



Field tests for tobacco gall nematodes resistance in France.

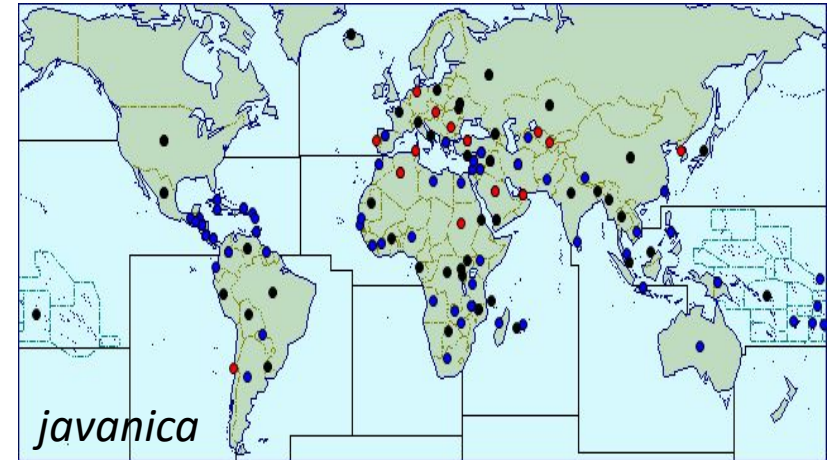
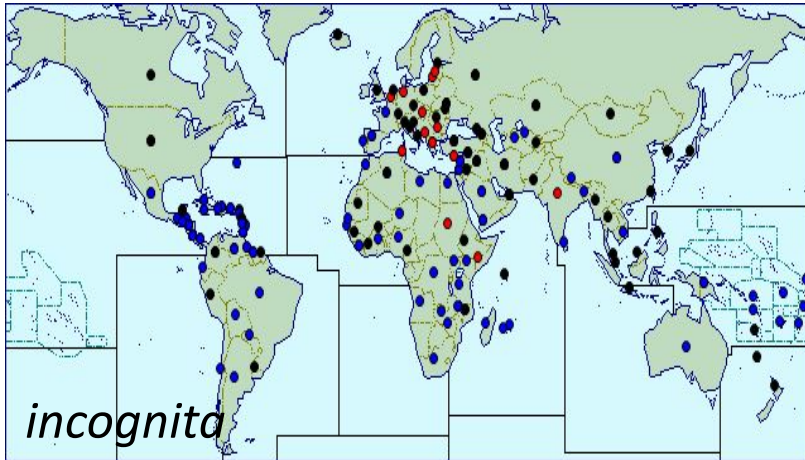
VERRIER Jean-Louis

47th Tobacco Workers Conference, Nashville, 2016

Gall (root-knot) nematodes on tobacco

- *Meloidogyne* genus
- Among species found parasitizing tobacco in the field:
- *M. incognita* (Kofoid & White, 1919) Chitwood 1949 MI
 - Root-knot nematode
- *M. javanica* (Treub, 1885) Chitwood, 1949 MJ
 - Sugarcane eelworm
- *M. arenaria* (Neal, 1889) Chitwood, 1949 MA
 - Peanut root-knot nematode

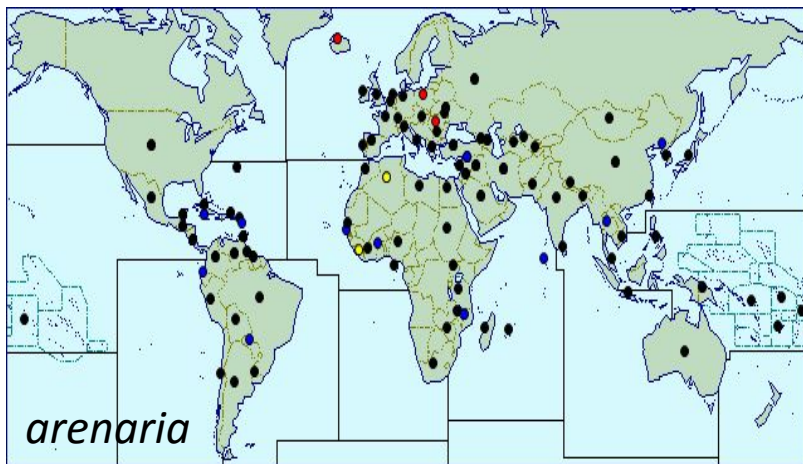
MI, MJ, MA distribution: world



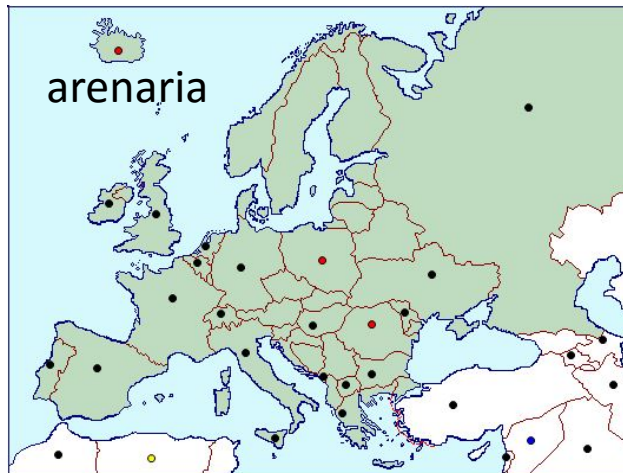
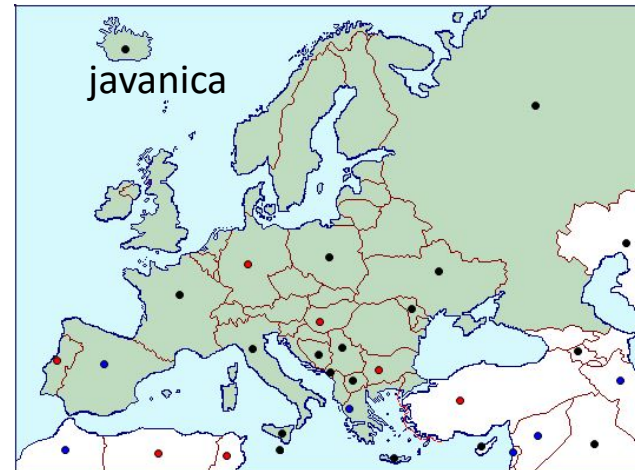
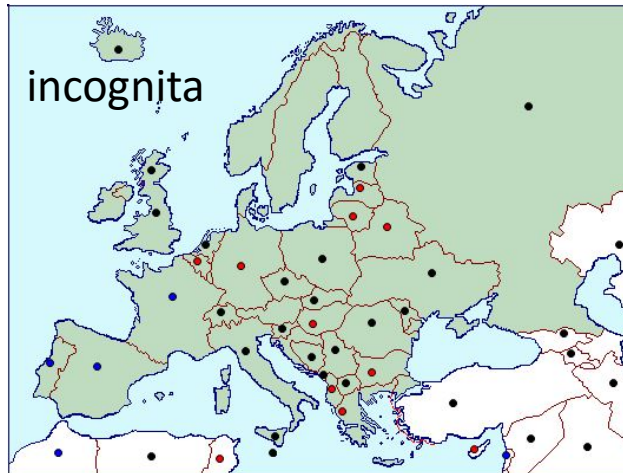
- Localized
- Present
- Widespread

Invasive species compendium, Jan. 2, 2016

<http://www.cabi.org/isc>



MI, MJ, MA distribution: Europe



- Localized
- Present
- Widespread

Invasive species compendium, Jan. 2, 2016

<http://www.cabi.org/isc>

Meloidogyne on tobacco: Europe

- 2004, AERET meeting
 - Generalized problem in Spain, Italy and Portugal
 - Exists also in Croatia, Hungary, Poland (south) and France (Garonne valley).
 - No problem in Germany, and no information from other countries
- Shift from *M. incognita* to *M. arenaria*
 - Well documented in Spain
 - Possible also in Italy
 - Cultivars with the Rk gene heavily attacked

AERET: European Association for Research and Experimentation on Tobacco

Endoparasitic Nematodes on Tobacco in France

- Cyst nematode *Globodera tabacum tabacum*
 - The most common
 - South-west of France mainly
- Gall (root-knot) nematodes *Meloidogyne* sp
 - Localized in the southern part of France
 - Species not known
 - Neighbouring countries: high infestation
 - Lack of control means other than res. varieties
 - → tests in 2014

Localization of 2014 tests

Partnership with growers' cooperatives to localize affected fields: Midi-Tabac, Poitou-Tabac

Two very different situations

- 1** Charente Maritime, Saint-Germain du Seudre
- 2** Aveyron, Calmels-Le-Viala



Meloidogyne species identification

- 2013, previous to tests
- Some soil from the identified fields sent to
 - ANSES, Laboratoire de santé des végétaux, Nématologie, 35653 Le Rheu, France.
- The species present is *Meloidogyne arenaria*
 - In both fields **1** & **2**

Variety set: resistant standards

- RL 2-1-1: « Rk resistant hybrid »
 - From CORESTA nematodes experiment 2005
 - Seed multiplied at Bergerac, 2005, then 2012 (no selection)
 - 2012 seed used in this experiment
- NOD 8: « RSA breeding line with resistance to *M. incognita* race 2 and race 4, tolerant of *M. javanica* and possible susceptibility to *M. thamesi* »
 - From CORESTA nematodes experiment 1996
 - Seed multiplication Bergerac 2001, then 2008 (no selection)
 - 2008 seed used in this experiment

Variety set: tested genotypes

- Breeding lines
 - L1, L2, L3, L4, L5: (NOD 8 x Flue-cured line possessing Rk and sometimes Ph) selfed and selected to the F5 generation
- CETARSA 613
 - Aromatic flue-cured variety with resistance to *Meloidogyne arenaria* and *Globodera tabacum*
 - Source: AERET breeders index 2011
- ITB 683: susceptible standard
 - Filler flue-cured grown in Europe.
 - Does not possess Rk neither Ph.

Field test protocol

- Healthy transplant production at Bergerac:
 - Float system
 - Shipment of transplants to both locations
- Field layout:
 - Randomized complete block, 2 reps.
 - Standard cultural practices for flue-cured in France
- Reading end of season by digging out 8 plants / plot
 - Scoring scale based on importance of galls
 - Importance of the root system also recorded

Scoring scale

Score	Importance of galls
0	No galling
1	1-2% of root system with galls
2	3-10%
3	11-30%
4	31-50%
5	51-80%
6	81-100%

Statistics

- Analysis of variance using the model:

Gall score (individual plant) =
constant term
+ variety effect
+ block effect
+ residual

- Statgraphics Centurion[®] XV

Field test calendar

- Seeding: March 21th, 2014

- Days:

Location	1	2
Seeding to transplantation	53	62
Transplantation to reading	126	123



Results

High infestation, both locations

- ITB 683 susceptible check
 - % of root system with galls
 - 1 Charente maritime 81-100%
 - 2 Aveyron 51-100%
- Sharp contrast with RL-2-1-1
 - % of root system with galls
 - 1 Charente maritime 0-2%
 - 2 Aveyron 0-2%

Sharp contrast, both locations



Significant variety effect

1

Charente
maritime

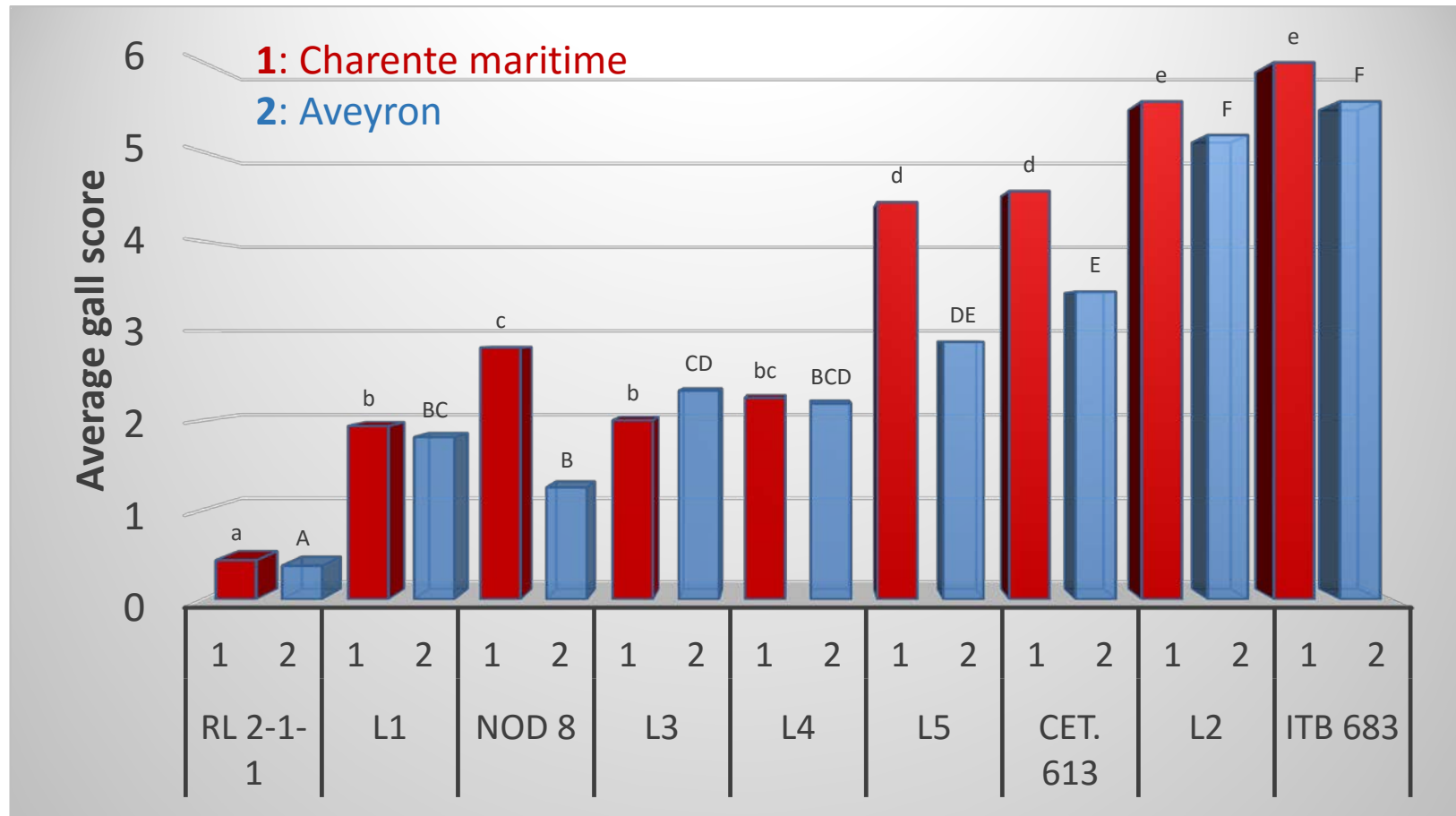
Source	Sum of squares	Df	Mean square	F	Probability
PRINCIPAL EFFECTS					
A:Variety	453.875	8	56.7344	74.46	0.0000
B:Block	0.0277778	1	0.0277778	0.04	0.8489
RESIDUAL	102.097	134	0.76192		
TOTAL (CORRECTED)	556.0	143			

2

Aveyron

Source	Sum of squares	Df	Mean square	F	Probability
PRINCIPAL EFFECTS					
A:Variety	377.096	8	47.137	38.02	0,0000
B:Block	5.2536	1	5.2536	4.24	0.0415
RESIDUAL	163.648	132	1.23976		
TOTAL (CORRECTED)	545.662	141			

Average gall scoring by variety



a...f: Newman-Keuls groups, 95%, Charente-Maritime

A ...F: Newman-Keuls groups, 95%, Aveyron

Conclusions & Perspectives

- *Meloidogyne arenaria* presence in France on tobacco
 - Two very similar situations with regard to tobacco infestation, despite agro-climatic differences and geographic distance:
 - Charente-Maritime, Aveyron
- With respect to galling:
 - Partial resistance of NOD 8
 - Some lines derived from NOD 8 show the same resistance level
 - High resistance level of RL-2-1-1
- These results need being compared to other situations in Europe
- Breeding efforts underway

Thank you for your attention!

Acknowledgements

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Rep 1
NG 4