



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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2 ARN

3 Institut du Tabac

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

n 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

n France

Biological characterization of French *Potato virus Y* (PVY) isolates collected from PVY-susceptible or -resistant tobacco plants possessing the recessive resistance gene *va*

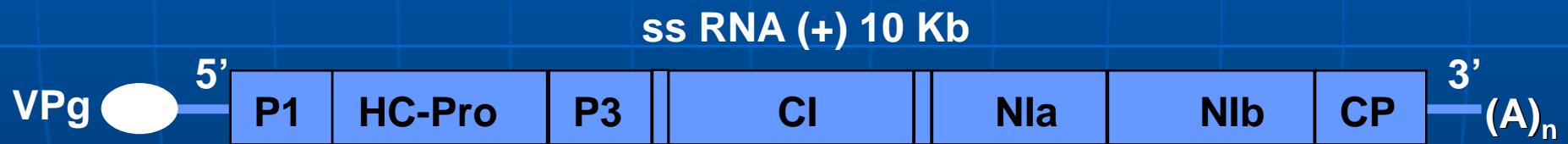
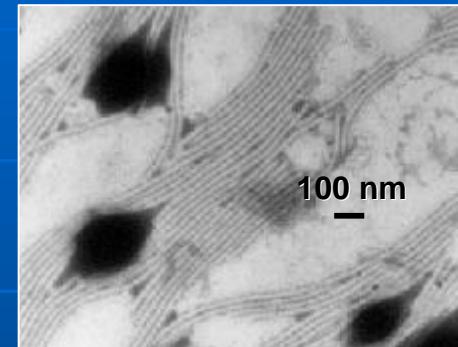
PLANT PATHOLOGY

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)

n *Potyvirus* genus

- Filamentous flexuous particle
- 180 species
- PVY = type-member



n Aphid transmitted

- Non persistent
- 40 species potential vectors

PVY Host Plants

Crops



Ornamentals



Black nightshade



PVY in Tobacco

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

Questions to answer

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

A 4-step process

1. **Field surveys**
 - Harvested leaves
 - From symptomatic or symptomless 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

n 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

n Double antibody sandwich enzyme linked immunosorbent assay (ELISA)

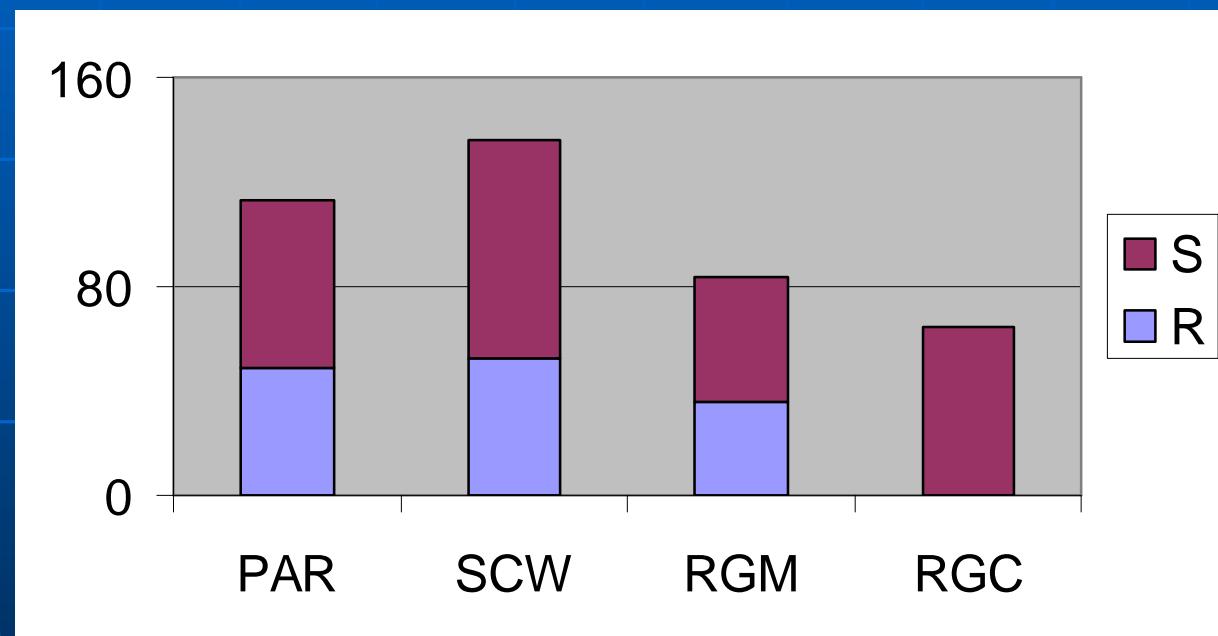
ELISA tests on PVY isolates

n Origin of antibodies

Polyclonal	PVY	INRA Rennes, FNPPPT
Monoclonal	PVY O/C	Neogen
Monoclonal	PVY N	INRA Rennes, FNPPPT

Field survey, Brazil 2009-10

n 397 samples from R & S cultivars



Va Va
va va

PAR Parana
SCW Santa Catarina West

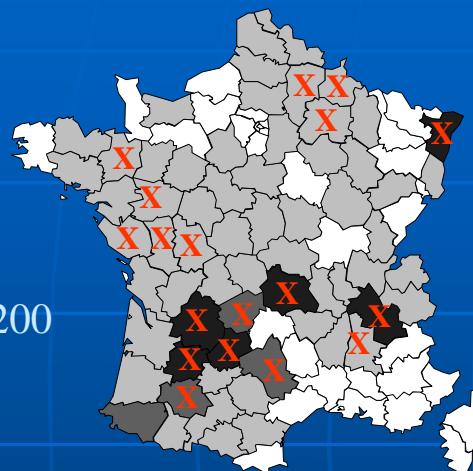
RGM Rio Grande do Sul Mountains
RGC Rio Grande do Sul Center

Field survey France 2007

Number of
producers :

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

Areas of
sampling : x



Veinal necrosis



Mosaïc



Particular
symptoms

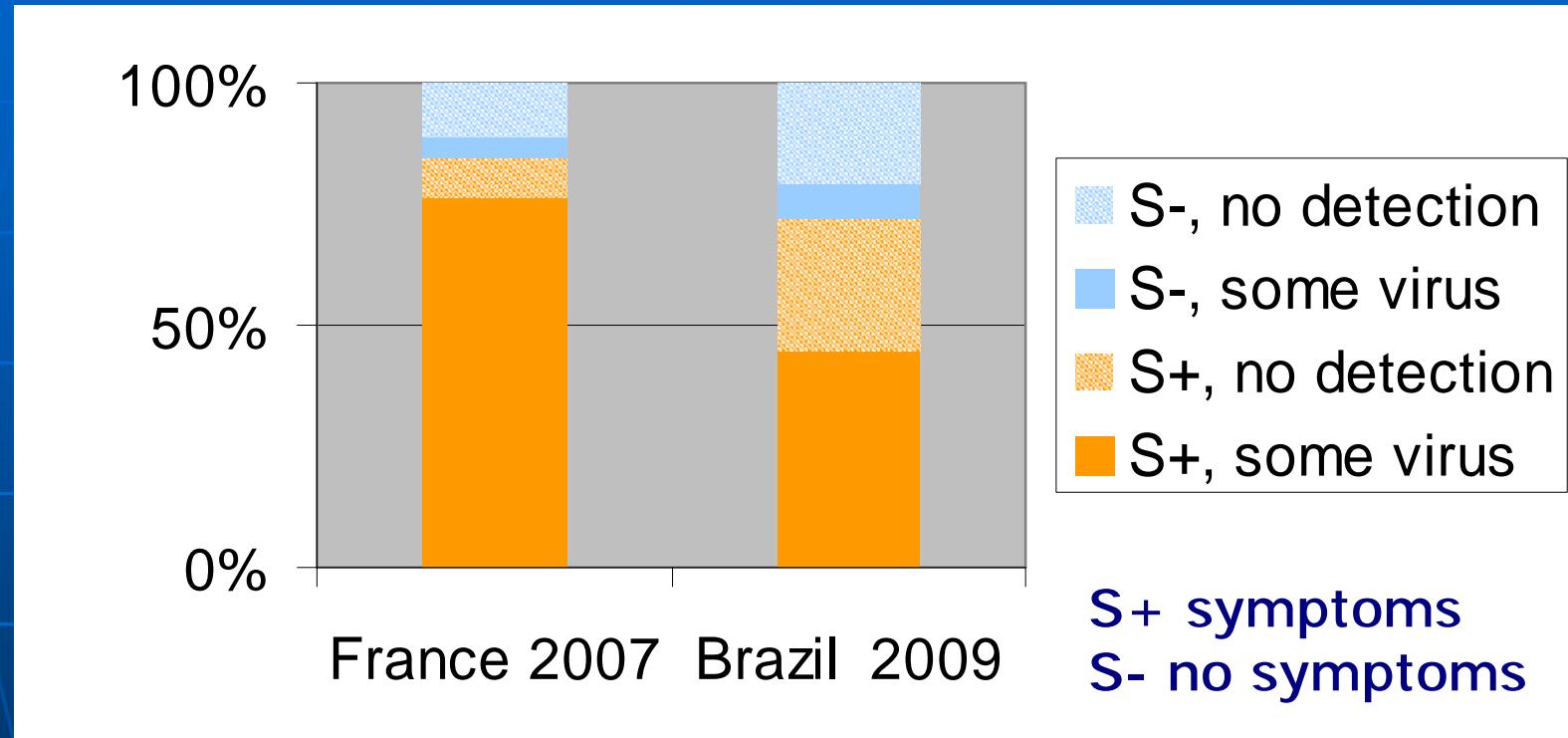


No
symptoms



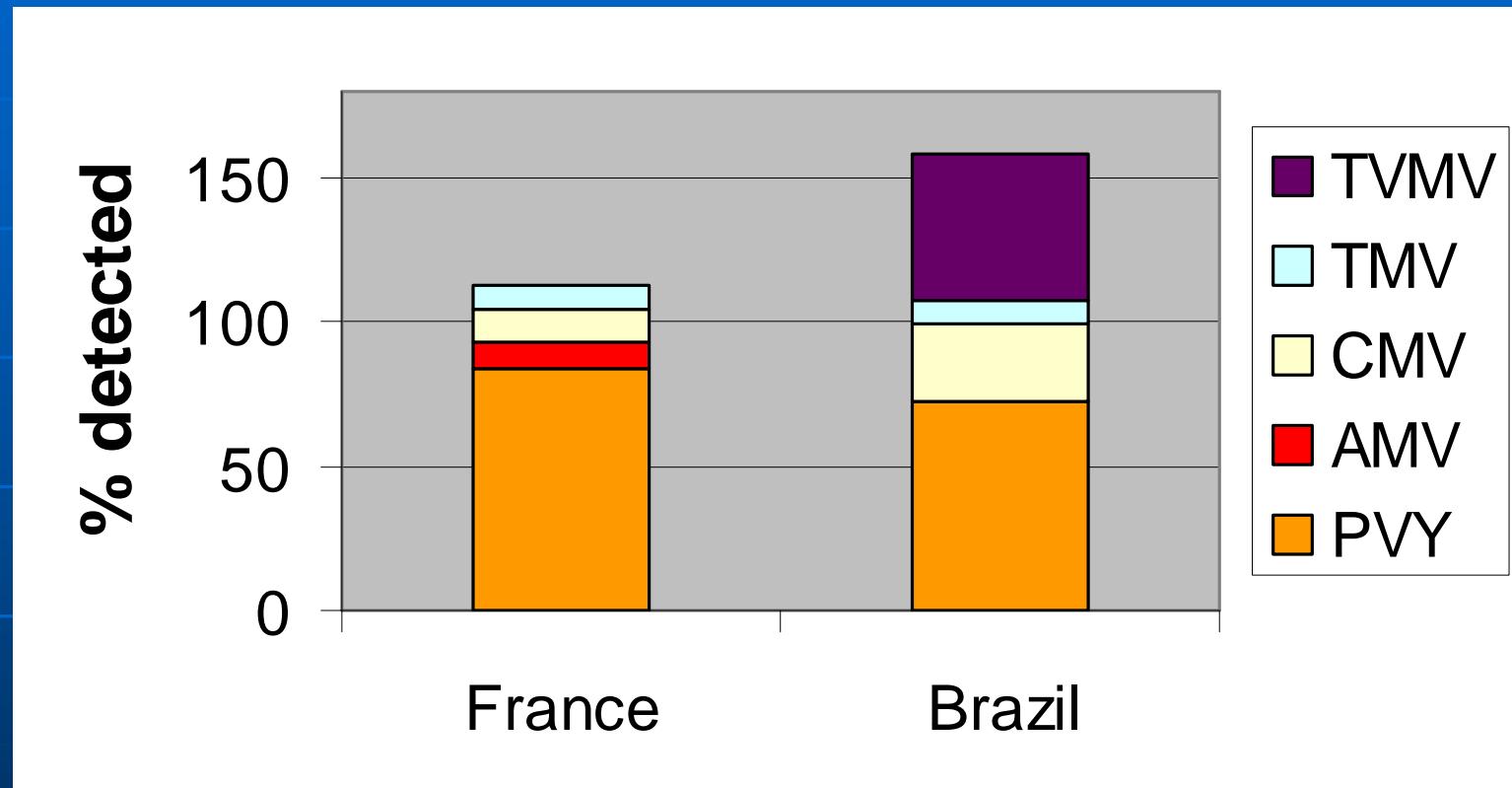
- 556 samples
- S+: 471 Symptomless : 85
- North: only resistant cvs
- South: res. and susceptible cultivars

Virus detection and symptoms



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

Identified viral species



$n > 100$: Mixed infections
common in both countries

ELISA tests on PVY isolates

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

PVY^U

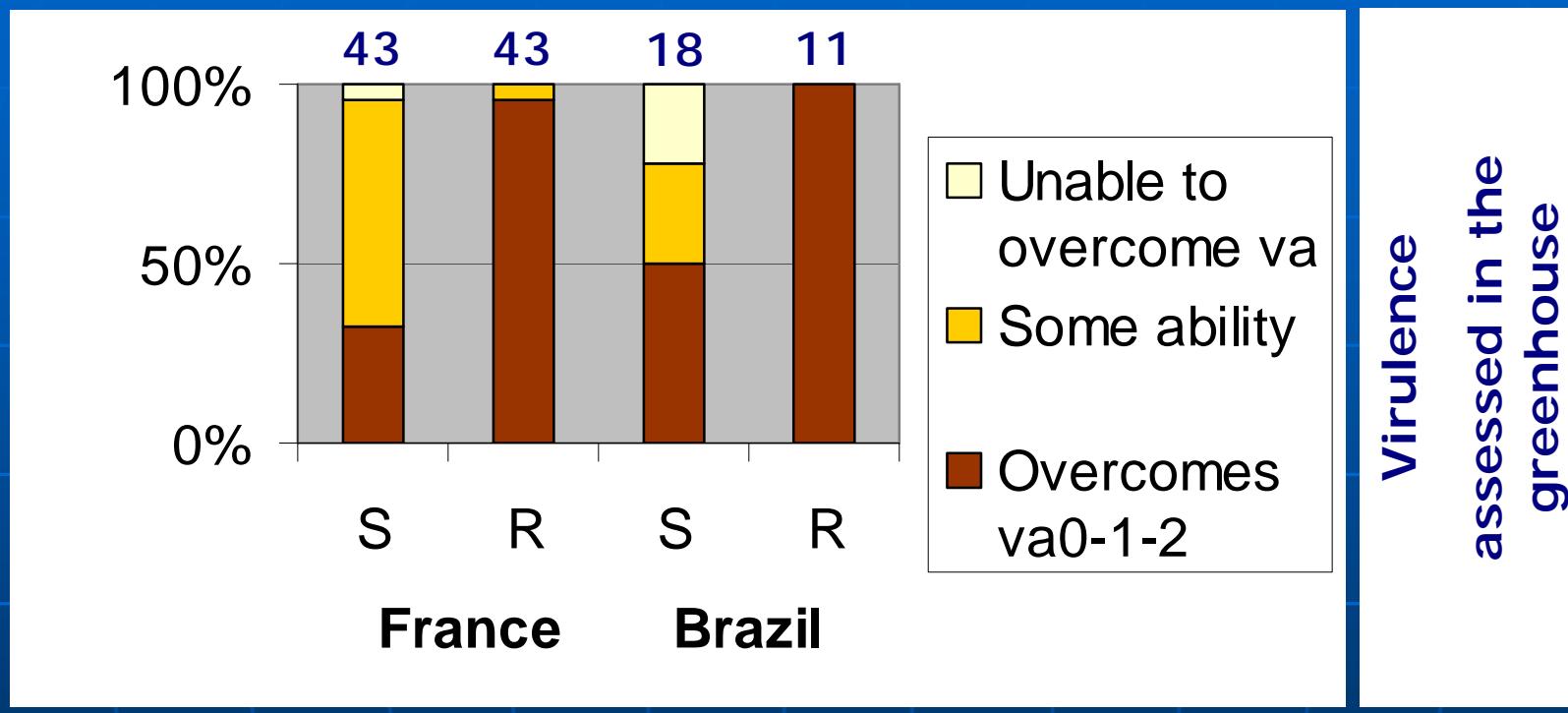
- In south of Brazil, the most frequent serotype on tobacco cannot be assigned to the classical PVY^O / PVY^N serogroups

Virulence of PVY isolates

- n Sub-sample of isolates representative of geographic origin and host resistance (Va or va)
 - France: 86, Brazil :29
- n 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)
- n 4 plants of each line + healthy control
- n 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



Host tobacco plant from which collected

S: Va. , R: vava

Treatment of results, Brazil

- n Probability for a plant to be infected by PVY
 - smaller in va-resistant tobacco hosts ($P<0.01$)
- n 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?
- n 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 $\text{PVY}^{\text{O/C}}$ 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

- n PVY is the most prevalent virus on tobacco, both in France and Brazil.
- n In south of Brazil, the most frequent serotype cannot be assigned to the classical PVY^O / PVY^N serogroups
- n 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