# Progress in breeding and agronomical approaches for control of tobacco broomrapes

Malpica Anna, AP40
CORESTA 2019, Victoria falls

# Progress in breeding and agronomical approaches for control of tobacco broomrapes

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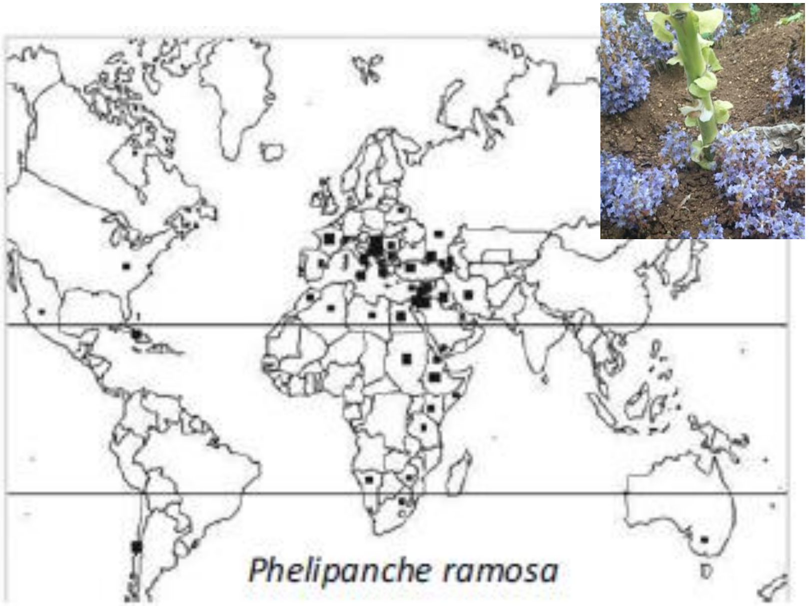
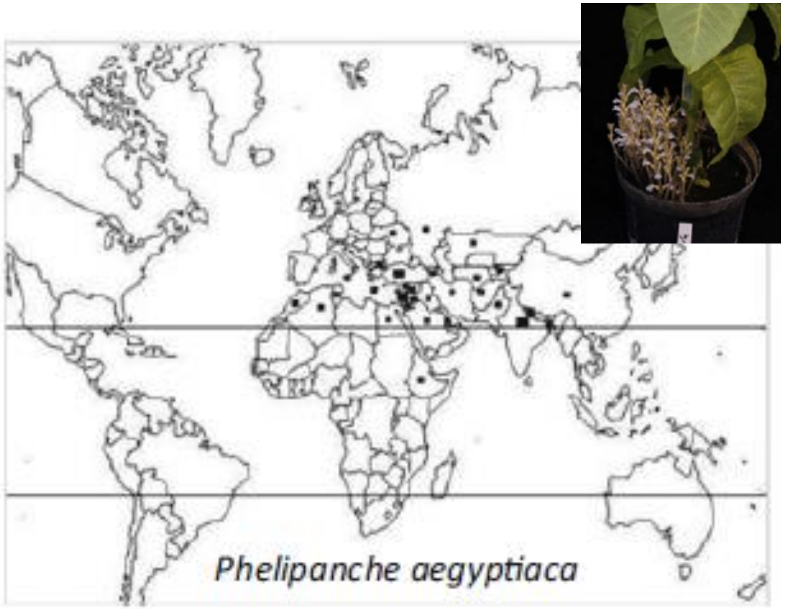
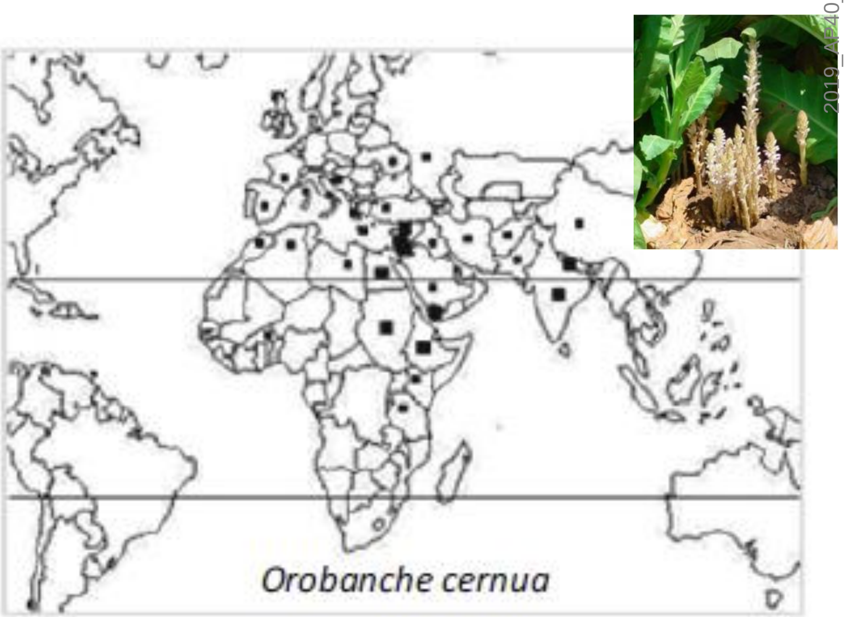
4. Conclusion and next steps

*P. ramosa* on Tobacco, France 2018

# Broomrapes affecting tobacco crops




World distribution of broomrape species. Larger symbols indicate countries in which it causes significant crop losses. Smaller symbols indicate countries in which it occurs mainly on wild hosts, Parasitic Orobanchaceae, Joel & al, 2013

| | | |
|---|---|---|
| **Host range:** Tomato, eggplant, tobacco, pepper, rapeseed, hemp, lentil, pea, carrot, celery, lettuce + wild hosts<br><br>**Economic importance:** Tobacco seriously affected in Europe, Cuba. 70-80% biomass loss. | **Host range:** Same than *P. ramosa* + Brassicas (mustard in India) + Cucurbitaceous<br><br>Distribution of *P. aegyptiaca* overlaps with *P. ramosa*<br><br>**Economic importance:** severe damages in Turkey and Israel. | **Host range:** Solanaceae crops (tomato, eggplant, tobacco)<br><br>**Economic importance:** it has become a severe problem in tobacco in India and Pakistan. About 40 000ha devoted to tobacco in Andra Pradesh state have been infested with losses of yield of 25-50% and losses in quality. |

# Broomrape cycle

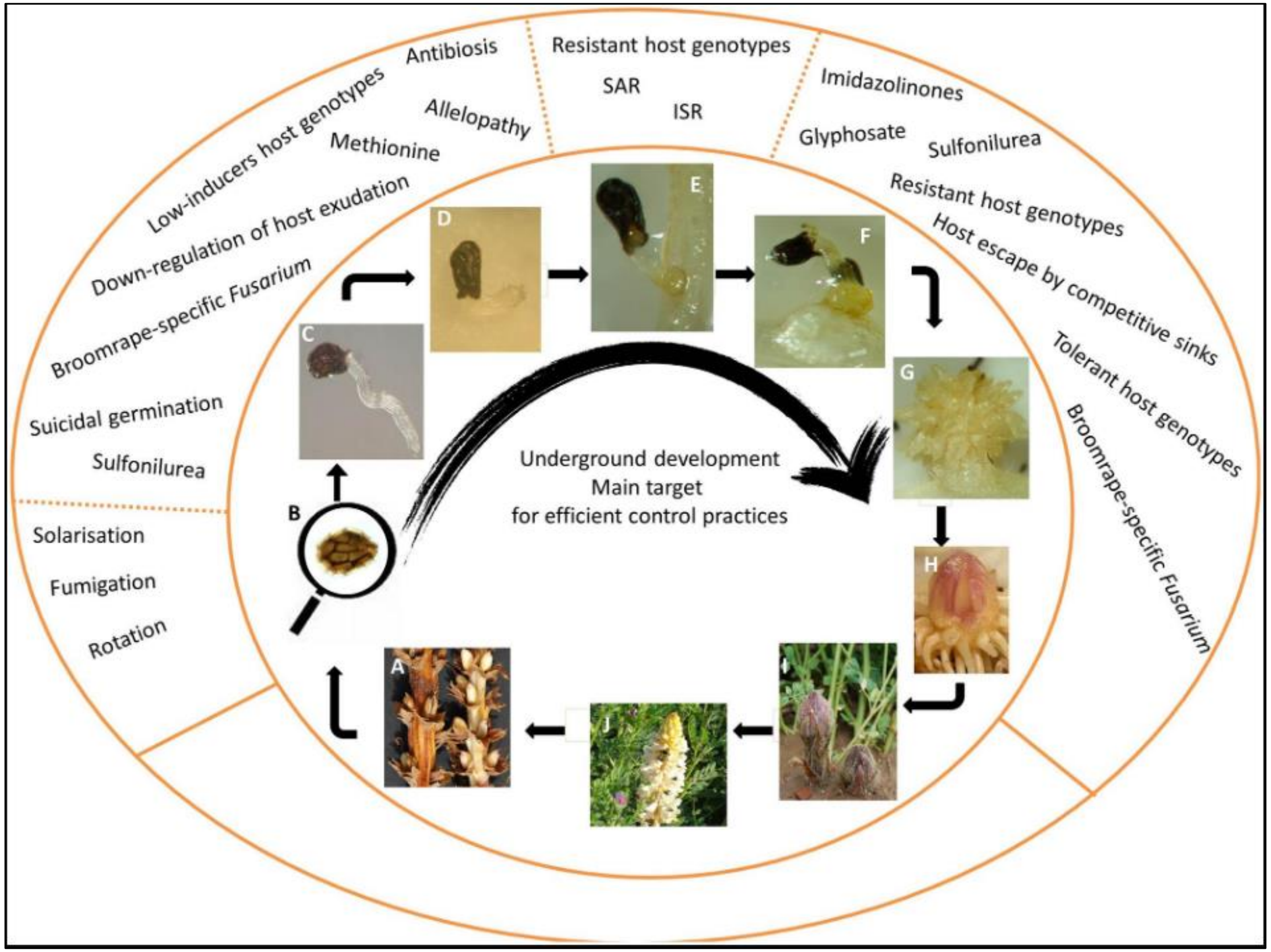



Illustration of broomrape life stages and mechanisms of control. Joel et al. (2007)

-broomrape is an obligate plant-parasitic plants
-it has physical and metabolic overlap with the crop cycle
-underground parasitism
-small, long-lasting, and hardly destructible seeds

→ Not controlled by management strategies designed for non parasitic weeds (i.e. use of agro-chemicals)

→ Points of vulnerability are reviewed as inhibition targets of the broomrape-tobacco association

20% of cultivated surface contaminated in France (rapeseed, sunflower, hemp, tobacco)

# Broomrape, control strategies

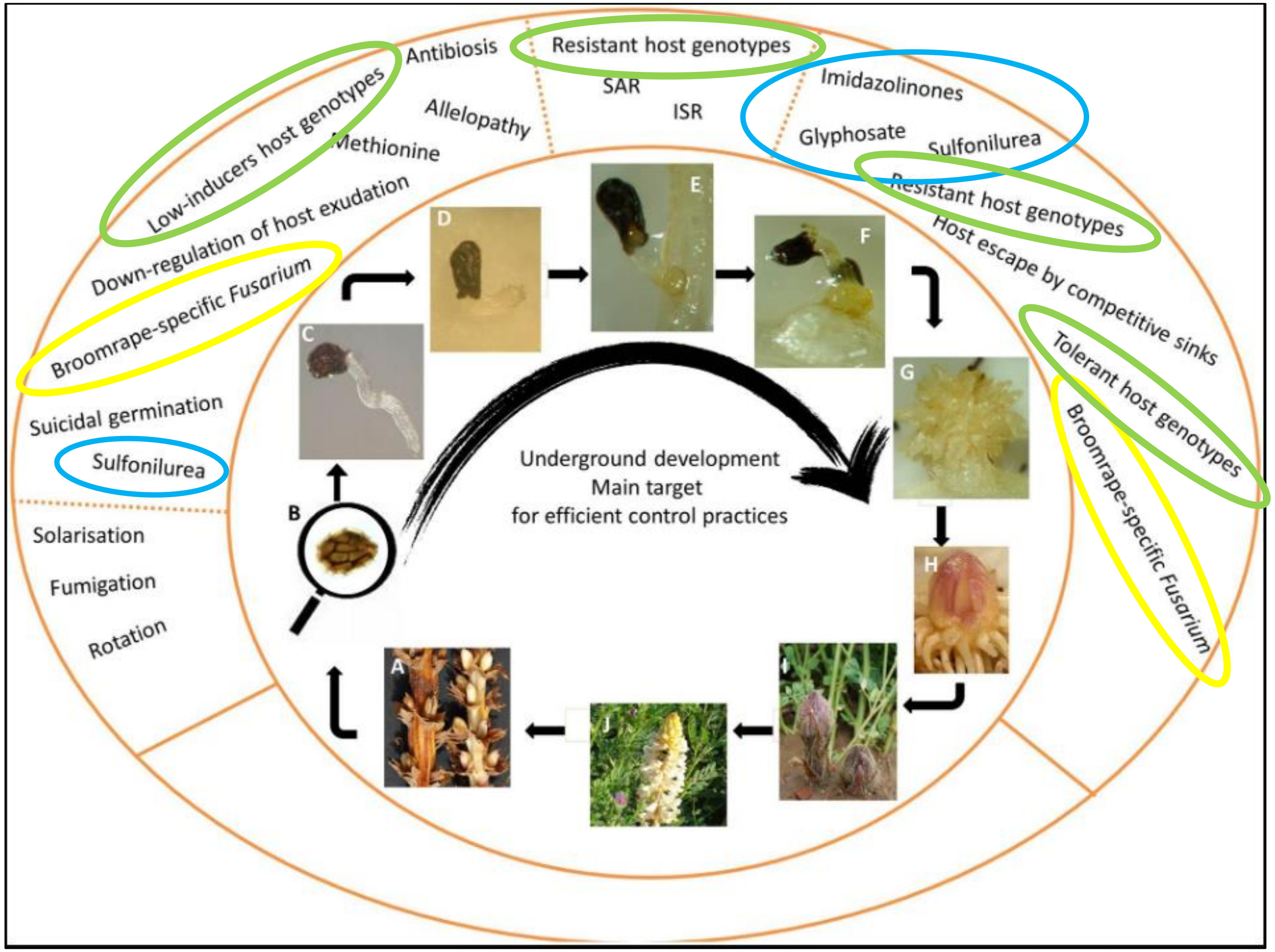



Illustration of broomrape life stages and mechanisms of control. Joel et al. (2007)

Chemical control of post attached parasites
-in 2015: soil acidification, menthol oil application, imazamox, MH
-2016: rimsulfuron, sulfosulfuron, Pilot (quizalofop-P-éthyl), Foly R (clethodim)
-2017: rimsulfuron, sulfosulfuron, methionine, laminarine
-in 2018: rimsulfuron, amidosulfuron, Fresco (metobromuron), Bion, Laminarine

→No fully satisfactory results obtained
(Results available on demand)

Breeding for tolerant/resistant varieties to broomrape invasion: 2016-2019

Development of mycoherbicides as biocontrol agents: 2017-2019

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Broomrape tolerance breeding

*P. ramosa* on Tobacco, France 2018

# Broomrape tolerance breeding

- Wika, shows later/lower stimulation of Orobanche seed, this tolerance is recessively inherited (Cailletau et al., CORESTA 2006)
- Breeding lines were developed by conventional breeding from Wika tolerance.
- Development of a molecular marker, on chm 14, by Imperial team, TWC-2018

ITB 31612

Wika

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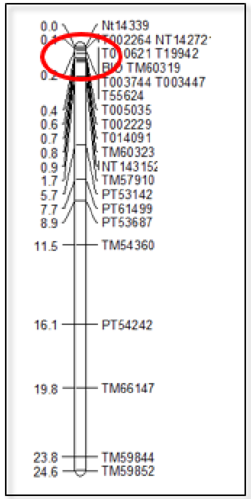
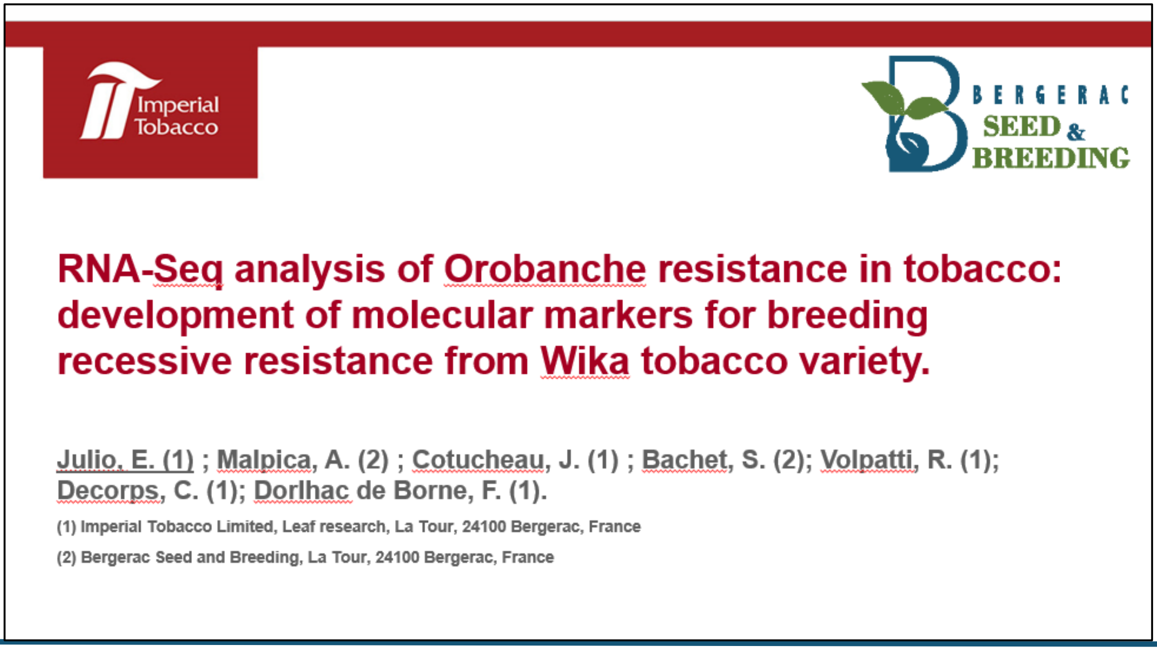


Imperial Tobacco

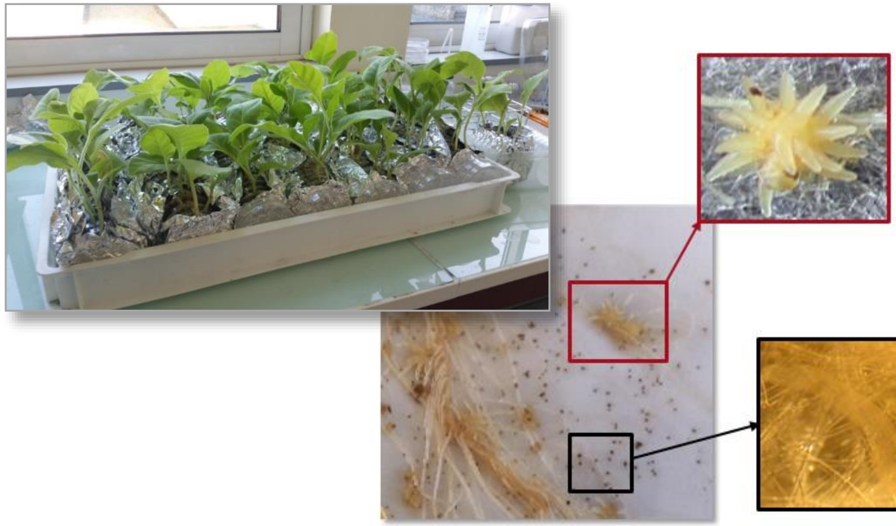
BERGERAC SEED & BREEDING

**RNA-Seq analysis of Orobanche resistance in tobacco: development of molecular markers for breeding recessive resistance from Wika tobacco variety.**


Julio, E. (1) ; Malpica, A. (2) ; Cotucheau, J. (1) ; Bachet, S. (2); Volpatti, R. (1); Decorps, C. (1); Dorlhac de Borne, F. (1).

(1) Imperial Tobacco Limited, Leaf research, La Tour, 24100 Bergerac, France

(2) Bergerac Seed and Breeding, La Tour, 24100 Bergerac, France

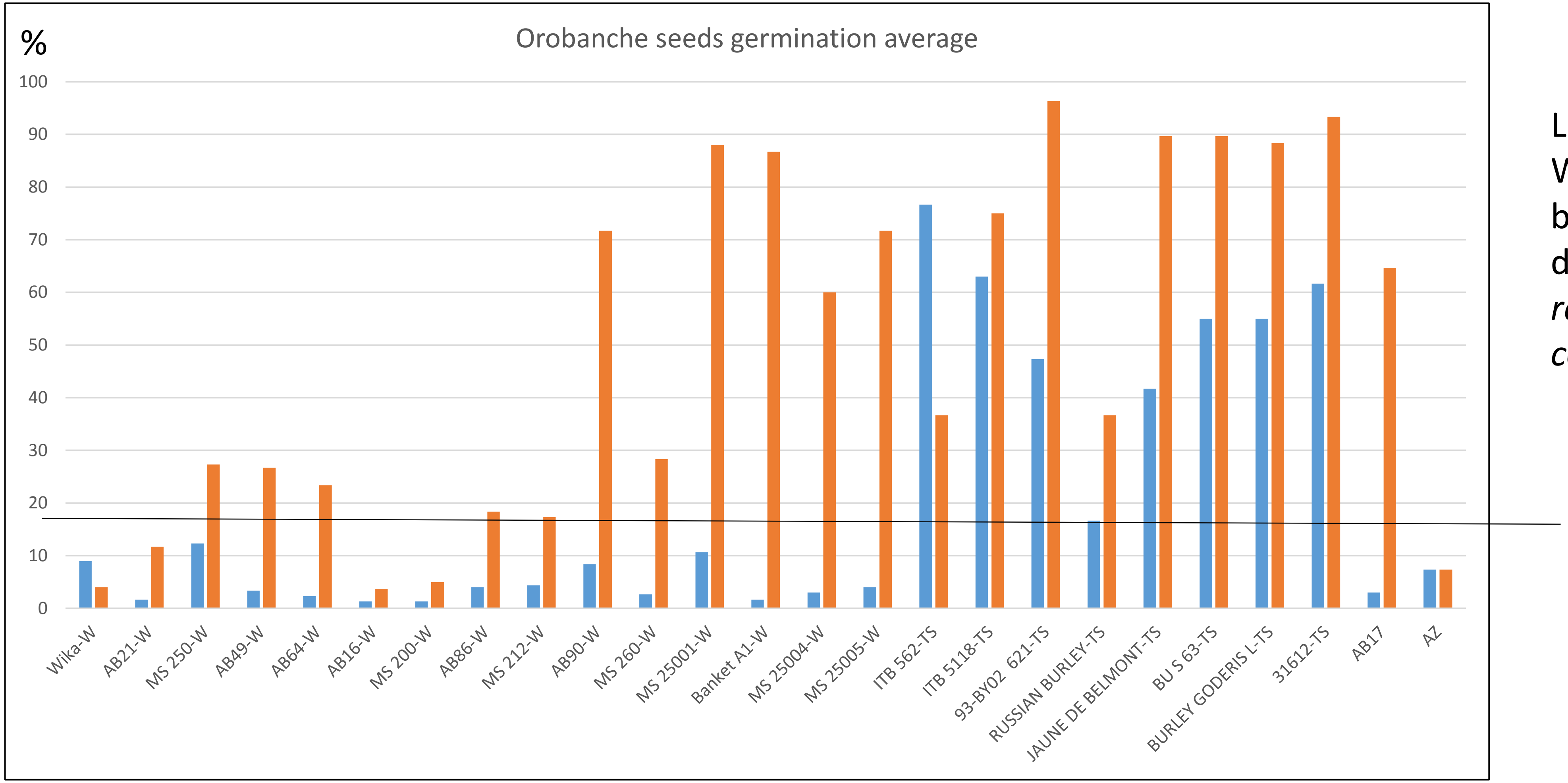
# Broomrape tolerance breeding, next steps

- Development of new hybrids with high agronomic value, 4 new FC hybrids in 2019

BSB 6191 | MS 39925 | MS 39929 | MS 39930 | MS 39931

# Broomrape tolerance breeding, next steps

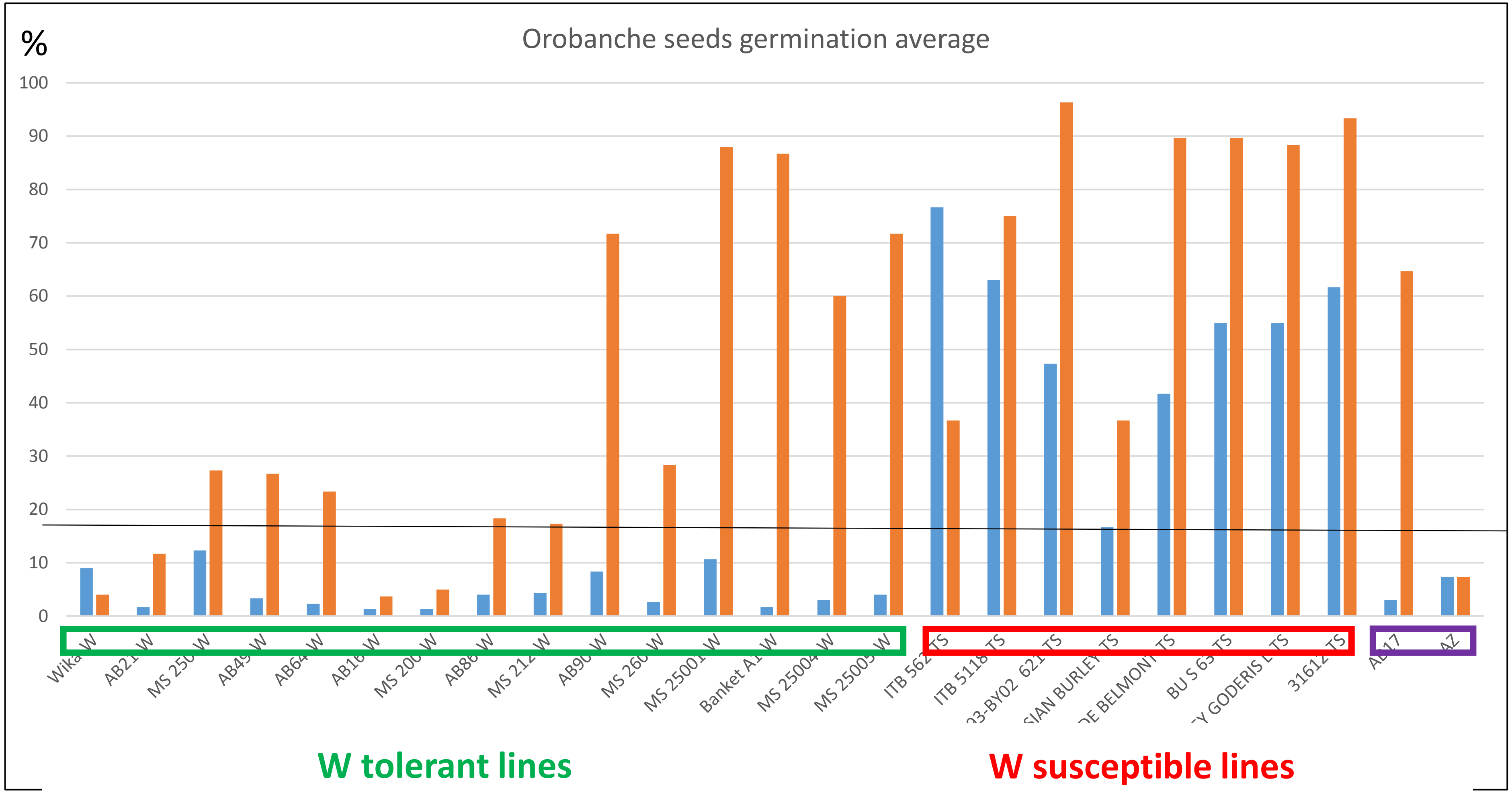
- Improve understanding of Wika tolerance broadness and durability




Lines with and without Wika tolerance have been tested in Petri dishes tests with *P. ramosa* inoculum and *O. cernua* inoculum

# Broomrape tolerance breeding, next steps

- Improve understanding of Wika tolerance broadness and durability




Within this test panel:

-Susceptible lines *to P. ramosa* are also susceptible to *O. cernua*

-Within group of lines with Wika tolerance all are tolerant to *P. ramosa* but most of these are fully susceptible to *O. cernua*

-2 new accessions are showing tolerance to 1 or both broomrapes with no Wika tolerance

# Progress in breeding and agronomical approaches for control of tobacco broomrapes



Agronomical trials 2016-2018:

Biological control with mycoherbicide

INRA SCIENCE & IMPACT

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ARVALIS Institut du végétal

Catherine Vacher

*P. ramosa* on Tobacco, France 2018

# Biological control with mycoherbicides


Harvest of broomrape plants with fungus symptoms for creation of a collection of fungal candidates with potential mycoherbicide effect.

A total of 573 samples collected in 2017 and 54 samples collected in 2018

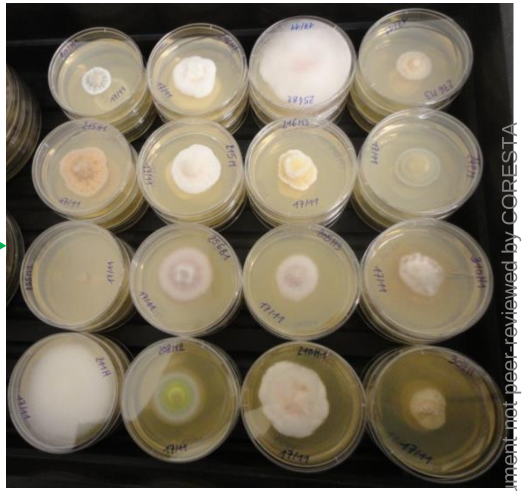
Isolation on acidic malt + antibiotic media of fungal population collected

Morphological and taxonomical characterization of isolated population

**→525 fungal strains isolated**

**→An important diversity dominated by genus *Fusarium***



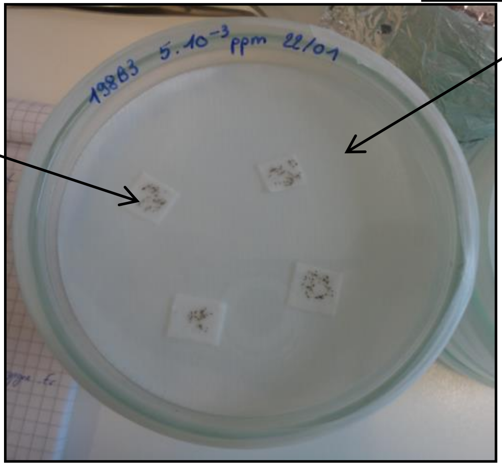


# Biological control with mycoherbicides

Müller-Stöver method

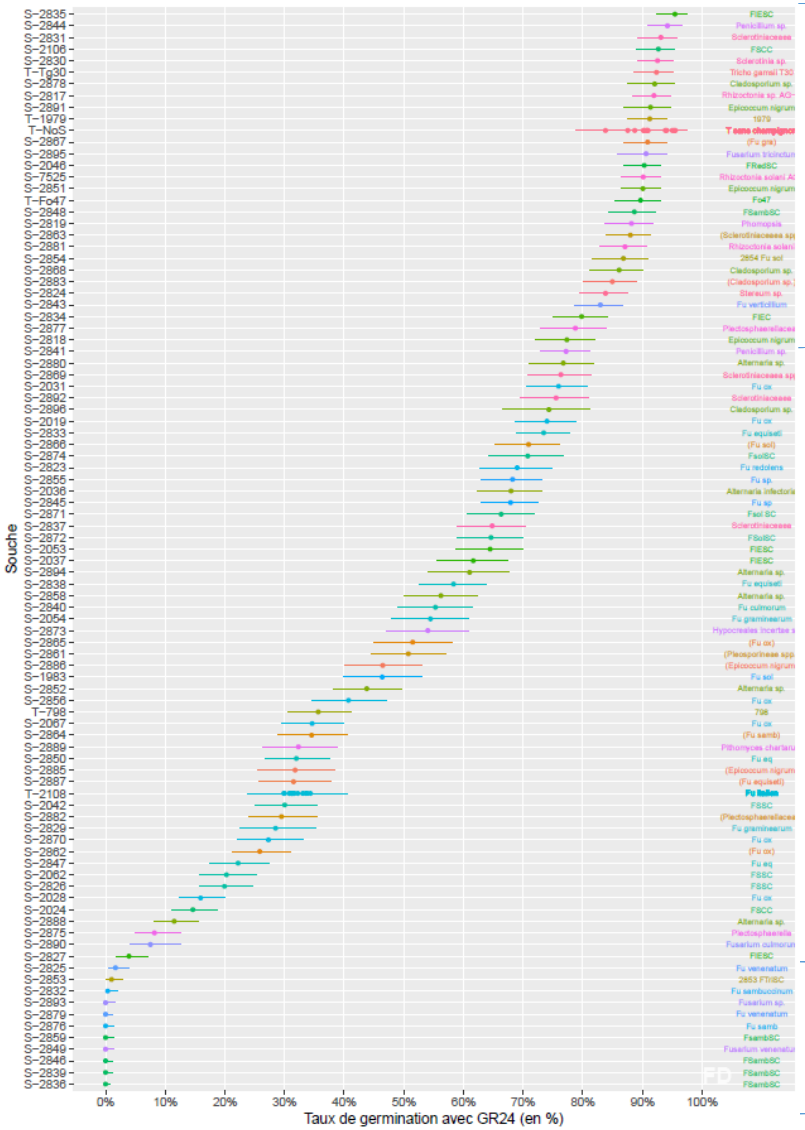
Disinfected non dormant broomrape seeds

Filter with 3 mL fungal suspension



For each fungal strain: 2 Petri dishes with GR24 and 2 Petri dishes without GR24

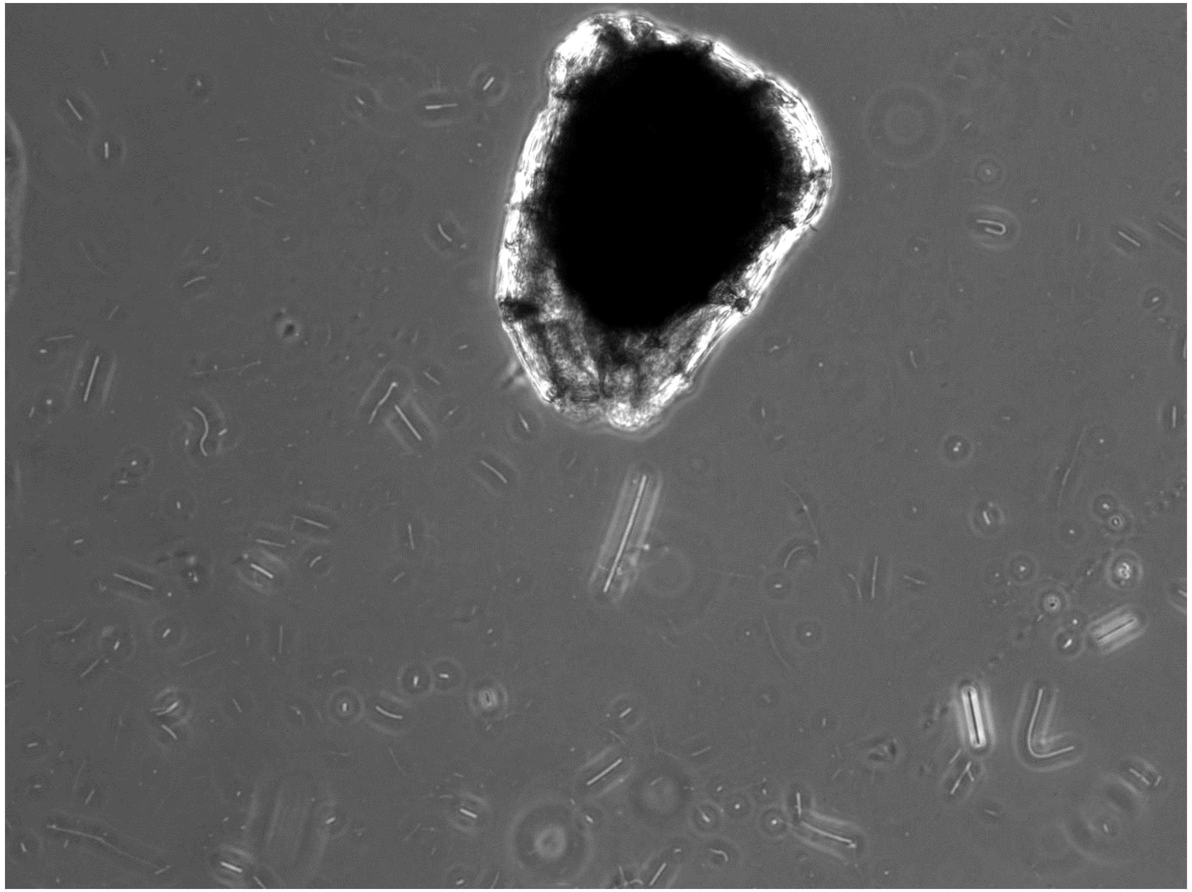
Evaluation of germinated broomrape seeds after 3 weeks test



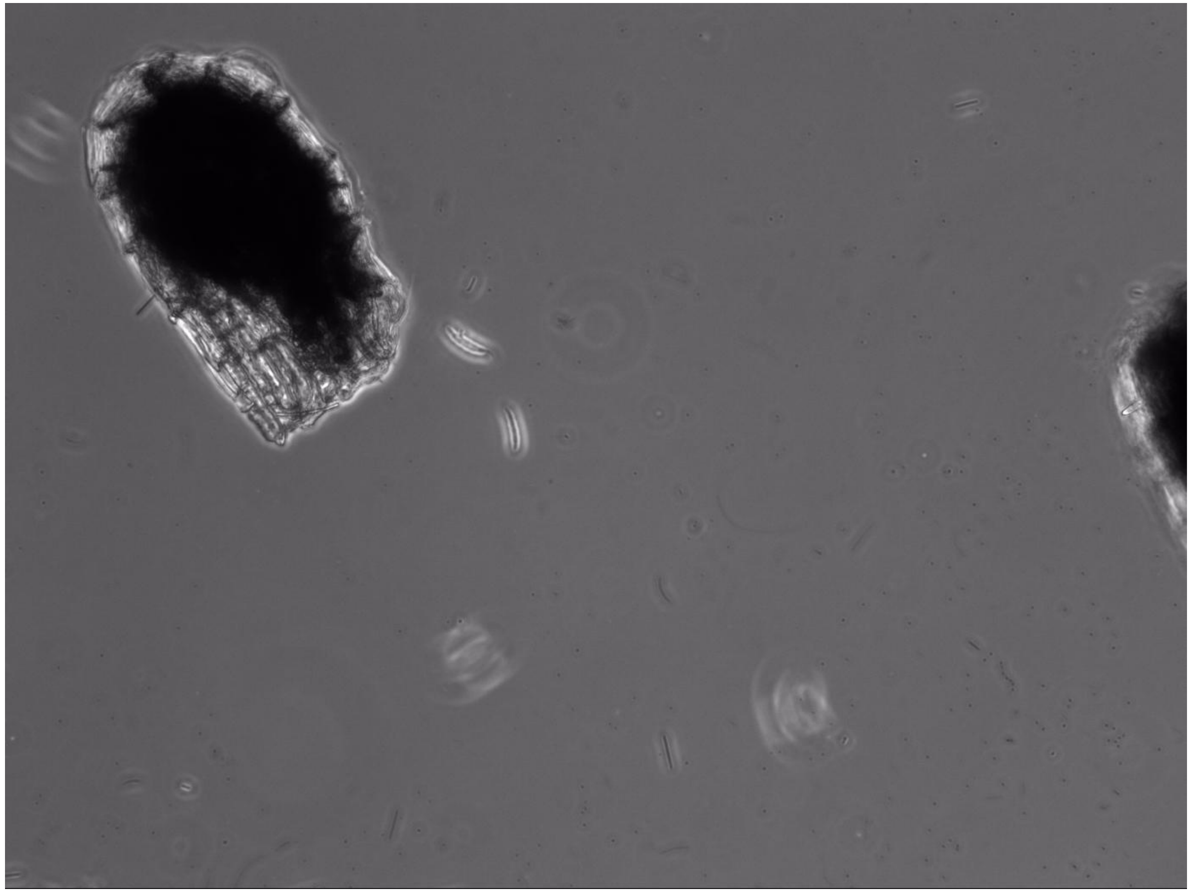

No significant differences with the control

Selection of the 20 most efficient strains (>75% of germination inhibition)

# Biological control with mycoherbicides



Fo47 (control, non pathogen strain)



*Strain* 2876

# Biological control with mycoherbicides

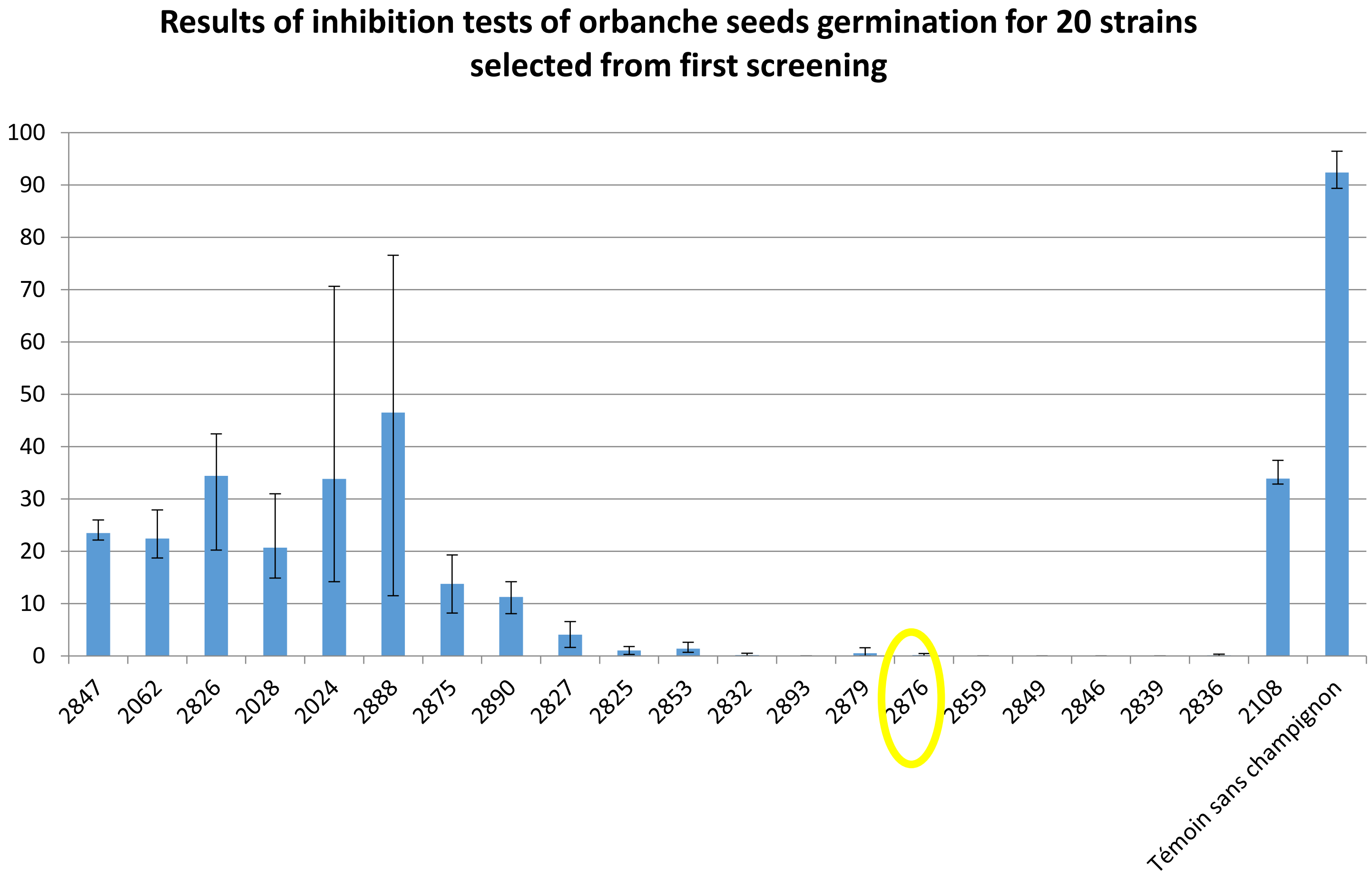


Koch pathogenicity test


Fo47 (souche témoin non pathogène)

*Strain* 2876

Non-inoculated control



# Conclusion