  - 3.3 Role of row spacing and cultivation**
4. Other cultural practices
  - 4.1 Tillage
  - 4.2 Hay





# Timing



Best dates for first destruction and best intervals between destructions according to the trials (for 3 destructions – Montreal area):

	Canada and sow T.	Coldsfoot
Best date for first destruction	May 15-30	May 15-June 10
Best intervals between destructions	15-30 days	10-20 days

For 2 destructions: more precision required



- 🌱 CAUTION: only based of 5 years of observations; success is due to a combination of factors – numbers to be refined
- 🌱 Avoid: starting after mid-June (use plant stage to decide when to start)
- 🌱 Short or long intervals do not work: enough growth is required to exhaust the roots and plants must not be able to accumulate new reserves





## 3.2 Role of a competitive crop

No crop competition =  
treatments not effective  
Observed many times



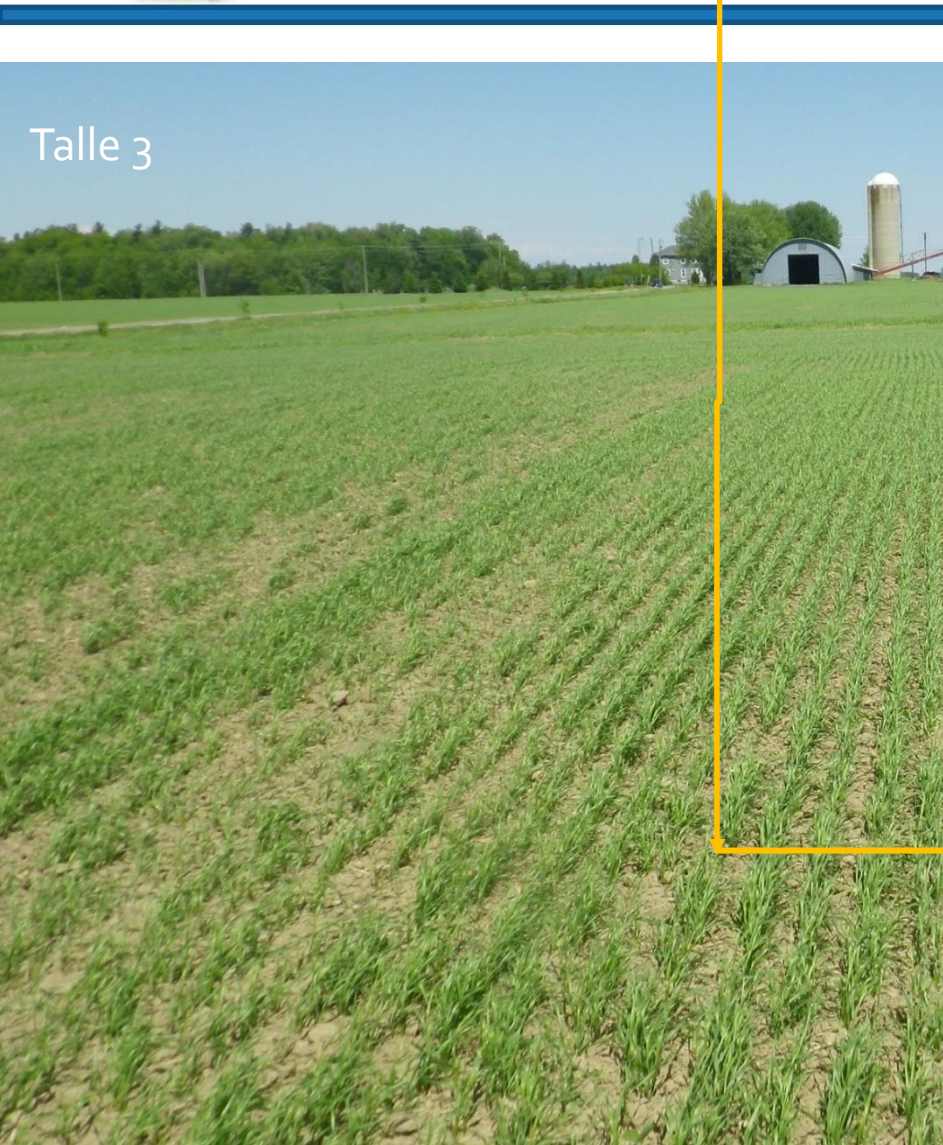
Soybean destroyed by  
cultivation = coltsfoot  
grows well (same for  
the 2 other thistles)







And regrows well the next season...



Talle 3



Good crop previous year – 4 pl/m<sup>2</sup>



Damaged crop previous year – 120 pl/m<sup>2</sup>





## 3.3 Role of row spacing and cultivation

Row spacing 12,5  
cm (5 in)

Row spacing 75 cm  
(30 in) + cultivation







# Following year



14 / 07 / 2014





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  - 3.2 Role of an aggressive crop
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4. **Other cultural practices**
  - 4.1 **Effect of tillage**
  - 4.2 **Effect of hay**



## 4.1 Effect fall plowing

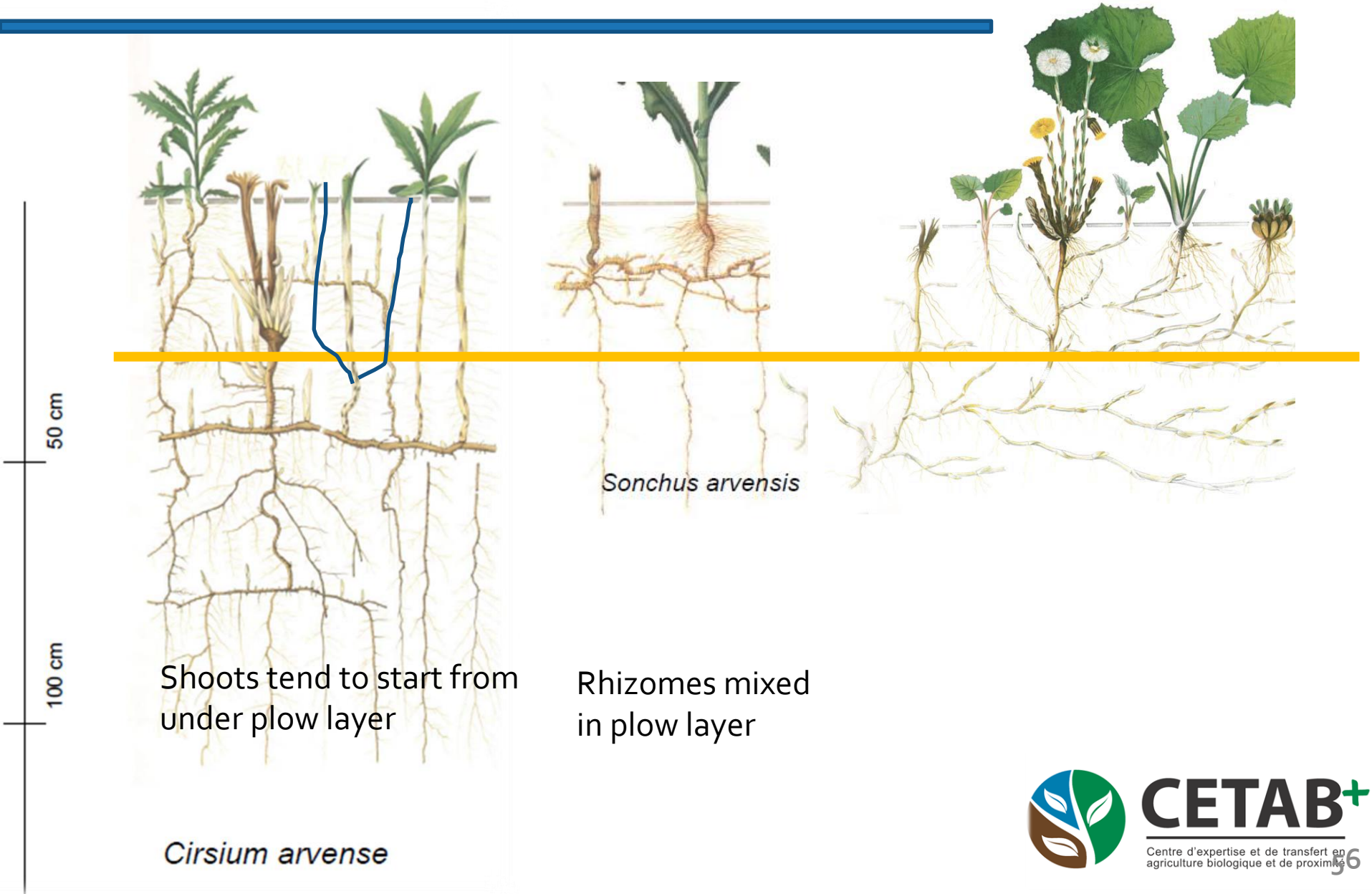


- 🌱 Plowing: can be effective against Canada thistle <sup>1</sup>
  - also observed in trial but the effect consists in giving an advance to the crop
- 🌱 Plowing: not effective against sow thistle<sup>1</sup>
  - also observed in trial

<sup>1</sup> Melander, Bo, N. Holst, L. A. Ramussen, P.K Hansen. Direct control of perennial weeds between crops – Implication for organic farming  
Crop protection 40:36-42. 2012.



# Roots– vs depth of plowing







# Effect of plowing on Canada T.

## Moldboard plow versus no-till (ridges)

No fall tillage (ridge)

Fall plowing

Canada thistle starts faster

03 / 06 / 2013



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# Effect of plowing on Canada T.

## Moldboard plow versus no-till (ridges)

Fall plowing

No fall tillage (ridge)

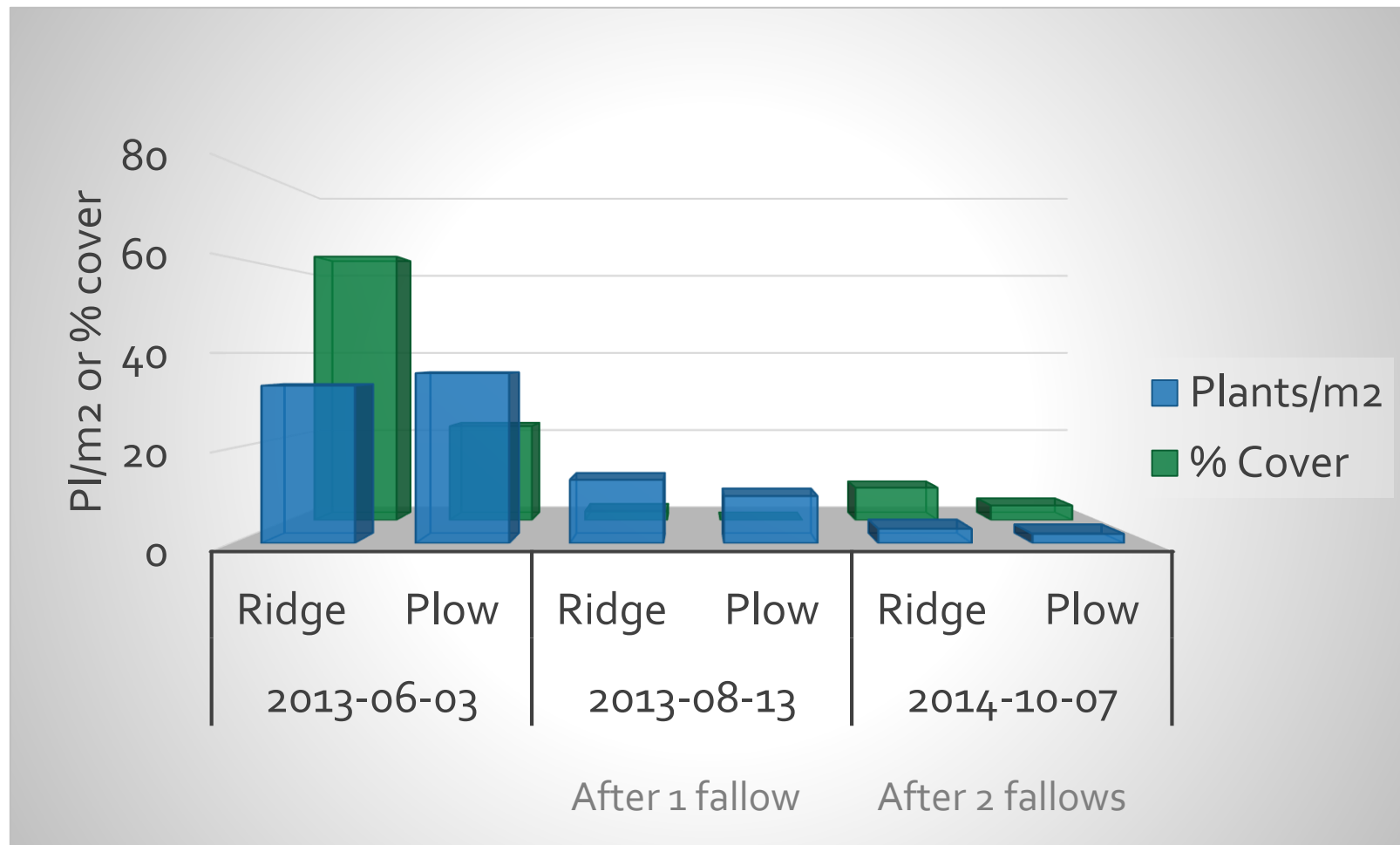
Thistle starts faster but density is the same

After a spring fallow, the difference tends to disappear

03/06/2013



# Effect of plowing on C. thistle density and %cover



Stats: Pl/m2  
Stats: % cover

NS  
\*

\*  
\*

NS  
NS



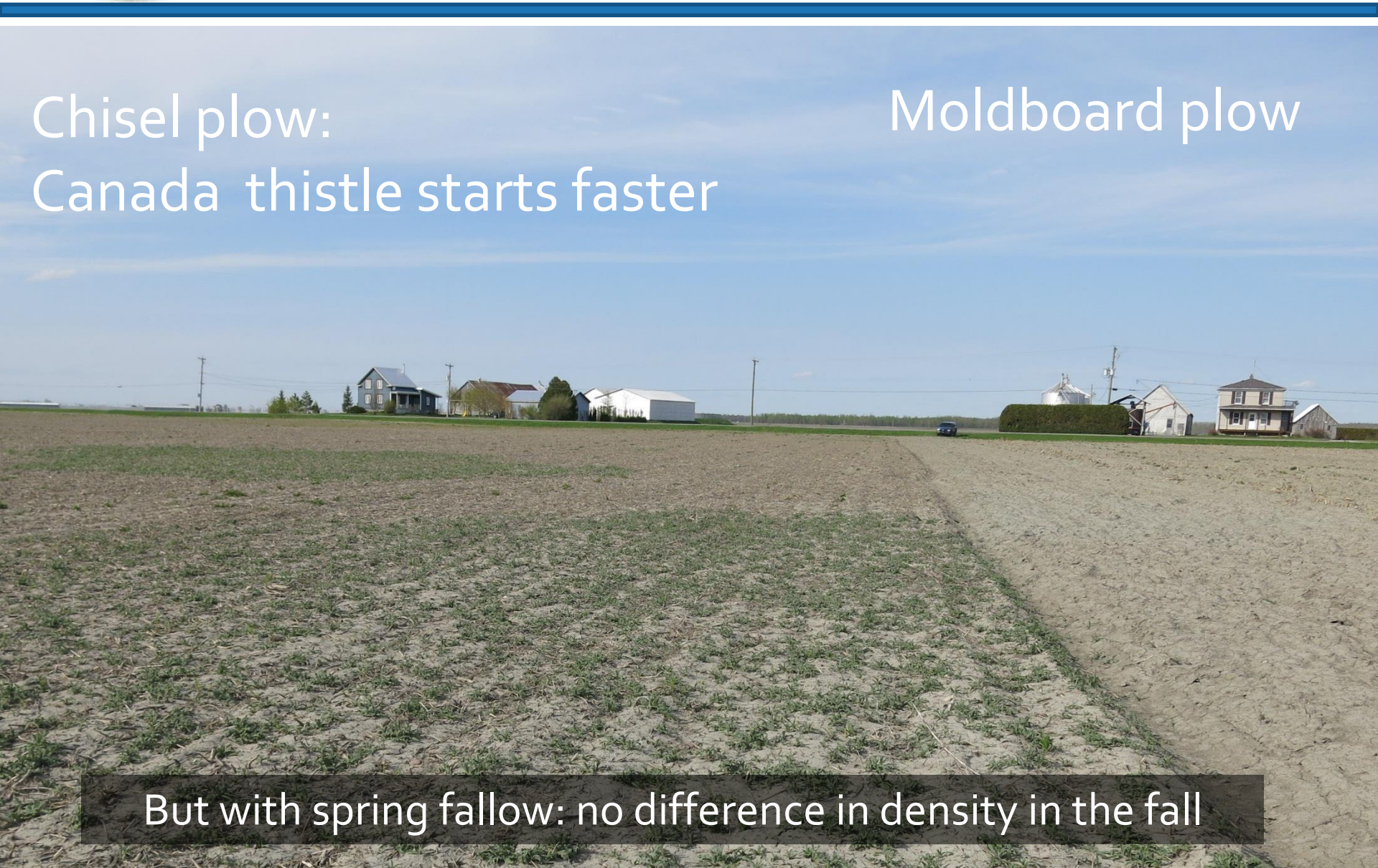


# Effect of plowing on Canada T.

Moldboard versus chisel plow

Chisel plow:  
Canada thistle starts faster

Moldboard plow

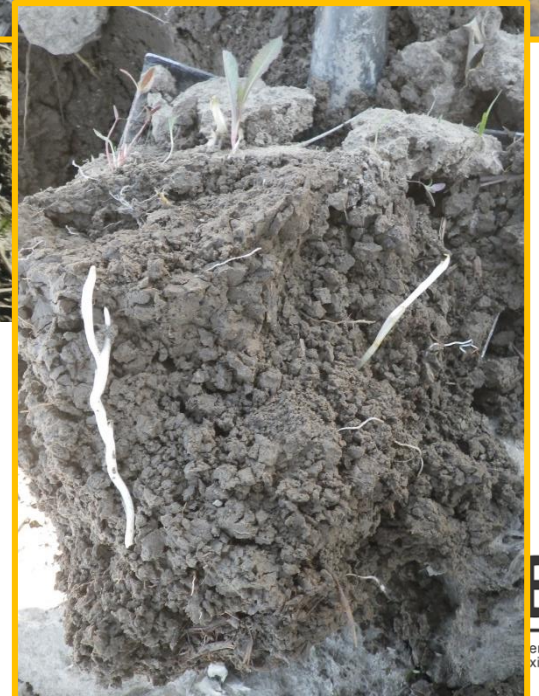


But with spring fallow: no difference in density in the fall





# Fall plowing – observation on Sow thistle



Rhizomes at all depth – some  
plants start very fast; many  
different stages

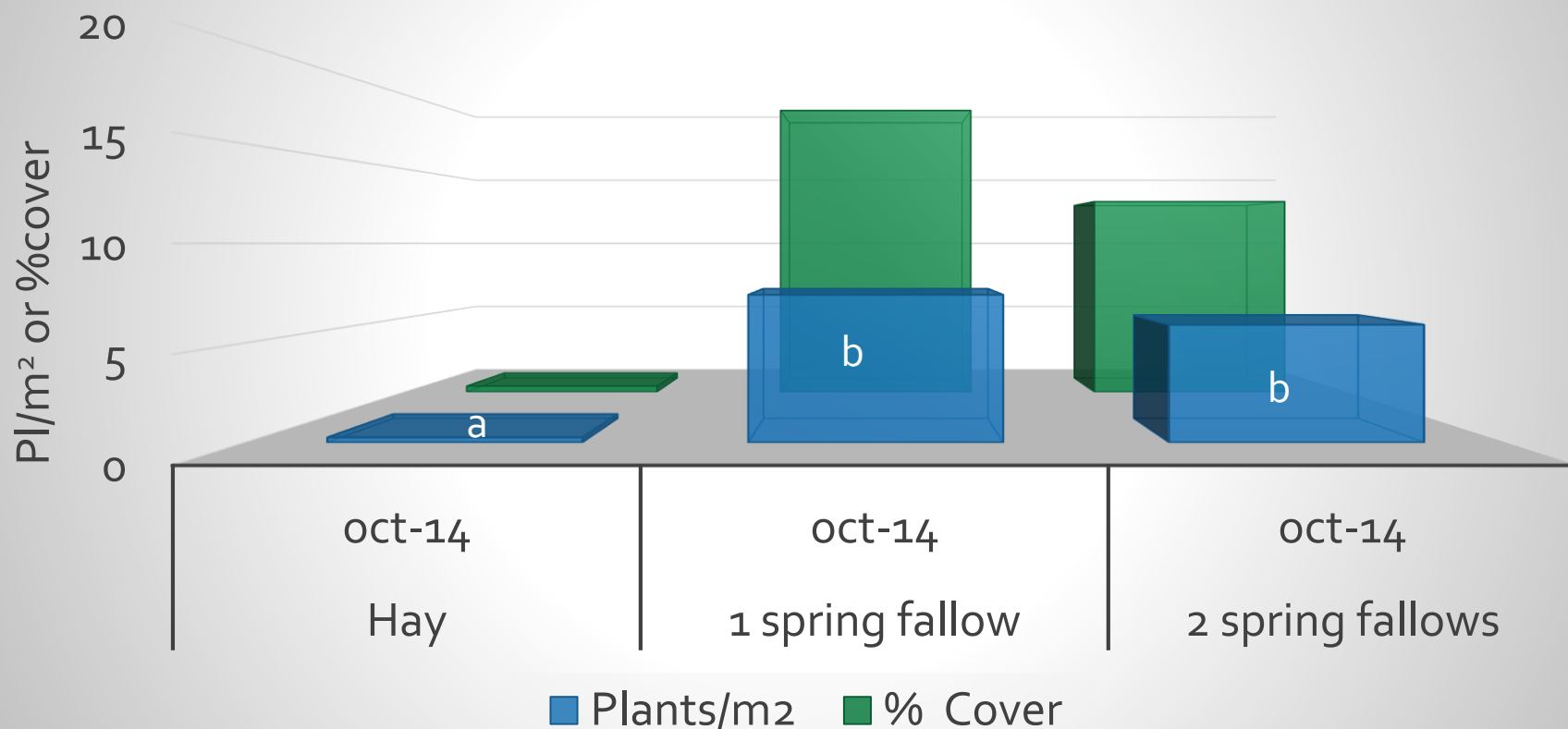




## 4.2 Effect of hay – farm trial on Canada thistle – (1 trial+observations)

Before treatments (mai 2013): 20 plants/m<sup>2</sup>; 40% cover

Hay = the most effective

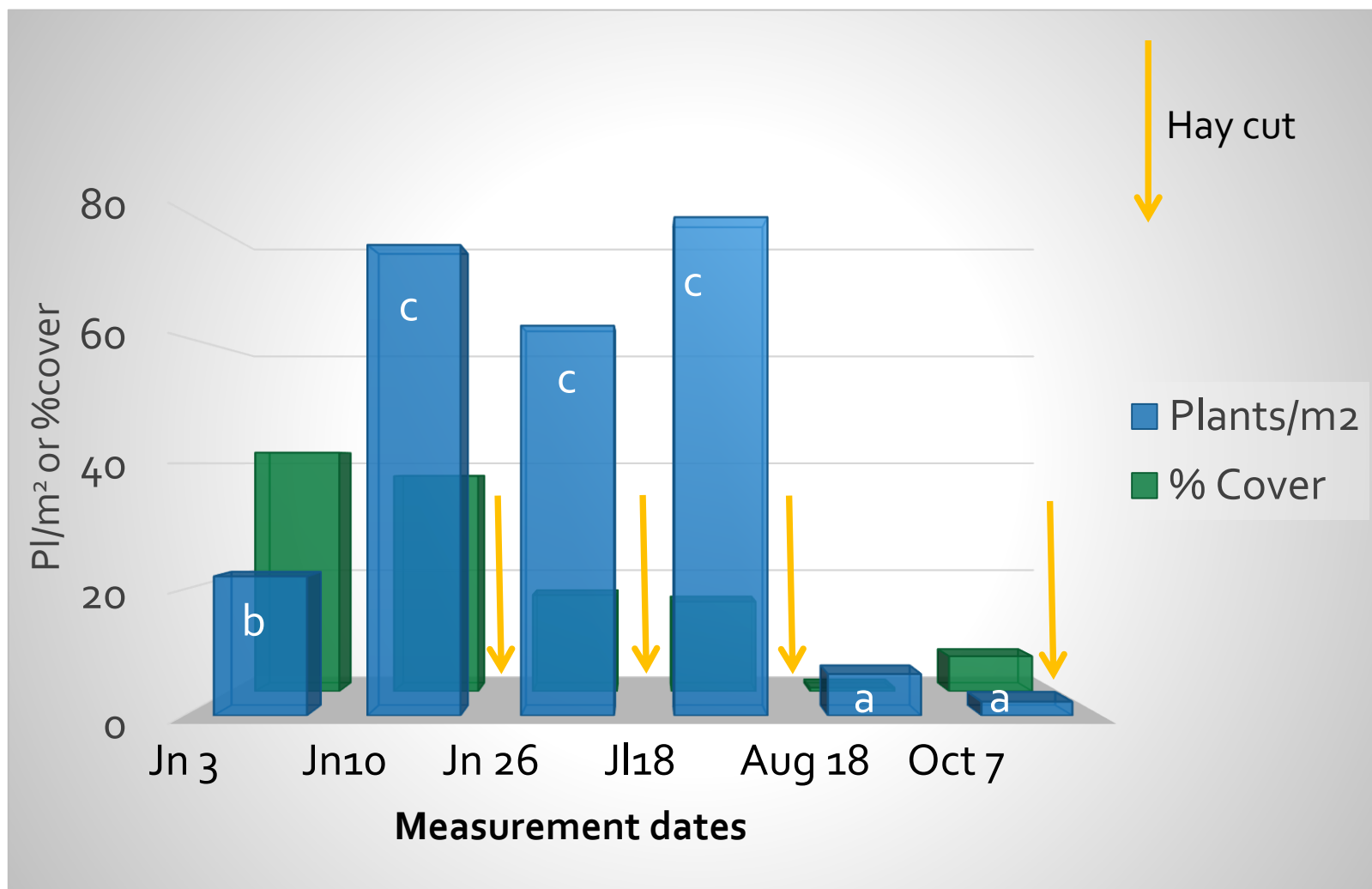


Means with different letters are statistically different at level 0,05



# Canada thistle slows down after 3 cuts of hay (1 trial)

Haycut: June 20, July 9, Aug 10, Oct 10;



Means with different letters are statistically different at level 0,05





# Effectiveness of hay

- Can be very effective, even with just one year
  - Need to make sure that the hay can grow (in areas dominated by the weed it may be difficult)
  - Need more than 3 cuts
- It does not work if weeds are aggressive and alfalfa cannot establish
- We observed situations with poor results with sow-thistle and we are not sure why – probably poor establishment of hay at the beginning



# Conclusion

and points to remember for a good control

- 🌱 Spring fallow followed by a cultivated soybean crop works well
- 🌱 Weeds have to be properly destroyed with efficient wide sweep that overlap well
- 🌱 Weed destruction timing is crucial – more work required on ideal timing
- 🌱 Plowing may help for Canada-thistle but not sow thistle – unknown for coltsfoot
- 🌱 Hay is effective - 3 cuts seem necessary
- 🌱 Do not let seedling establish in the fall







<http://www.cetab.org/>

## Check for the reports

- Development of two methods to combat perennial sow thistle (*Sonchus arvensis* L.) and Canada thistle (*Cirsium arvense*) in organic field crop production
- Comparaison of two methods to combat (*Tussilago farfara* L.) in organic field crop production (will be posted later)

Translated by Amy Kremen - COG



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Check also our detailed document on subsoiling:

Successful subsoiling depends not only on soil conditions.

- Other factors such as tractor power and balancing, tine protection mechanism strength, and subsoiler adjustments play an essential role in obtaining good results.

- Working depth, and tine spacing and geometry must be taken into account in order to succeed. If it is not possible to work at the desired depth or when the subsoiler cannot be adjusted, alternative strategies are available in order to achieve proper soil loosening



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## A GUIDE TO SUCCESSFUL SUBSOILING





# Funding and partnership

## Funding

- Natural Sciences and Engineering Research Council of Canada (NSERC)
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## Partners

- Ferme Agri-Fusion 2000 Inc.
- Ferme Alain Ravenelle
- Fermes Longprés 2009 Ltée
- Ferme Mylamy
- Ferme Tullochgorum
- Ferme Ancestrale 1793 inc.

**Thank you!**













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# Collaboration



-  Noémie Gagnon Lupien, biologist, M.Sc., CETAB+
-  Joshua Bougon-Ronin, trainee
-  Murielle Bournival, agr., CETAB+
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-  Jean Duval, agr., Ph.D., CETAB+
-  Aurélie Demers, technician, CETAB+
-  Audrey Fréchette, student, Cégep de Victoriaville
-  Jean-Pierre Hivon, agr., CETAB+
-  Denis La France, teacher, Cégep Victoriaville
-  Olivier Thibodeau, student, Cégep de Victoriaville



# Thank you

