Winter Oilseed Rape (WOSR) pest control in France:

*Examples of the **rape winter stem weevil (C. picitarsis),** cabbage stem flea beetle (P. chrysocephala) and green peach aphid (M. persicae) management.*

Ruck L. – Robert C. **Terres Inovia**

Delos M. **SRAL/DRAAF Occitanie**

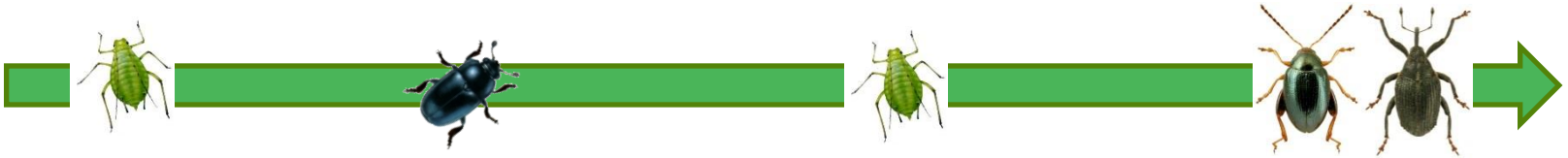
Contact:
l.ruck@terresinovia.fr

OEPP – WORKSHOP BERLIN
2017/09/20-22

Context : several insect species are resistant to insecticides

For decades, WOSR pest management has relied on insecticide applications and limited chemical families

➡ **EMERGENCE OF RESISTANT POPULATIONS IN FRANCE**



1997:
Green peach aphid (*Myzus persicae*) resistance to PYR

1999:
Pollen beetle (*Meligethes aeneus*) resistance to PYR

2009:
Green peach aphid (*Myzus persicae*) resistance to pirimicarb

2014-2015:
Rape winter stem weevil (*Ceutorhynchus picitarsis*) and cabbage stem flea beetle (*Psylliodes chrysocephala*) resistance to PYR.

***Phyllotreta sp. , C. pallidactylus , C. napi , C. obstrictus* : no resistance today**

(monitoring in progress)

60 ans Terres Inovia
l'agronomie en mouvement

Green peach aphid

Green peach aphids are resistant to pyrethroids and carbamate in France. Neonicotinoids (foliar application) are the only remaining effective solution.

This aphid is a problem in France through the transmission of viral diseases (TuYV, CaMV and TuMV)

Evaluation of the interest of tolerant varieties against TuYV in comparison with insecticide treatment (ongoing work).

Tolerant variety	Insecticide protection
Sensitive variety	No protection

X

60 ans Terres Inovia l'agronomie en mouvement

Bulletin de santé du végétal ÉCOPHYTO

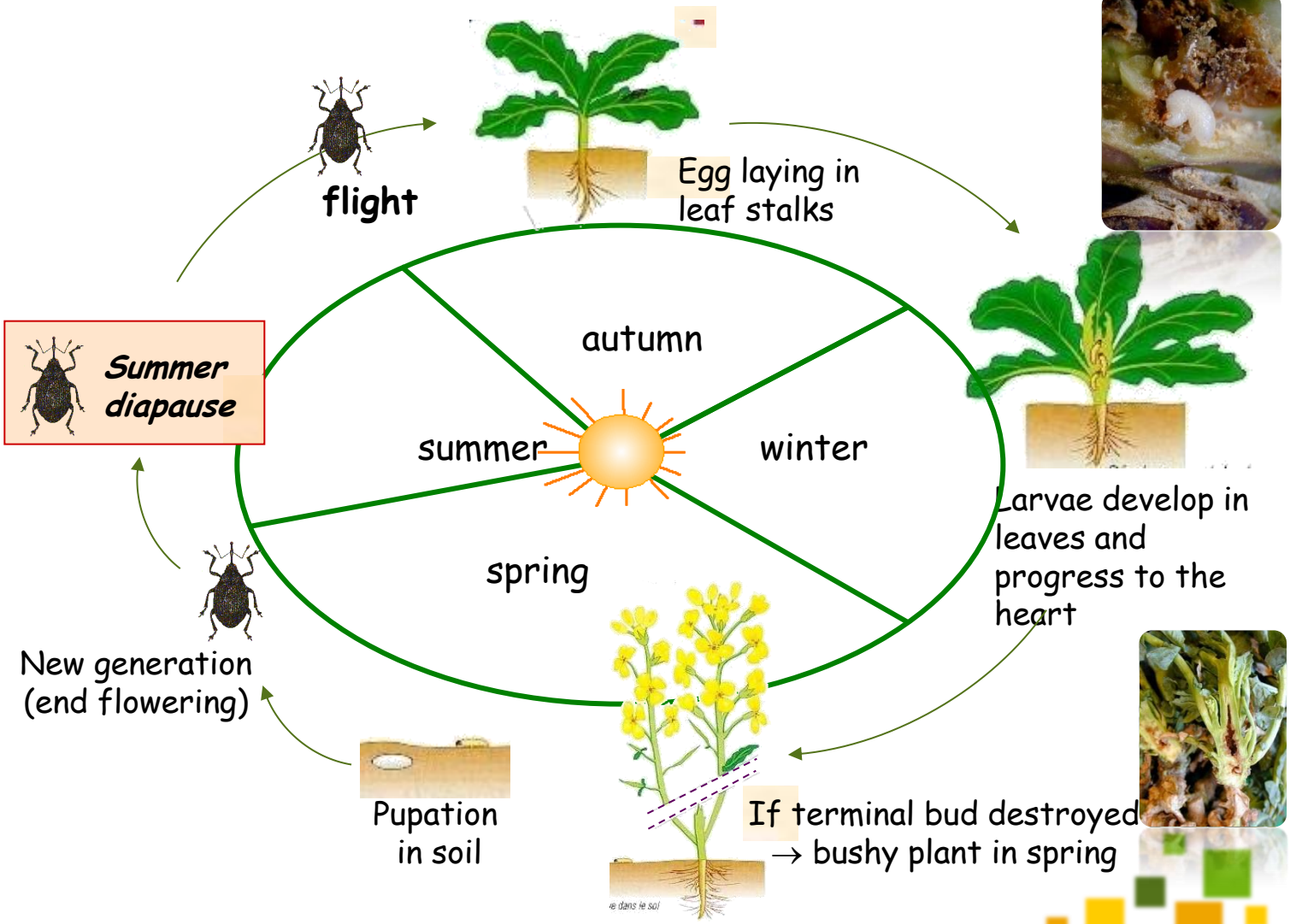
Life cycle of *rape winter stem weevil*

The life cycle is similar to cabbage stem flea beetle

BUT:

-Weevil adults do not induce damage.

- Weevil eggs are laid in the leaf stalks



Very low infestation levels (number of egg/larvae per plant) can induce important damages, even with one larvae per plant

More information about rape winter stem weevil

A very discreet **adult**. Detection of **eggs and young larvae** requires precise observations (binocular, magnifying glass). It's difficult to base the control strategy on the first eggs observations.

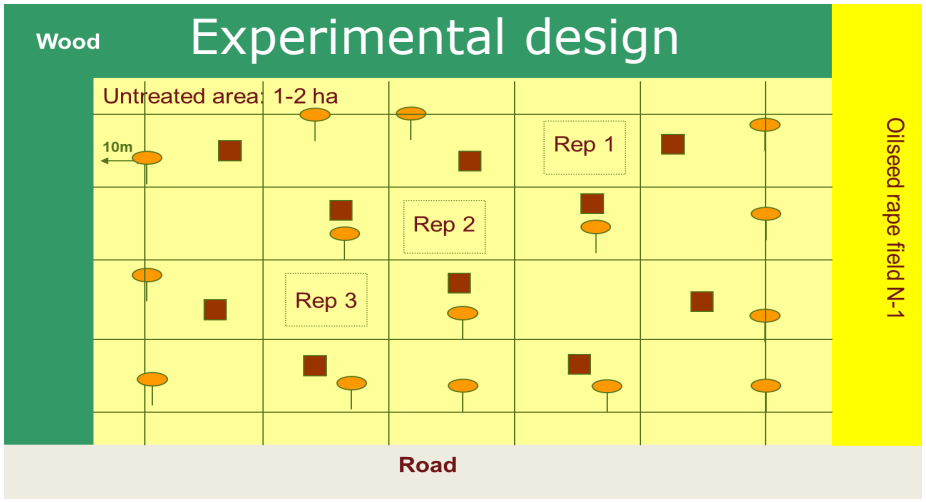
Among the available insecticides, none is effective against eggs or larvae. When the damage is observable (larvae in the heart of plants, or bushy plants), it is too late to spray.

Decision rules

No treshhold. Spraying against adults is the priority source for control : application just before egg laying. The decision is based both on trapping in field and on a regional trapping network -usually 10-15 days after first insect trapped.

Trapping rape winter stem weevil

The number of adults caught in yellow traps is not correlated with the real infestation (number of insect/m²). Yellow trap gives only a qualitative information and the signal of a beginning infestation.



Yellow trap on top of the vegetation

Box

Yellow trap

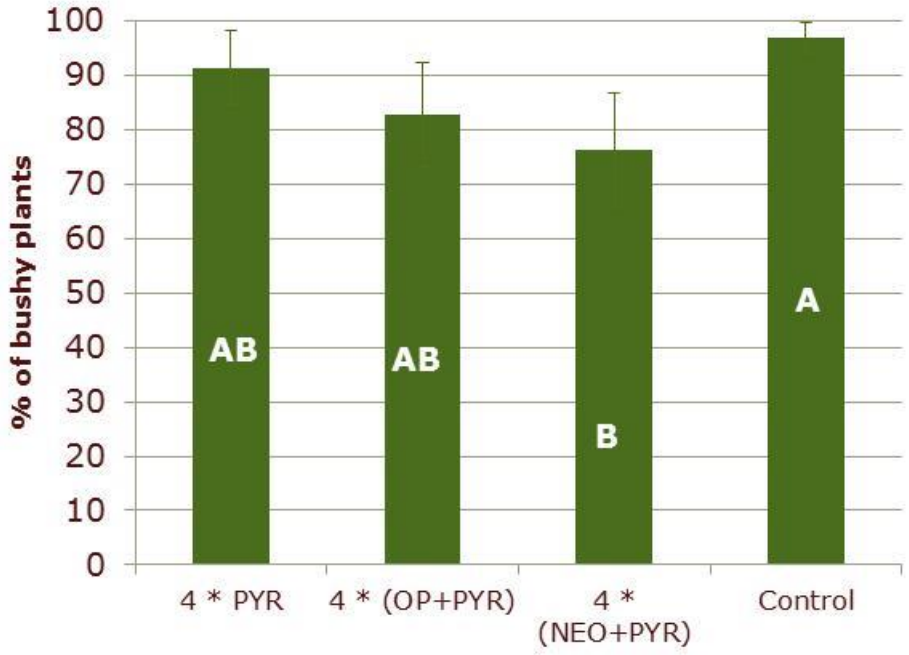
box

larvae

Significant correlation

No correlation

Example of insecticide low efficiency on rape winter stem weevil in field



(Lunery, March 2014)

- A very low efficacy even after 4 foliar applications.
- Plants with low biomass before winter (fresh matter 136 g/m2) are more susceptible to damages

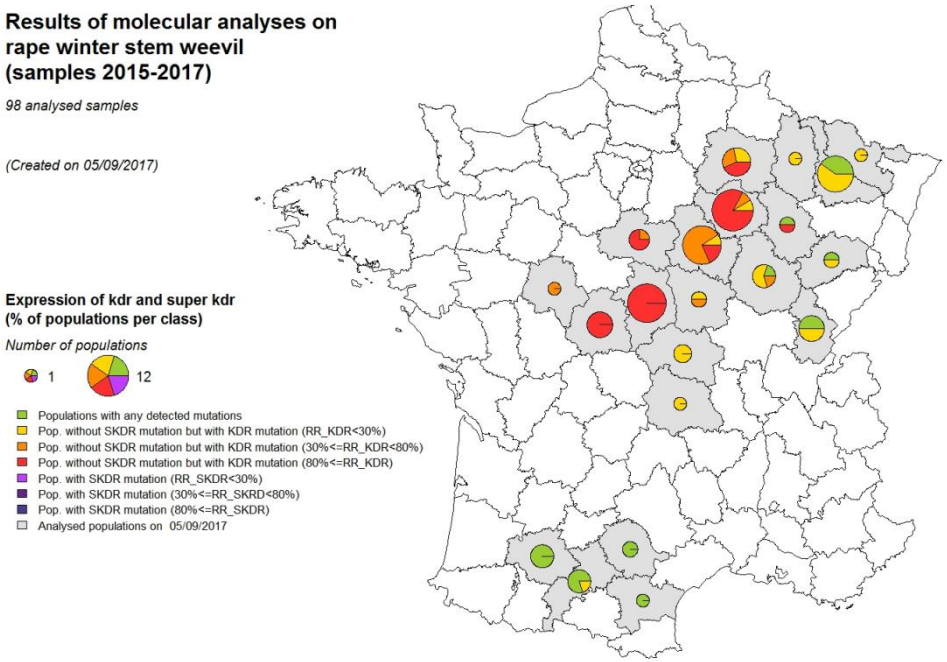
Test of Tukey 5%

Egg lying begins around 15th October
Foliar applications: 3rd-10th-18th October and 28th November
Mortality rate in vial test : 30% (no information on resistance mechanism) involved

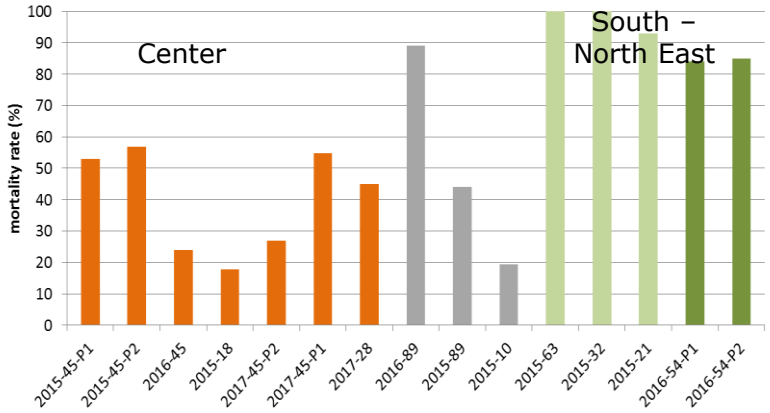
Terres Inovia
l'agronomie en mouvement

Update pyrethroid resistance mechanims of rape winter stem weevil

Frequency of kdr mutations in 98 populations 2015-2017



Mortality rate in vial tests, after a 24 hours exposure to 15ng/cm² of λ-cyhalothrin. 2015-2017(15)



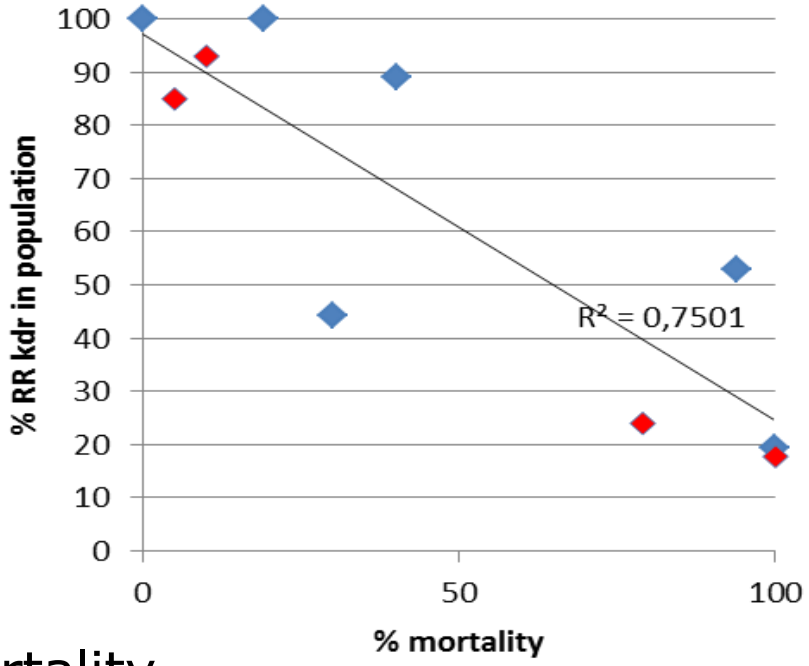
Mortality rate is very variable in the 15 vial tests : from 17% (Cher, Aube) to 100% mortality

Main resistance mechanisms to pyrethroid selected: mutations kdr and metabolic resistance. No skdr mutation.
Three other target site mutation were identified.

60 ans Terres Inovia
l'agronomie en mouvement

More inormation about pyrethroid resistance mechanims of winter stem weevil

Correlation between kdr frequency in rape winter stem weevil populations and their sensitivity to insecticide (at 15ng/cm² de λ-cyhalothrin).



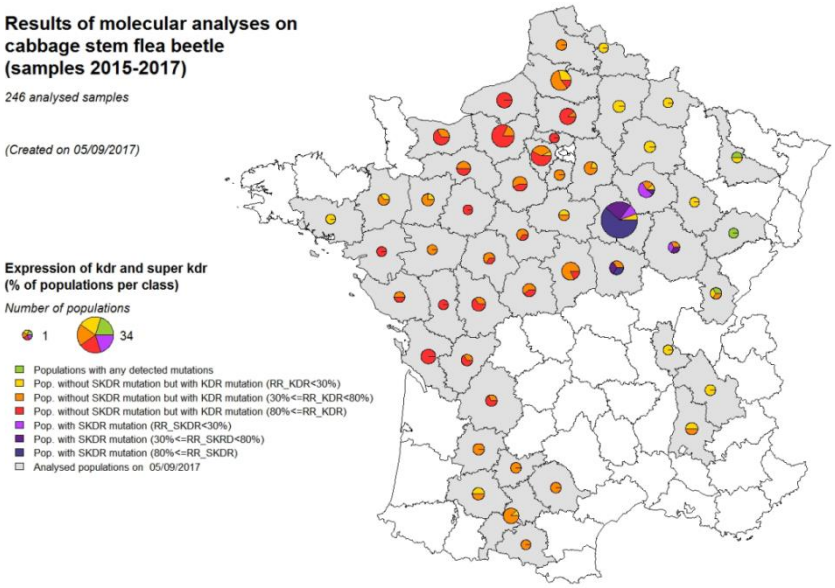
Mortality rate is very variable in the 10 vial tests : from 17% to 100% mortality

Despite mechanisms by detoxification, **kdr mutation** seems to have a visible effect on the mortality rate (red population with detoxification, blue no information).

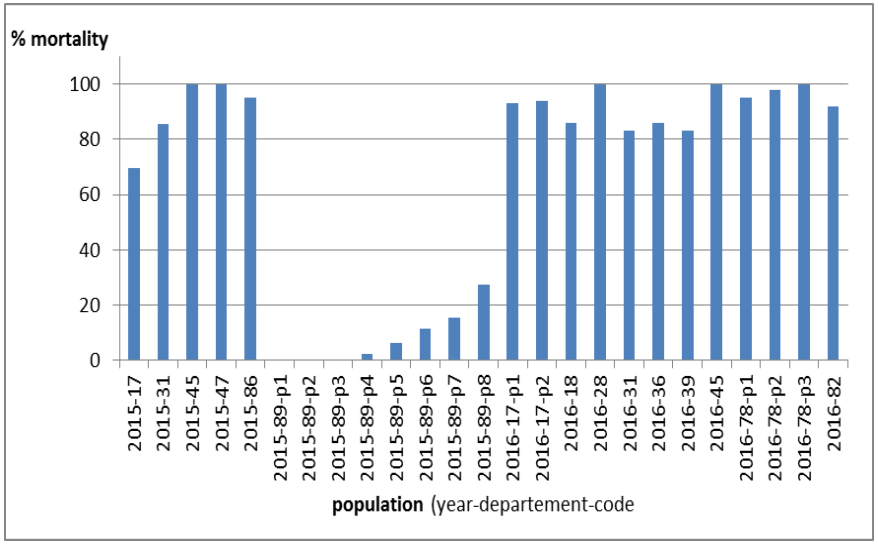
60 ans Terres Inovia
l'agronomie en mouvement

Update resistance of cabbage stem flea beetle

Frequency of kdr and skdr mutations in 246 cabbage stem flea beetles populations 2015-2017.



Mortality rate in 25 vial tests, after a 24 hours exposure at 15ng/cm² of λ-cyhalothrin 2015-2017.



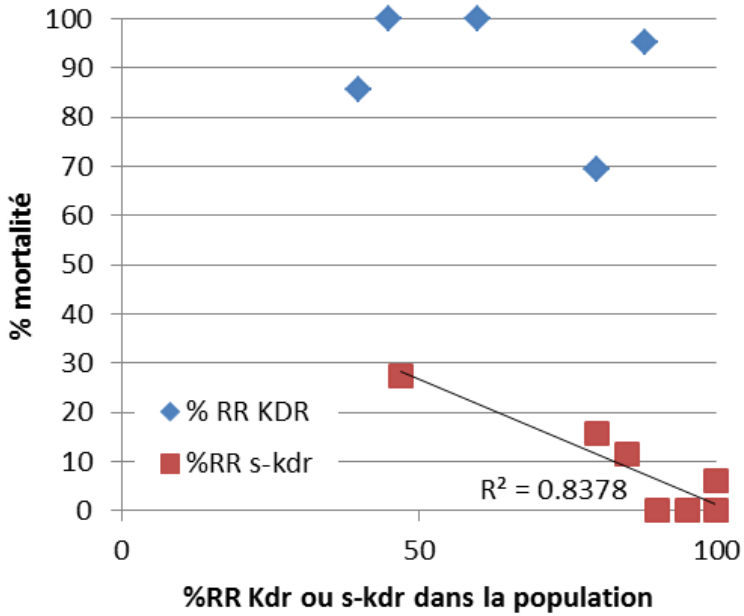
- Main **resistance mechanisms** to pyrethroid detected: mutations (kdr and skdr) ; metabolic resistance. Two other target site mutations were identified.
- **Mortality rate** variable (25 vial tests): less than 30% in Yonne up to more than 70% elsewhere

60 ans Terres Inovia l'agronomie en mouvement

More information about resistance of cabbage stem flea beetle

Correlation between kdr/skdr frequency in cabbage stem flea beatle populations and their sensitivity to insecticide (at 15ng/cm² de λ-cyhalothrin).

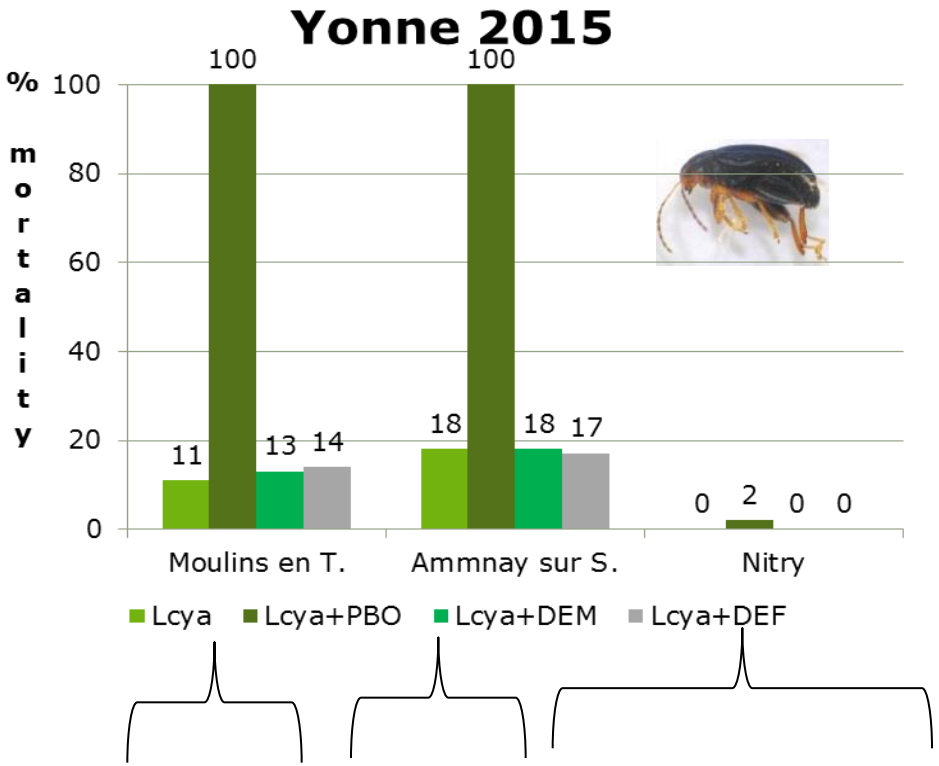
12 populations with variable frequencies of kdr alone or skdr mutation.

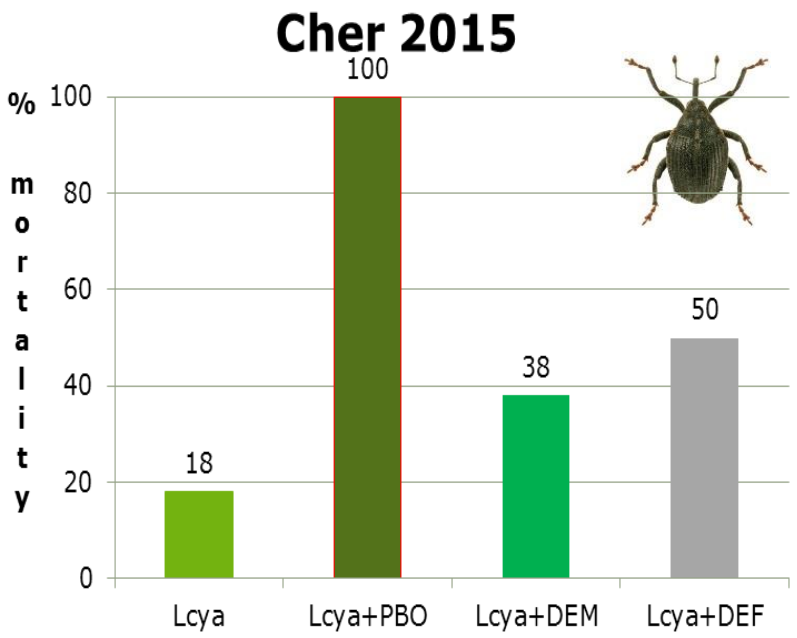


- % kdr mutation : no marked effect on the mortality rate in bottle tests.
- % Skdr mutation : populations with skdr more resistant than those without this mutation. It seems that there is a correlation between the mortality rate in the vial test and frequency of skdr mutation

Examples of metabolic resistance

Mortality rate after a 24-hours exposure to l-cyhalothrin at 15 ng/cm2





High metabolic resistance level

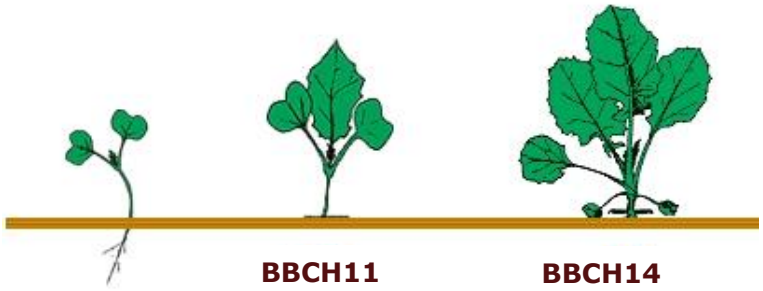
Probably other mechanism involved

Very fiew results metabolic resistance

Terres Inovia
l'agronomie en mouvement

Preventive measures

Adults - risk avoidance approach



Slow growing phase

Adults migration into fields between September 20 and early October.

Strategy

Adapt sowing date to reach BBCH14 stage (after slow growing phase) around the 20th September

Sowing date between 15th – 31th August

Preventive measures

Larvae : the autumn biomass growth dynamic is determinant.
It is a race between the speed of migration of the larvae (to the heart) and the growth of the plant (biomass producing).

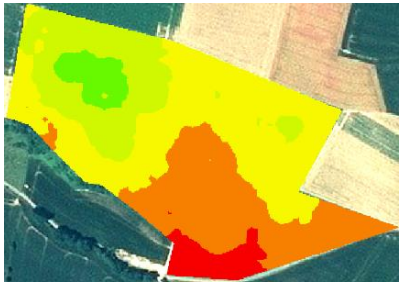
Mobilise all the agronomical techniques to succeed in having a quick and continuous growth of the crop in autumn and at the beginning of spring:

– Pay attention to crop establishment and favour the root system growth (sowing date, soil preparation, P2O5…)
– Avoid nitrogen deprivation (organic fertilizer, WOSR with frost sensitive legume crop…)
– Pay attention to phytotoxicity or to any accident that could stop the growth.

Flea beetle larvae are less harmful on strong crops.

A satellite map of rape biomass before winter

>1,0 kg/m²



Farmstar-Airbus

	0.2 - 0.4	0.0
	0.4 - 0.6	5.7
	0.6 - 1.0	27.3
	1.0 - 1.5	40.9
	1.5 - 2.0	21.1
	2.0 - 2.5	5.1
	2.5 - 3.0	0.0
	> 3.0	0.0

Biomasse moyenne produite 1.3 kg/m²

Azote moyen absorbé 82 Unités

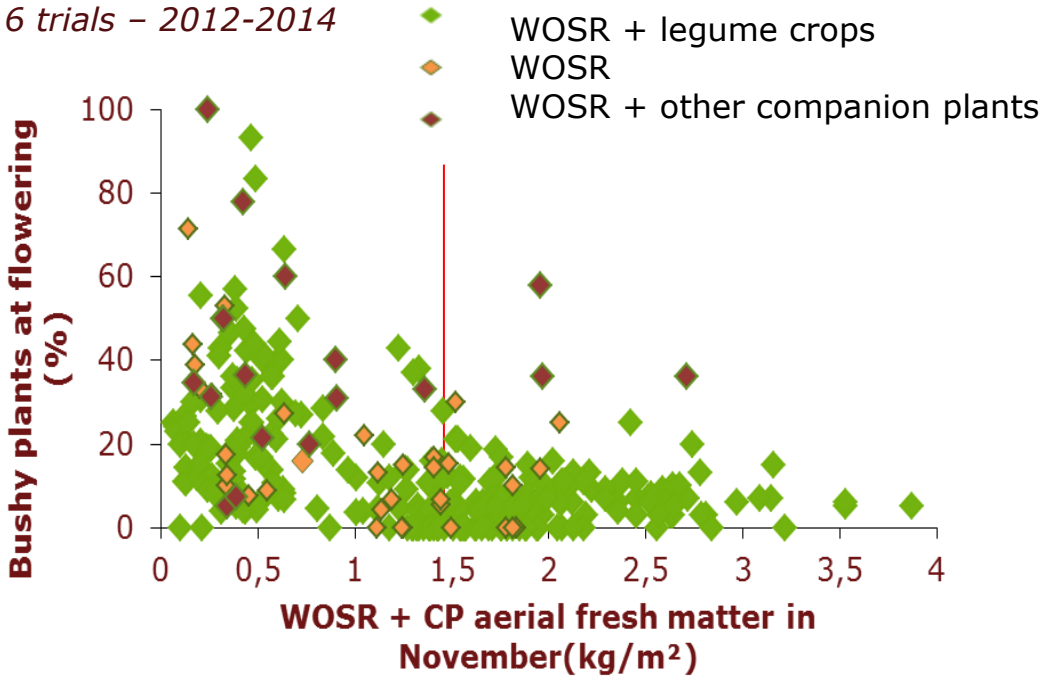
0,6 à 1,0 kg/m²

0,4 à 0,6 kg/m²

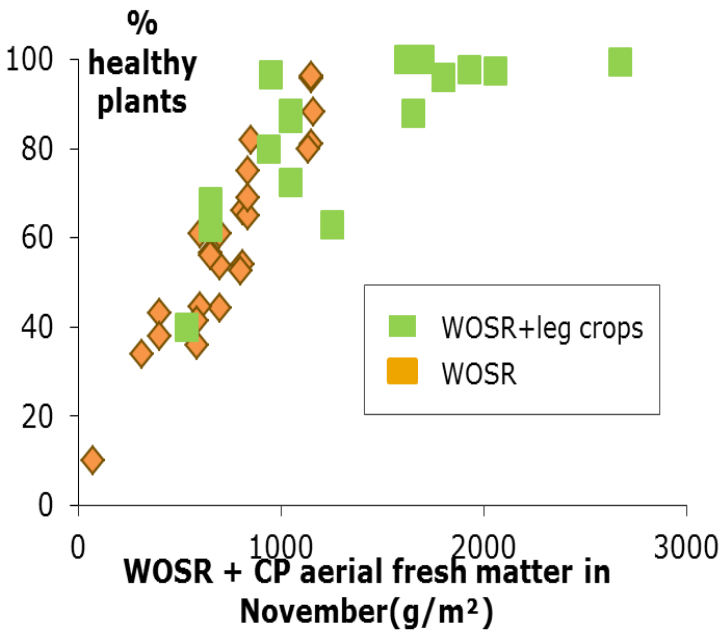
60 ans Terres Inovia
l'agronomie en mouvement

Importance of autumn plant growth to reduce damages caused by RWSW

6 trials – 2012-2014



Farmers fields -2016



Positive impact of a good crop establishment and a continuous crop growth (**WOSR + legume crop = 1,5 kg/m²**) to limit the % of bushy plants at flowering.

(Cadoux et al. , 2015)

On shallow and/or stony soils, it is easier to reach high biomasses with leguminous associations

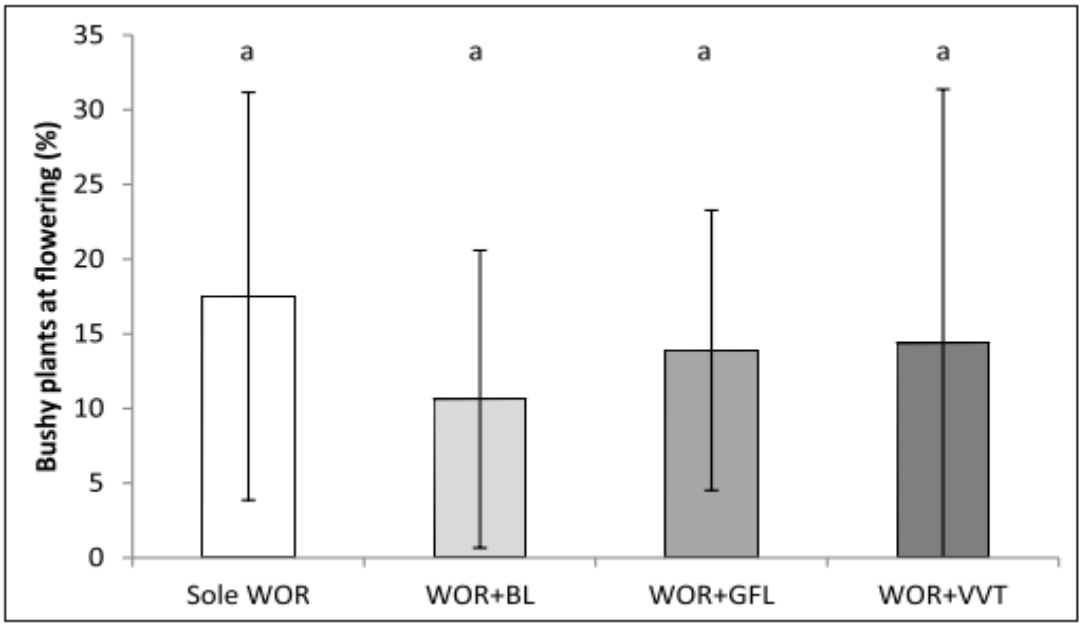
(Sauzet, 2016)

Terres Inovia
l'agronomie en mouvement

WOSR with frost sensitive legume crop

(Cadoux et al. , 2015)

(6trials - 2012-2014)



BL: faba bean (*Vicia faba*) + lentil (*Lens culinaris*)

GFL : grass pea (*Lathyrus sativus*) + fenugreek (*Trigonella foenum-graecum*) + lentil

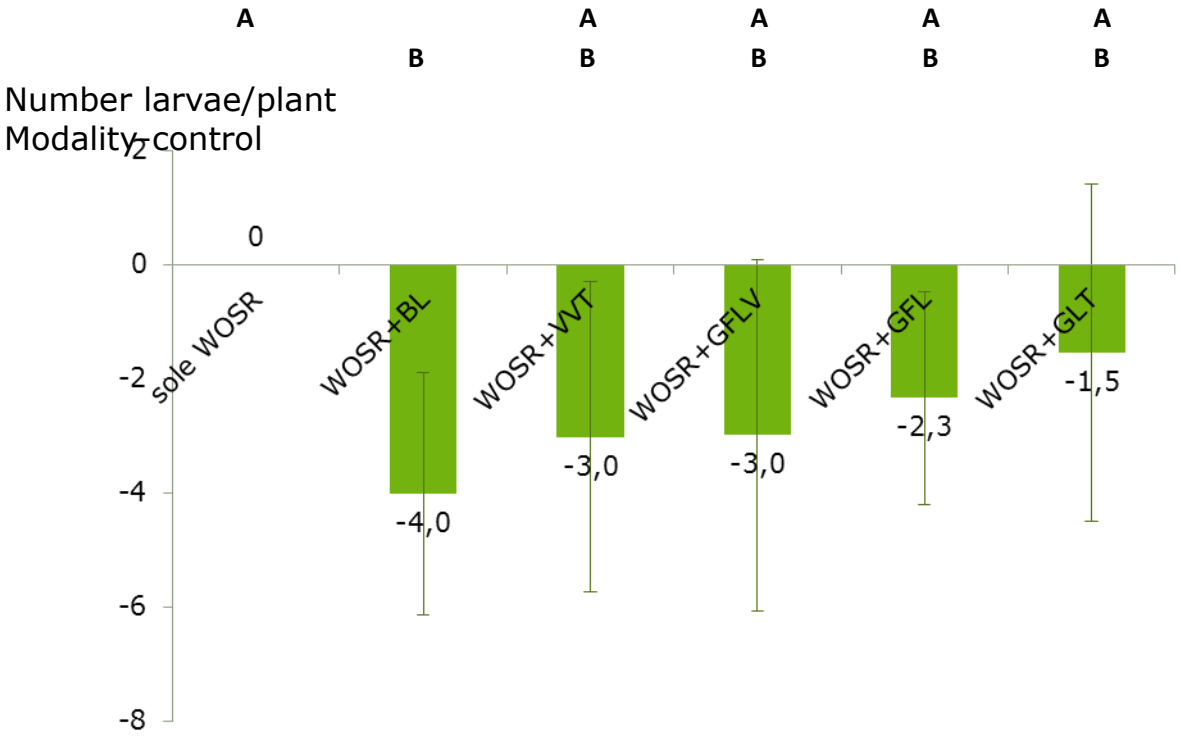
VVT: purple vetche (*Vicia benghalensis*) + common vetch (*Vicia sativa*) + berseem clover (*Trifolium alexandrinum*)

- Lower % of bushy plants at flowering for intercrop treatments.
- The difference is not significant but the p-value is low (p=0.095)
- Unknown mechanisms (physical barrier, olfactory cues changes, strongest WOSR growth …?)

60 ans Terres Inovia
l'agronomie en mouvement

WOSR with frost sensitive legume crop

(2 trials - Charentes)



BL: faba bean (*Vicia faba*) + lentil (*Lens culinaris*)

VVT: purple vetche (*Vicia benghalensis*) + common vetch (*Vicia sativa*) + berseem clover (*Trifolium alexandrinum*

GFL : grass pea (*Lathyrus sativus*) + fenugreek (*Trigonella foenum-graecum*) + lentil

GFLV = GFL +commun vetche (vicia sativa)

GLT=grass pea (*Lathyrus sativus*) +lentil + berseem clover (*Trifolium alexandrinum*)

Reduction of the number of larvae significant for bean-lentil association **(faba bean effect)**

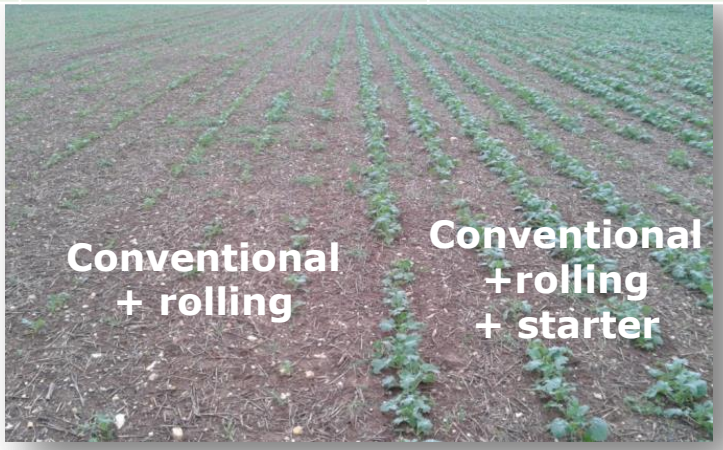
)

Rolling against adults cabbage stem flea beetle

In November

	Conventional + rolling + fertilization	Conventional + rolling	Conventional tillage	Direct drill
Aerial fresh matter g/m²	460	90	21	18
% plants with bites	45%	42%	78%	88%

Terres Inovia Agen – 2013
Very strong attack
Clay soil



CONVENTIONAL TILLAGE
heavy discs
Light tine cultivator
Cultimul strigle

Levers combination = key to success -1

Sowing 22/8/15
Clay soil
Sole WOSR
No insecticide

Sowing 22/8/15
Clay soil
WOSR+legume crops
No insecticide

29/03/2016

100 % attacked plants

30 % attacked plants

100 % bushy plants

< 20 % bushy plants

17/05/2016

15 q/ha

27 q/ha

Terres Inovia
l'agronomie en mouvement

Levers combination = key to success 2

- Sowing 26th August

WOSR 35 plants/m²

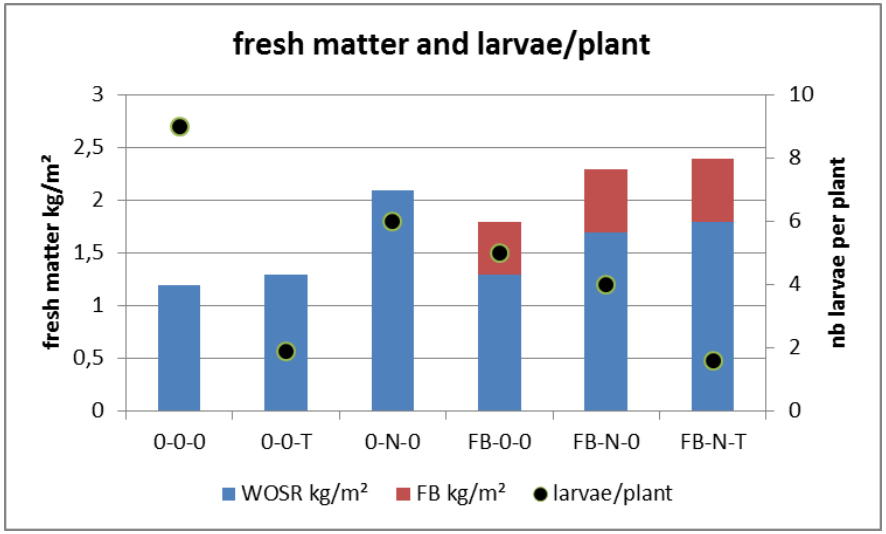
Jegun 2016/17

Faba bean 58 kg/ha arround 15 plants/m²

- N : 30 u at sowing
- Classical dynamic population

CSFB arrive early October and RWSW early November

Insecticide against RWSW (T): λ-cyhalothrin 3rd November



- Significant N effect on WOSR fresh matter before winter
- Significant effect from N or T or FB or combination FB+N+T on CSFB larvae after winter

Conclusions

- Main **resistance mechanisms** to pyrethroid were detected for the 2 studied autumn beetles. As several mechanisms can be mixed into one population, only vial tests and field tests can help us determine the level of resistance.

- Without new insecticide mode of action, **chemical control of** rape winter stem weevil and cabbage stem flea beetle is compromised

- The only way to reduce their harmfulness is to combine all preventive measures we can find and to use chemicals as the last resort

- **Current and future directions** of Terres Inovia works:
  - Crop associations (companion crop)
  - Increase and sustain autumn biomass production and dynamic (levers combination : sowing date, crop association, fertilization…)
  - Evaluate new varietal resistance traits (green peach aphid and rape winter stem weevil)
  - Risk evaluation
  - Try to improve or preserve natural regulation mechanism (effect of spring applications on natural regulation larvae RWSW and CSFB in trials and observations in a "zero insecticide" area").

Thank you for your attention!