Characterization and comparison of French and Brazilian Potato virus Y (PVY) isolates collected from PVY-susceptible or -resistant tobacco plants carrying the recessive resistance gene va

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Characterization of French and Brazilian PVY isolates from susceptible or resistant tobacco plants

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4 ANITTA 5 UNISC 6 AOB 7 FN3PT

A collaborative project

1. **INRA - Institut National de la Recherche Agronomique**
2. **ARN - Association pour la Recherche sur les Nicotianées**
3. **Institut du Tabac, Imperial Tobacco**
4. **ANITTA - Ass. Nationale Interprofessionnelle et Technique du Tabac**
5. **UNISC - Universidade de Santa Cruz do Sul**
6. **AOB - Alliance One Brasil**
7. **FN3PT – Fédération Nationale des Producteurs de Plants de Pommes de Terre**
8. **Université de Rennes 1**

The same team could run parallel PVY studies

- **Brazil**

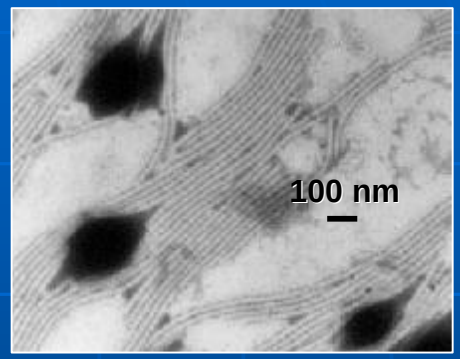
Impact of tobacco recessive resistance gene *va* on biological properties of Brazilian *Potato virus Y* (PVY) isolates
PLANT PATHOLOGY
Volume 60, Issue 6, December 2011, Pages: 1048–1054, C. Lacroix, L. Glais, J.-L. Verrier, C. Charlier, C. Lorencetti and E. Jacquot

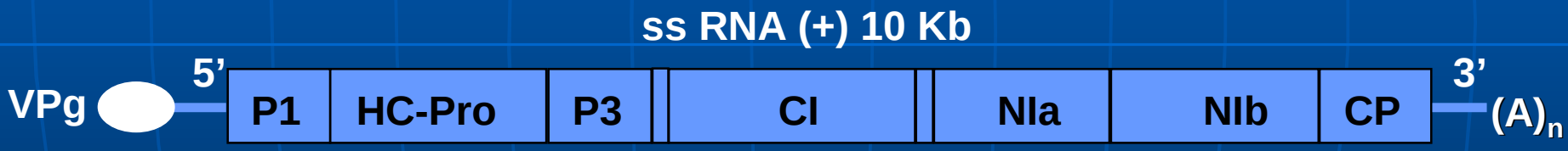
- **France**

Biological characterization of French *Potato virus Y* (PVY) isolates collected from PVY-susceptible or -resistant tobacco plants possessing the recessive resistance gene *va*
PLANT PATHOLOGY
Volume 59, Issue 6, December 2010, Pages: 1133–1143, C. Lacroix, L. Glais, C. Kerlan, J.-L. Verrier and E. Jacquot

Potato virus Y (PVY)

- ***Potyvirus* genus**
  - **Filamentous flexuous particle**
  - **180 species**
  - **PVY = type-member**





- **Aphid transmitted**
  - **Non persistent**
  - **40 species potential vectors**

PVY Host Plants

Crops

Tobacco

Potato

Tomato

Pepper

Principally Solanaceae

Ornamentals

Petunia

Weeds

Black nightshade

PVY in Tobacco

- **Worldwide distributed**
  - **Nearly all tobacco crops**
    - **More particularly Europe, Eastern Asia, also in South America and Southern Africa**
    - **Important economic impact**
- **Main means of control**
  - **Genetic resistance of cultivars**
    - **The only resistance developed : « va »**
    - **Some strains overcome this resistance,**
    - **A phenomenon observed worldwide**

Questions to answer

- **What is the prevalence of PVY in tobacco crops, compared to other viruses**
  - **Symptomatic / symptomeless plants**
- **How diverse are PVY isolates found on tobacco**
  - **With regard to area of origin**
  - **With regard to the partial resistance (va va) or suceptibility (Va va) (Va Va) of cultivars**

A 4-step process

1. **Field surveys**
   - **Harvested leaves**
     - **From symptomatic or syptomeless plants**
       - **More frequently symptomatic plants**
     - **France, 2007, Brazil, 2009-10.**
2. **Identification of viral species**
   - **Immunological (ELISA) tests**
3. **PVY isolates: virulence study**
   - **Ability to overcome or not several « va » alleles – tests in the greenhouse.**
4. **Treatment of results with regard to**
   - **Geographic origins**
   - **Resistance / susceptibility of the original host cultivar**

Identification of viral species

- **Origin of antisera**
  - **PVY: polyclonal, INRA-Rennes-FN3PT**
  - **CMV: polyclonal, INRA Avignon**
  - **AMV: polyclonal, LCA, Bordeaux, France**
  - **TMV: polyclonal, LCA, Bordeaux, France**
  - **TVMV: polyclonal, Sediag, France**
- **Double antibody sandwich enzyme linked immunosorbent assay (ELISA)**

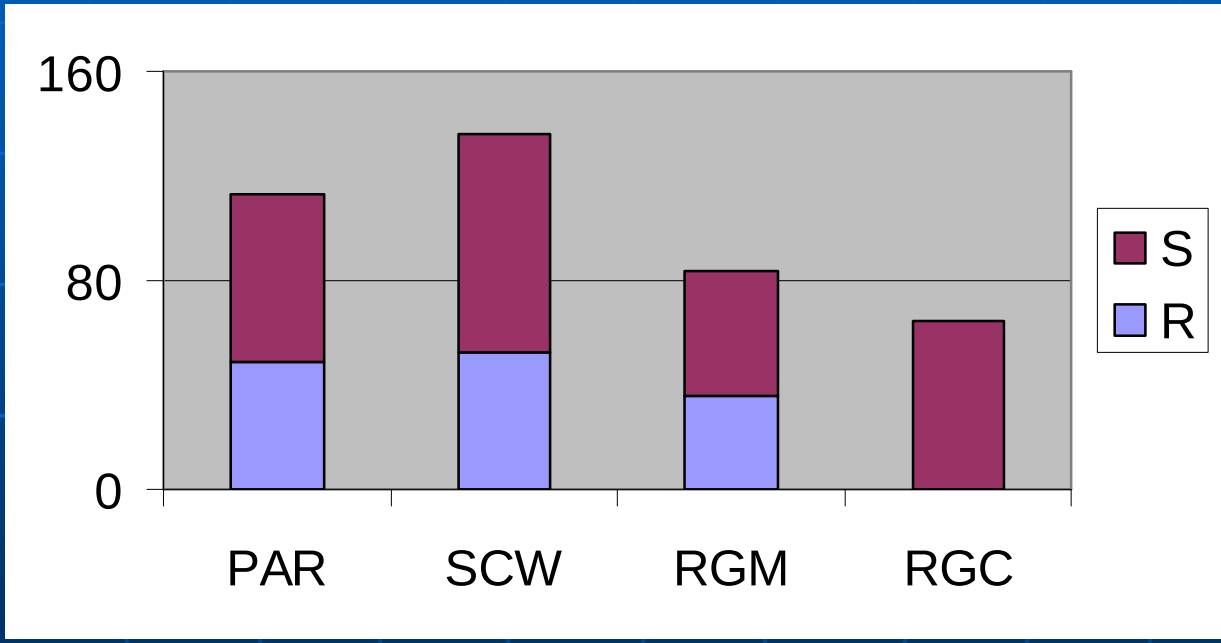
ELISA tests on PVY isolates

- **Origin of antibodies**

Polyclonal	PVY	INRA Rennes, FNPPPT
Monoclonal	PVY $^{O/C}$	Neogen
Monoclonal	PVY ^{N}	INRA Rennes, FNPPPT

Field survey, Brazil 2009-10

- **397 samples from R & S cultivars**



Va Va
va va

PAR	Parana
SCW	Santa Catarina West

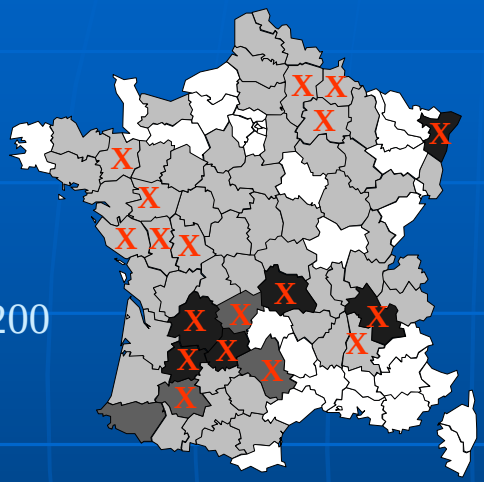
RGM	Rio Grande do Sul Mountains
RGC	Rio Grande do Sul Center

Field survey France 2007

Number of producers :

- 0
- 0 to 100
- 100 to 200
- more than 200

Areas of sampling : x



- 556 samples
- S+: 471 Symptomless : 85
- North: only resistant cvs
- South: res. and susceptible cultivars

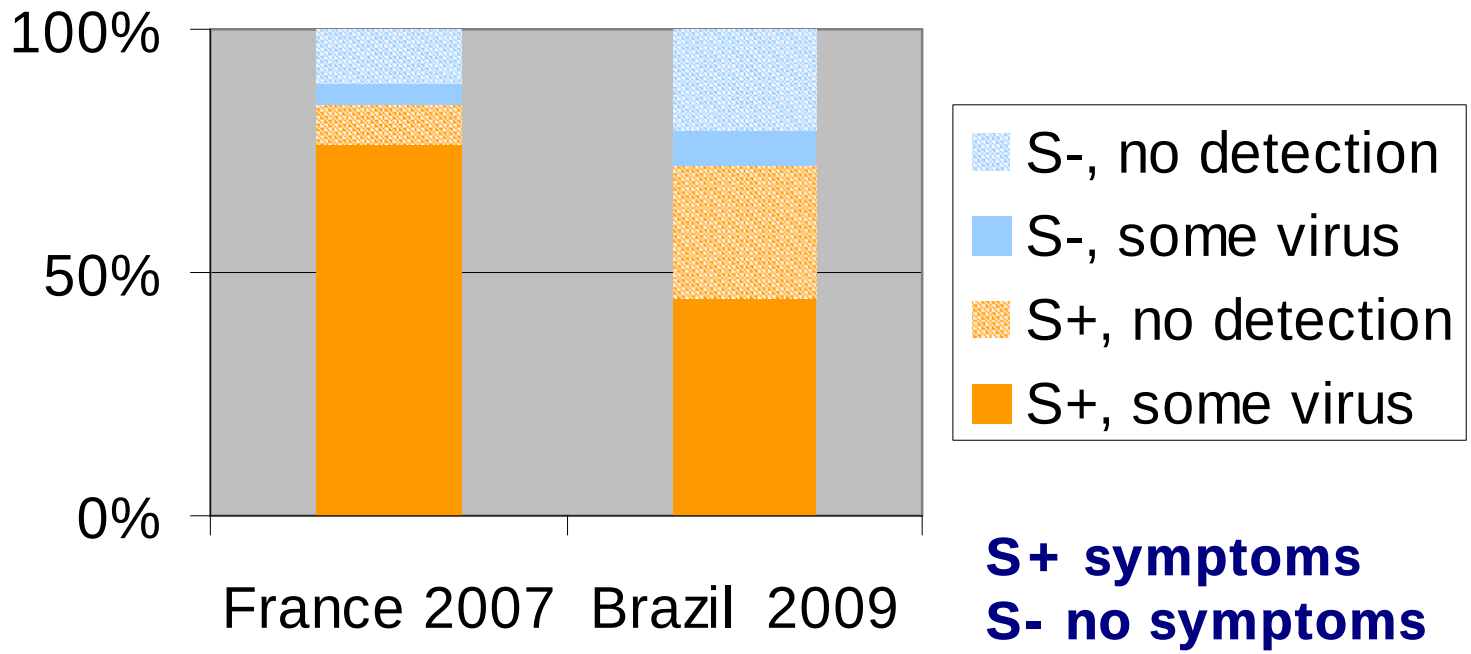
Veinal necrosis

Mosaïc

Particular symptoms

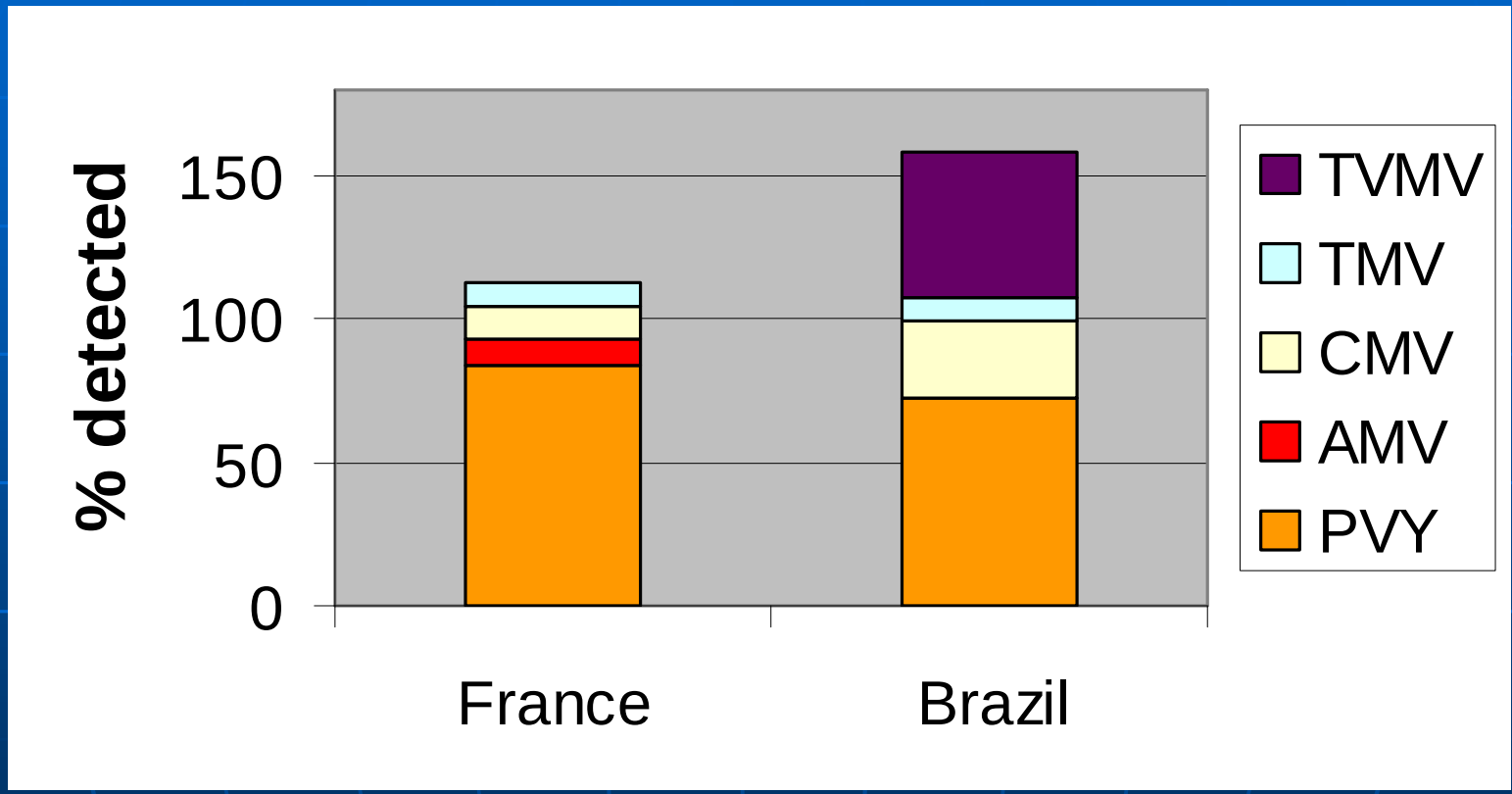
No symptoms

Virus detection and symptoms



- **Brazil: a significant percentage of plants that showed symptoms were ELISA negative for the 4 virus tested (PVY, CMV, TMV, TVMV)**

Identified viral species



- **> 100 : Mixed infections common in both countries**

ELISA tests on PVY isolates

	% of serotypes				
	O/C only $Y^{O/C}$	N only Y^{N}	both Y^{ON}	none	total
France (375 PVY isolates)	11	74	3	13	100
Brazil (150 PVY isolates)	11	19	5	**65**	100

PVY^{U}

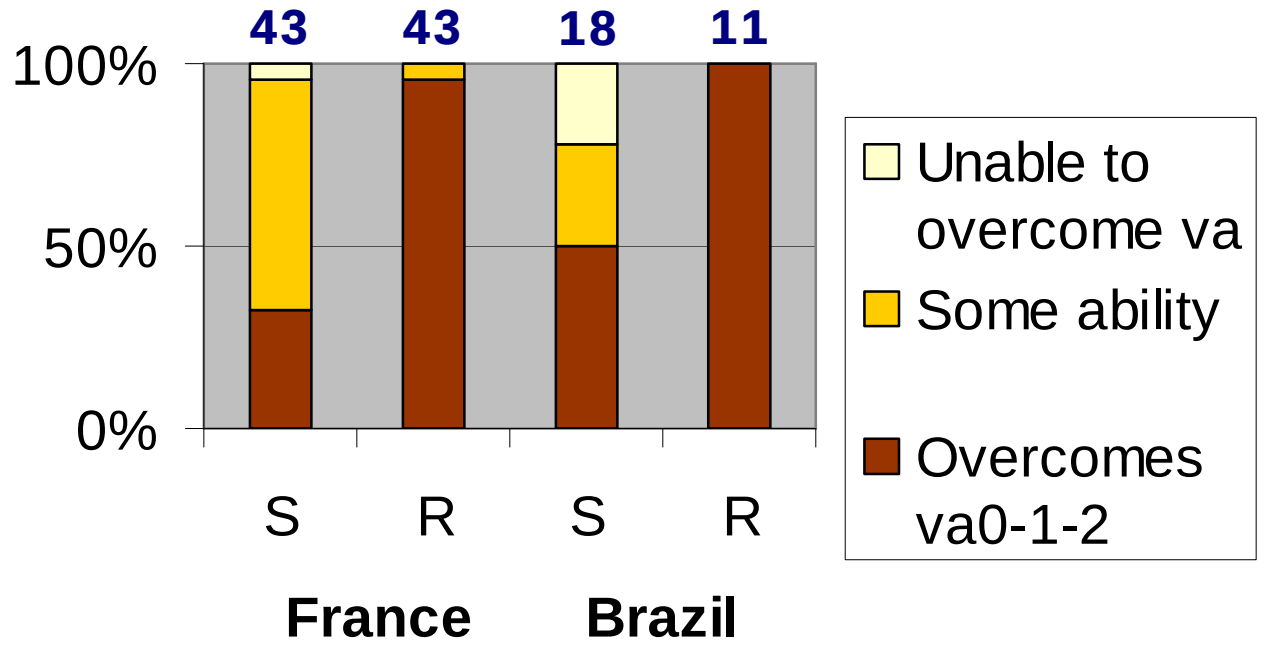
- **In south of Brazil, the most frequent serotype on tobacco cannot be assigned to the classical PVY^{O} / PVY^{N} serogroups**

Virulence of PVY isolates

- **Sub-sample of isolates representative of geographic origin and host resistance (Va or va)**
  - **France: 86, Brazil :29**
- **Inoculated in the greenhouse on:**
  - **Susceptible standard MN944 (Va Va)**
  - **VAM (va^0 va^0)**
  - **Wislica: (va^1 va^1)**
  - **PBD6: (va^2 va^2)**
- **4 plants of each line + healthy control**
- **Results based on ELISA.**
  - **« va » overcome if OD > 2*OD of healthy control**

OD: optical density of the signal from the ELISA procedure

Virulence versus original host



Virulence assessed in the greenhouse

Host tobacco plant from which collected

S: Va. , R: vava

Treatment of results, Brazil

- **Probability for a plant to be infected by PVY**
  - **smaller in va-resistant tobacco hosts ($P<0.01$)**
- **Distribution of serotypes**
  - **dependant on area ($P<0.001$)**
  - **PVY and Y^U isolates more frequent in Santa Catarina West ($P<0.01$)**
  - **High % of Y^N isolates in the northern area (PAR, SCW). Connections between potato and tobacco compartments?**
- **Among the 29 isolates studied for virulence, the 20 pathotypes va0-1-2 are from the PVY^U group**

Treatment of results, France

- **Probability for a plant to be infected by PVY**
  - **smaller in va-resistant tobacco hosts (P=0.02)**
- **Distribution of serotypes**
  - **dependant on area**
  - **% of $PVY^{O/C}$ higher in south than in NE (P=0.013) and NW (P<0.01)**
  - **% of PVY^{N} higher in NE (P<0.01) and NW(P=0.019) than in South**
- **PVY^{U} (non O non N) was more frequent on "va va" tobacco plants than on "Va ." ones (P<0.01)**

Conclusions

- PVY is the most prevalent virus on tobacco, both in France and Brazil.
- In south of Brazil, the most frequent serotype cannot be assigned to the classical PVY^{O} / PVY^{N} serogroups
- In both countries
  - isolates from « va » cultivars show a much broader virulence than those from « Va » plants.
  - « va va » plants less often infected by PVY
  - Same trends observed in different agronomic and climatic contexts