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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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HAL Authorization

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

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*

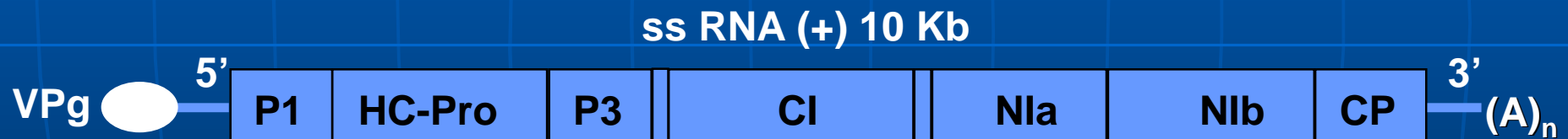
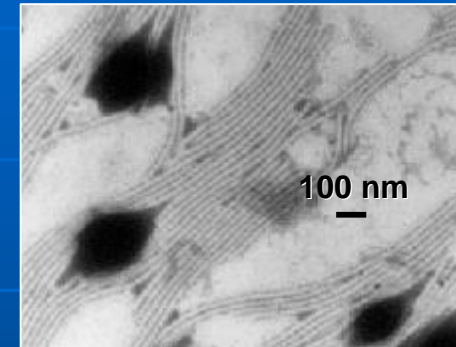
PLANT PATHOLOGY

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)

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



Ornamentals

Principally Solanaceae

Petunia



Weeds

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**
 - n From symptomatic or syptomeless plants
 - More frequently symptomatic plants
 - n 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)

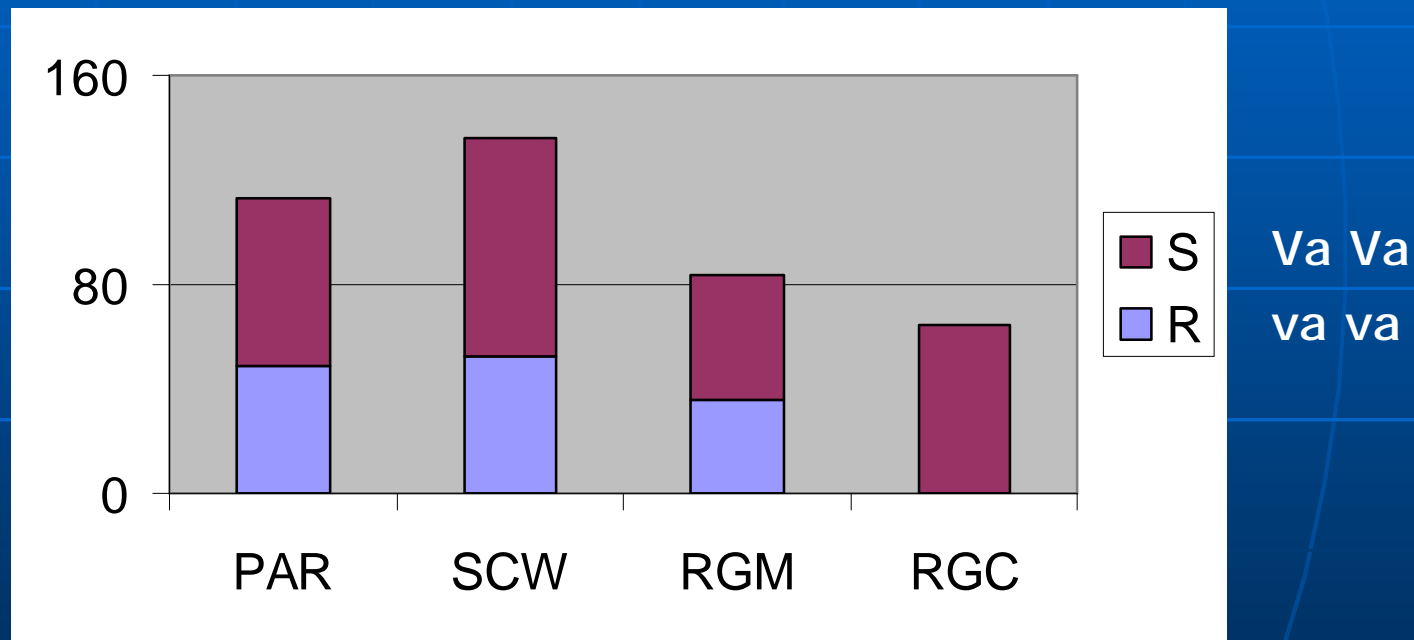
ELISA tests on PVY isolates

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



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 :

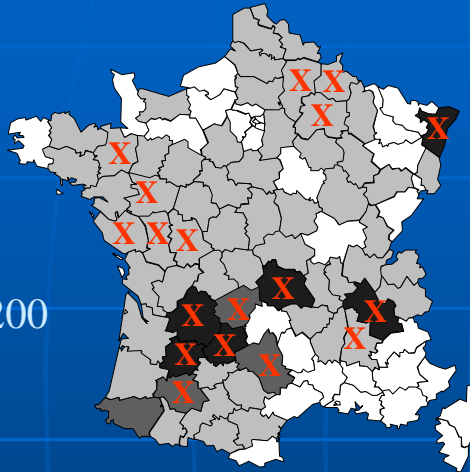
□ 0

■ 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



Mosaic



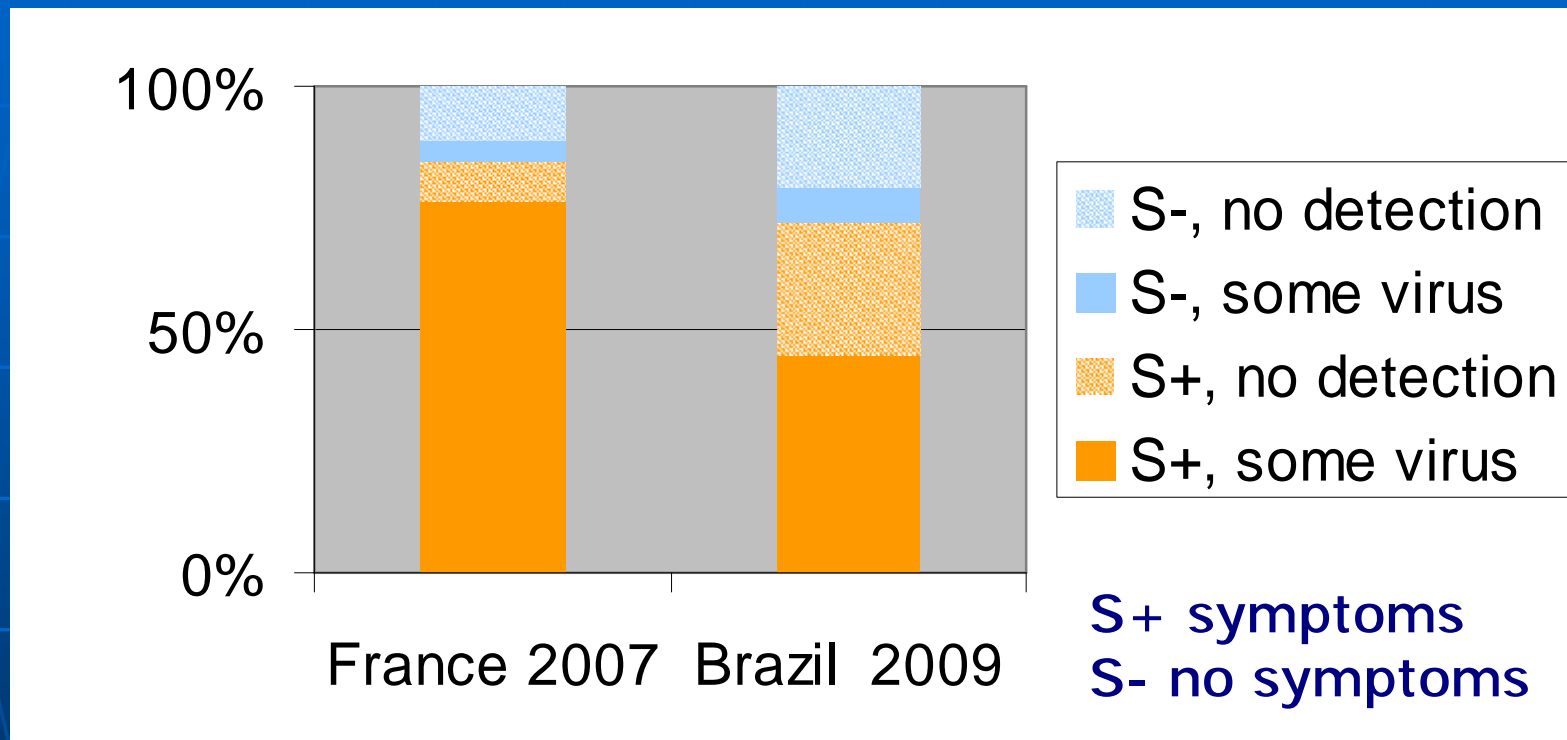
Particular symptoms



No symptoms

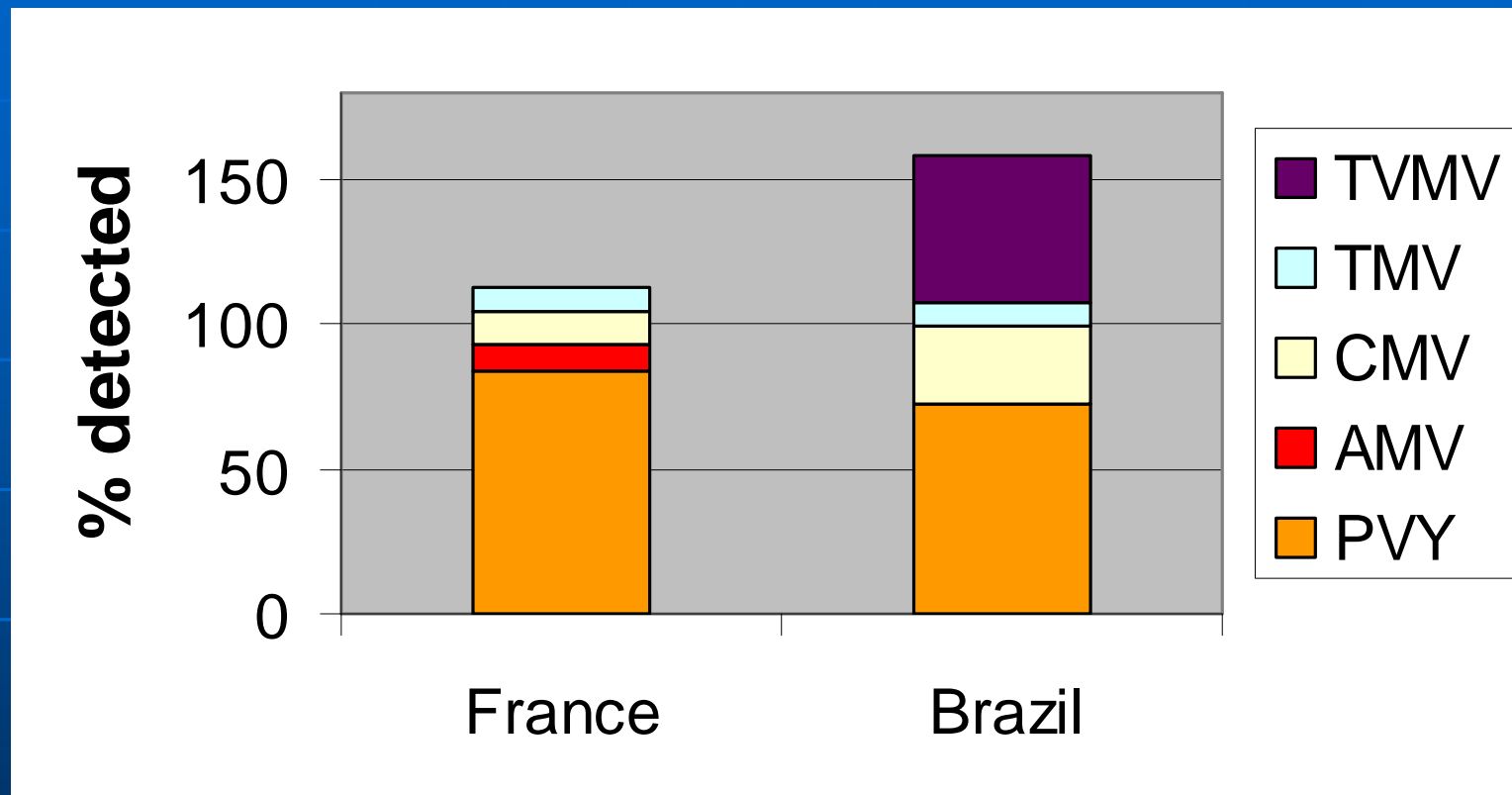


Virus detection and symptoms



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

Identified viral species



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

ELISA tests on PVY isolates

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

PVY^U

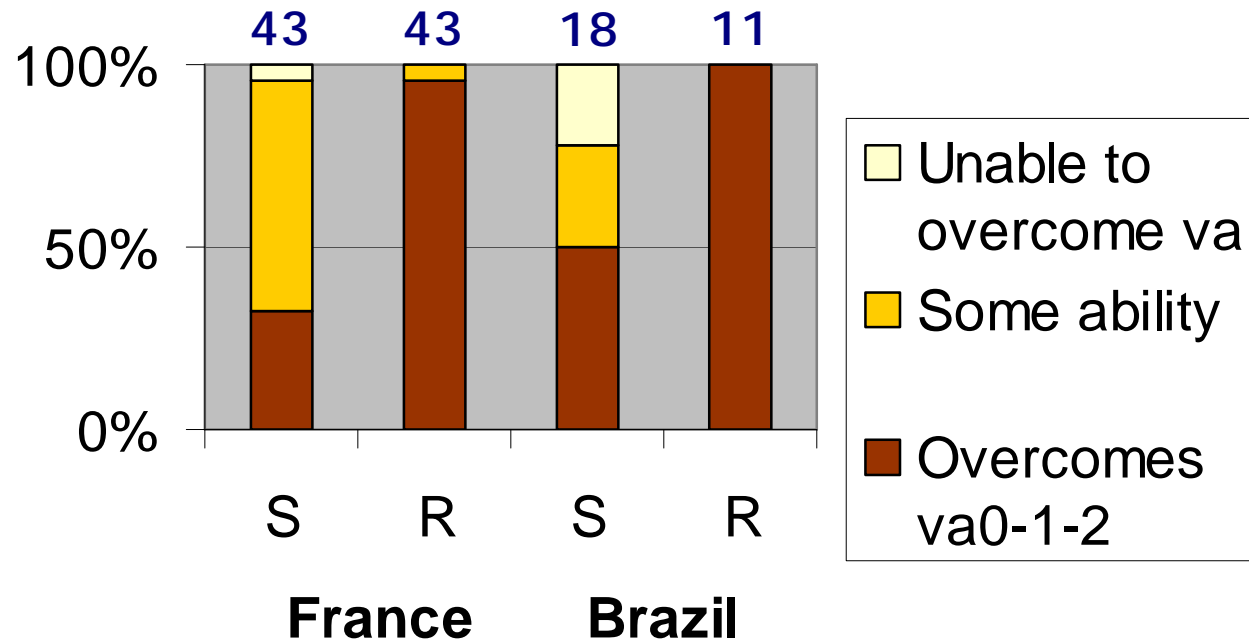
- n In south of Brazil, the most frequent serotype on tobacco cannot be assigned to the classical PVY^O / PVY^N serogroups

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



Virulence
assessed in the
greenhouse

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

- n Probability for a plant to be infected by PVY
 - smaller in va-resistant tobacco hosts ($P=0.02$)
- n 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
- n 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