

# ***Turnip yellows virus-resistant rapeseed varieties as a possible solution against aphid-borne virus disease***

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***International Consultative Group for Research on Rapeseed  
Berlin – June 2019***



# Context: Turnip yellows disease in France

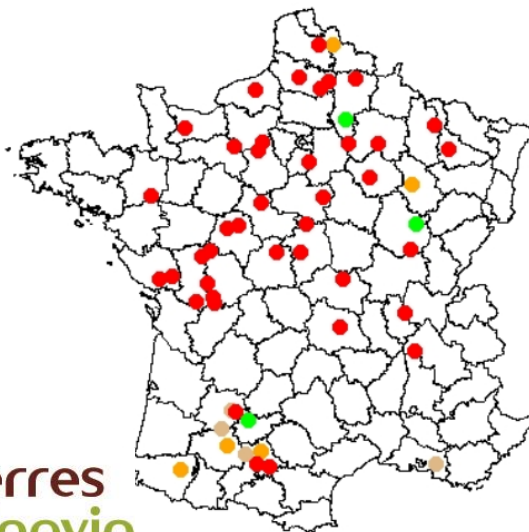
## Turnip yellows virus (TuYV):

- *Luteoviridae* family, *Polerovirus* genus
- Described in rapeseed in France in the early 1990's
- Transmitted in persistent manner by *Myzus persicae*

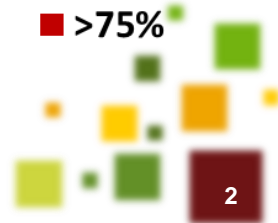
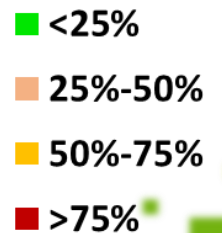
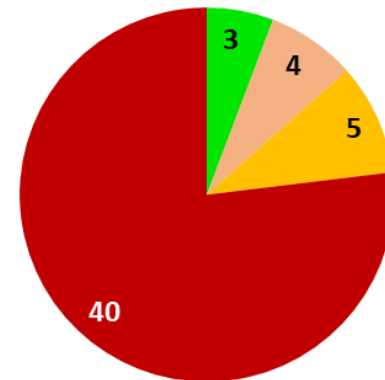
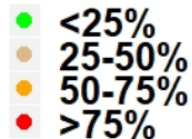
## Field surveys (spring 2018)

52 trials located in main rapeseed growing areas in France

TuYV infected plants  
Distribution classes  
Mean infection rate : 83%



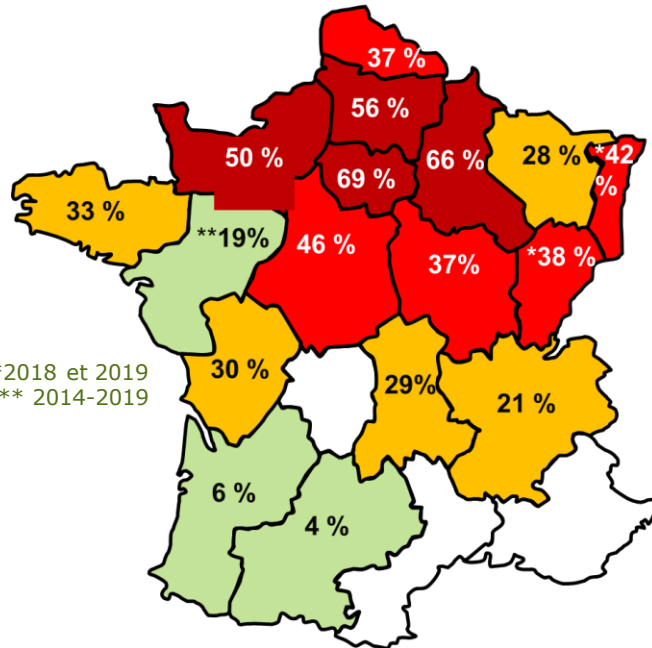
'Infected plants'



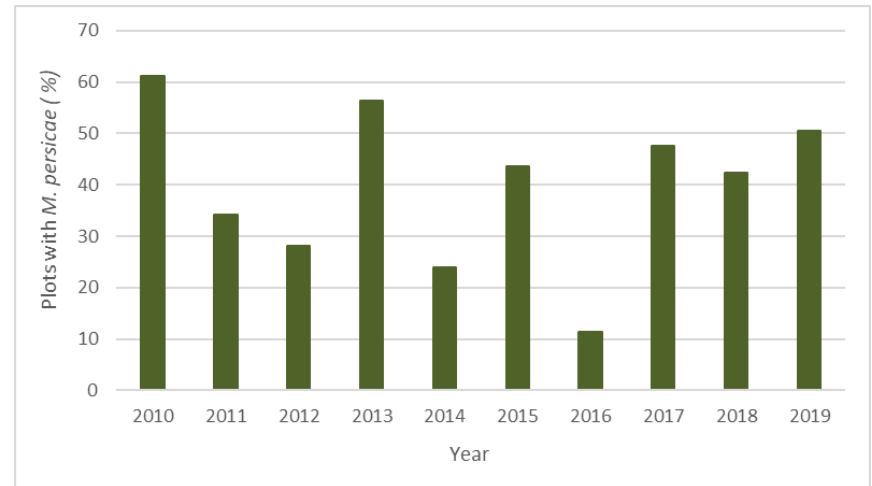
# Context: *Myzus persicae* in France

Mean frequency of rapeseed fields with aphids 2010-2019: 39%  
(In the range from 11% to 61%)

More prevalent in the North of France



Prevalence of *Myzus persicae* varies from year to year



## Percentage of plots with *Myzus persicae*

Source: Field surveys (Vigicultures and Vgobs)

Autumn 2018 : with the ban of neonicotinoid, no efficient insecticide against *Myzus persicae* available (resistant to pyrimicarb and pyrethroid).  
Flonicamid autorised in December 2018

# Context: Rapeseed resistant varieties

The rapeseed variety ALLISON, resistant to *Turnip yellows virus*, was grown for the first time in France in 2015

Since ALLISON, several new varieties described for their TuYV-resistant phenotype are cultivated in France.

ARCHITECT and ANGELICO (Limagrain),  
TEMPTATION, DELICE and SMARAGD (DSV),  
COOGAN (RAGT),  
Etc...



Are these varieties the solution against TuYV ?



# Material and methods

**Field experiments:** 5 (2016/17) +2 (2017/18)

*In progress 5 (2018/19)*

## Trial design

Variety

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- TuYV-resistant (ARCHITECT)
- Susceptible (DK EXCEPTION)

Insecticide protection

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- X
- Treated
  - Untreated (control)

Insecticide sprays (1 or 2 sprays) at threshold of 20% of plants infested by aphids or at observation of the first aphid.

# Material and methods

## Viral diagnosis:

**What ?** 10 plants (one leaf per plant) per plot

**When ?** Before winter (weeks 48 to 50)

**How ?** ELISA test

The presence of TuYV in samples was validated by spectrophotometric measurements

Viral load in infected plants was estimated using a standard curve produced with serially diluted fractions of an infected control

## Statistical analysis:

SAS for Windows 9.4. GLM function.

Dunnett's test at a significance level of 5%.



# Data obtained from untreated plots

	Low infection		Standard infection		Severe infection	
	ARCHITECT	DK EXCEPTION	ARCHITECT	DK EXCEPTION	ARCHITECT	DK EXCEPTION
<b>% of infected plants</b>	<b>2.5</b>	<b>22.5</b>	<b>9</b>	<b>84</b>	<b>20.1</b>	<b>95</b>
	b	a	b	a	c	a
<b>Average viral load of plots</b>	<b>0.1</b>	<b>3.2</b>	<b>0.43</b>	<b>10.4</b>	<b>1.8</b>	<b>27.6</b>
	b	a	c	a	b	a
<b>Viral load of infected plants</b>	<b>0.8</b>	<b>10.8</b>	<b>2.6</b>	<b>12.2</b>	<b>5.1</b>	<b>29.6</b>
	b	a	b	a	b	a

The trials were described according to **the level of TuYV infections** :  
 Low (1 trial), Standard (3 trials) or Severe (3 trials)

When compared with DK EXCEPTION, ARCHITECT presents:

A **significant lower rate of infection**

A **significant lower viral load of infected plants**

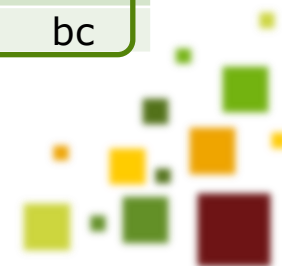


# Impact of insecticide treatments on yield under low/standard infections

	Low infection				Standard infection			
	ARCHITECT		DK EXCEPTION		ARCHITECT		DK EXCEPTION	
	Control	+ insecticide	Control	+ insecticide	Control	+ insecticide	Control	+insecticide
<b>% of infected plants</b>	<b>2.5</b>	<b>0</b>	<b>22.5</b>	<b>17.5</b>	<b>9</b>	<b>7</b>	<b>84</b>	<b>80</b>
	b	b	a	a	b	b	a	a
<b>Average viral load of plots</b>	<b>0.1</b>	<b>0</b>	<b>3.2</b>	<b>1.8</b>	<b>0.4</b>	<b>0.25</b>	<b>10.4</b>	<b>7</b>
	b	b	a	ab	c	c	a	b
<b>Viral load infected plants</b>	<b>0.8</b>	<b>0</b>	<b>10.8</b>	<b>9.7</b>	<b>2.6</b>	<b>0.4</b>	<b>12.2</b>	<b>9.2</b>
	b	b	a	a	b	b	a	a
<b>Yield (t/ha)</b>	<b>4.4</b>	<b>4.5</b>	<b>4.5</b>	<b>4.4</b>	<b>4.7</b>	<b>4.8</b>	<b>4.4</b>	<b>4.5</b>
	a	a	a	a	ab	a	c	bc



No significant effect





# Impact of insecticide treatments on yield under severe infection

	Severe infection			
	ARCHITECT		DK EXCEPTION	
	Control	+ insecticide	Control	+ insecticide
<b>% of infected plants</b>	<b>20.1</b>	<b>13.3</b>	<b>95</b>	<b>90.6</b>
	b	b	a	a
<b>Average viral load of plots</b>	<b>1.8</b>	<b>0.9</b>	<b>27.6</b>	<b>24.8</b>
	b	b	a	a
<b>Viral load of infected plants</b>	<b>5.1</b>	<b>5.9</b>	<b>29.6</b>	<b>26.5</b>
	b	b	a	a
<b>Yield (t/ha)</b>	<b>5.0</b>	<b>5.2</b>	<b>4.7</b>	<b>5.0</b>
	a	a	b	a



No significant effect for ARCHITECT but significant yield improvement for DK EXCEPTION with aphids protection (+0.3 t/ha).

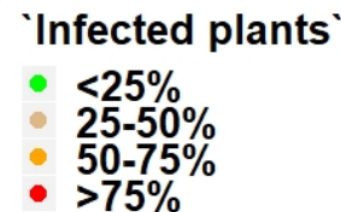
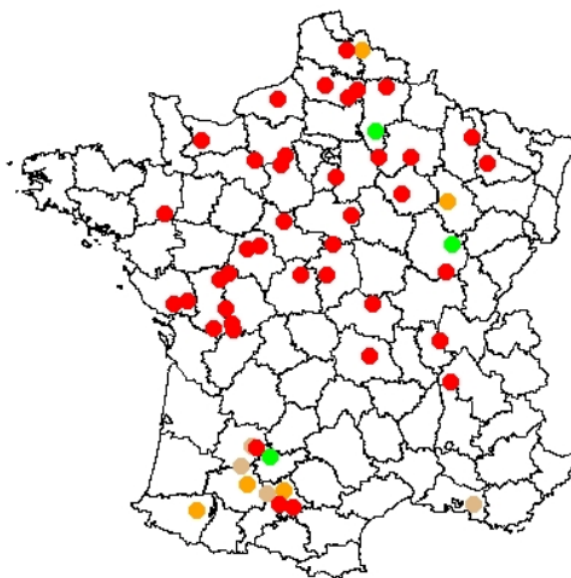


# In the presence of TuYV, what is the behavior of different rapeseed varieties?

After studying the impact of aphicide protection on the reference resistant variety ARCHITECT, Terres Inovia wanted to study the behavior of different rapeseed varieties under low, standard and severe TuYV infection.

52 trials located in main rapeseed growing areas in France were surveyed (harvested in July 2018).

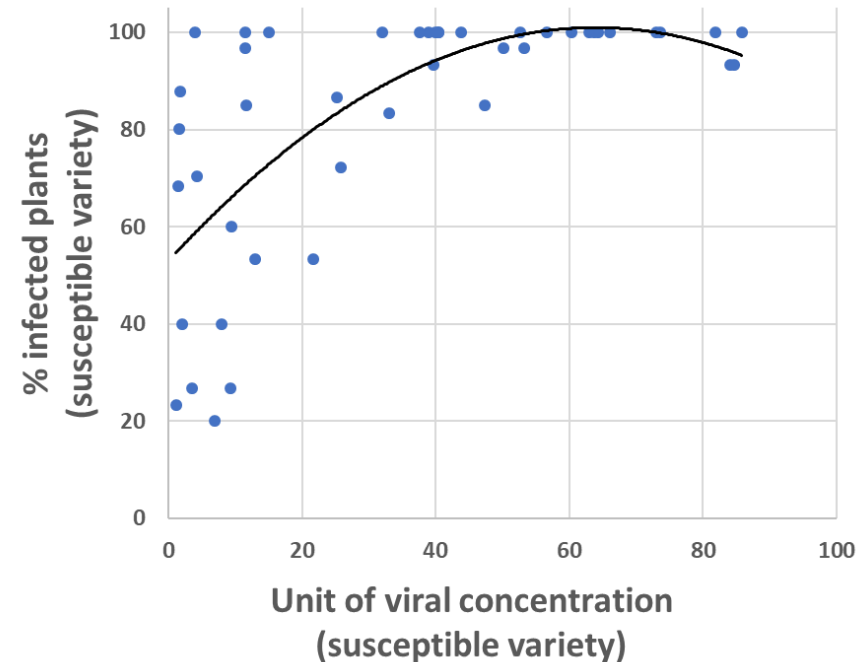
The average percentage of infected plants was high : 83%



# What indicator ? Percentage of infected plants or viral pressure ?

The average viral load is more discriminating : 5 to 80 unit

The majority of trials has a percentage of infected plants greater than 75%



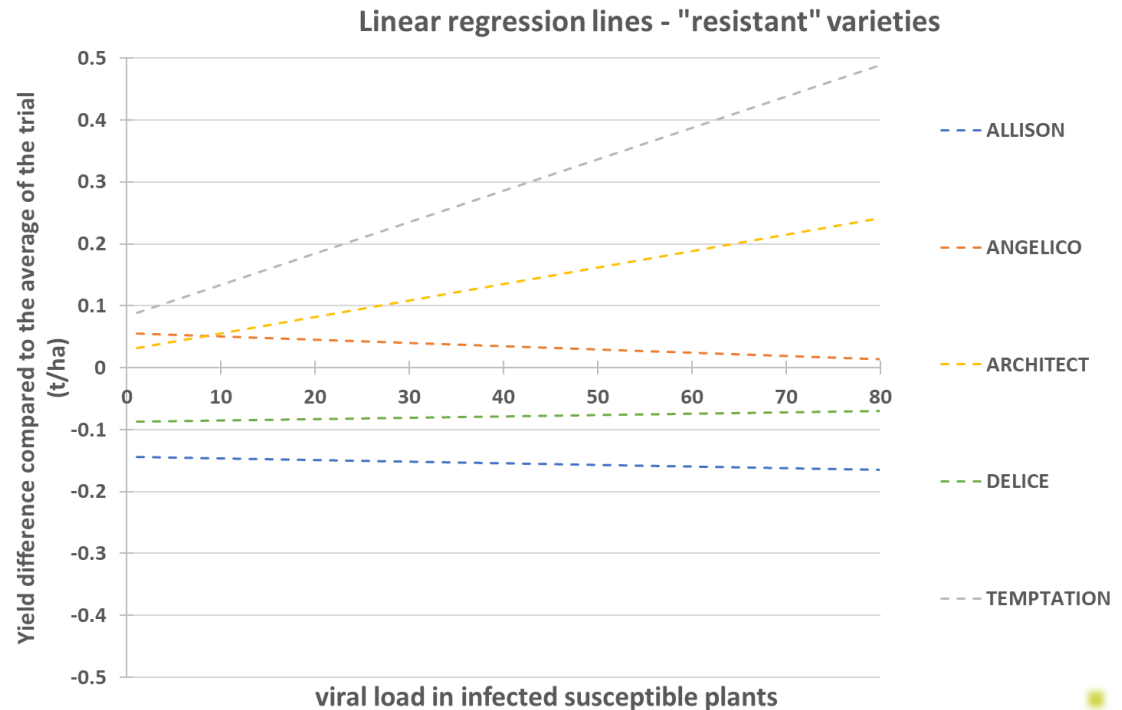
**Viral pressure.**



# Impact of viral load in infected susceptible plants on yield potential of TuYV resistant varieties.

ALLISON, DELICE, ANGELICO have a stable level of yield difference.

ARCHITECT and TEMPTATION showed a yield improvement.



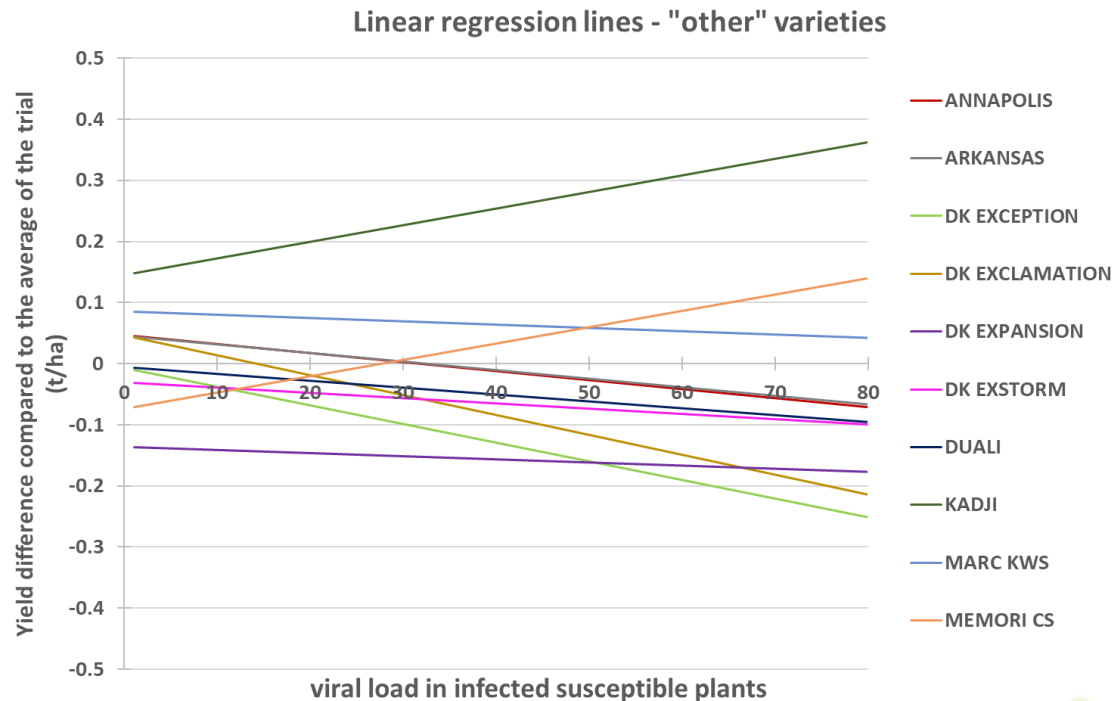
Source: Terres Inovia study in collaboration with the Union Française des Semenciers (UFS) and trials partners



# Impact of viral load in infected susceptible plants on yield potential of not yet characterized varieties.

Not yet characterized varieties are associated to a decrease or to a stable "yield difference" when viral load increase in the infected plants.

Two exceptions : KADJI and MEMORI CS. Is there an other mechanism of resistance for these two varieties ?



Source: Terres Inovia study in collaboration with the Union Française des Semenciers (UFS) and trials partners



# Conclusions

- ❑ Infection rate and viral accumulation in infected plants are lower in the “partial resistant” variety ARCHITECT than in the susceptible control DK EXCEPTION
- ❑ Under low and standard infections, no significant effect of insecticide protection on yield.
- ❑ Under severe infection, a higher yield is expected with the use of insecticide on susceptible variety.
- ❑ The aphids protection provide no significant yield gain on the resistant variety ARCHITECT whatever the level of infection

Virus pressure cannot be determined before late autumn, it is still difficult to decide whether or not to avoid the use of insecticide without risking yield decrease on susceptible varieties.



# Conclusions

A yield improvement compared to the average yield of the test when the virus is more present is observed for varieties with the TuYV partial resistance but also for varieties that probably do not have this partial resistance.

Another mechanism may be involved in the resistance phenotype expressed by these varieties.

The “partial TuYV” resistant varieties are susceptible to mosaic viruses (i.e. CaMV and TuMV) reported in oilseed rape crops. These viruses can occasionally but strongly affect rapeseed production

The characterization of the durability of the “partial resistance” TuYV remains to be evaluated.



# Acknowledgements

Terres Inovia

Epidémiologie Végétale et Vection,  
INRA Montpellier

Acolyance  
Soufflet Agriculture  
Vivescia  
Agora

Ruck Laurent

Jacquot Emmanuel

Guerle Gautier

Van Boxsom Arnaud

Pichon Elodie

Pernollet Nicolas

Souquet Marlène

Piot François

Vandeputte Luc

All collaborators from Acolyance, Agora, Soufflet Agriculture, Vivescia as well as the farmers who lent their fields for the experiments

Some results come from work carried out in the ABCD-B project, a project of the "Neonicotinoids" APR and receiving financial support from the AFB



## Thank you for your attention

