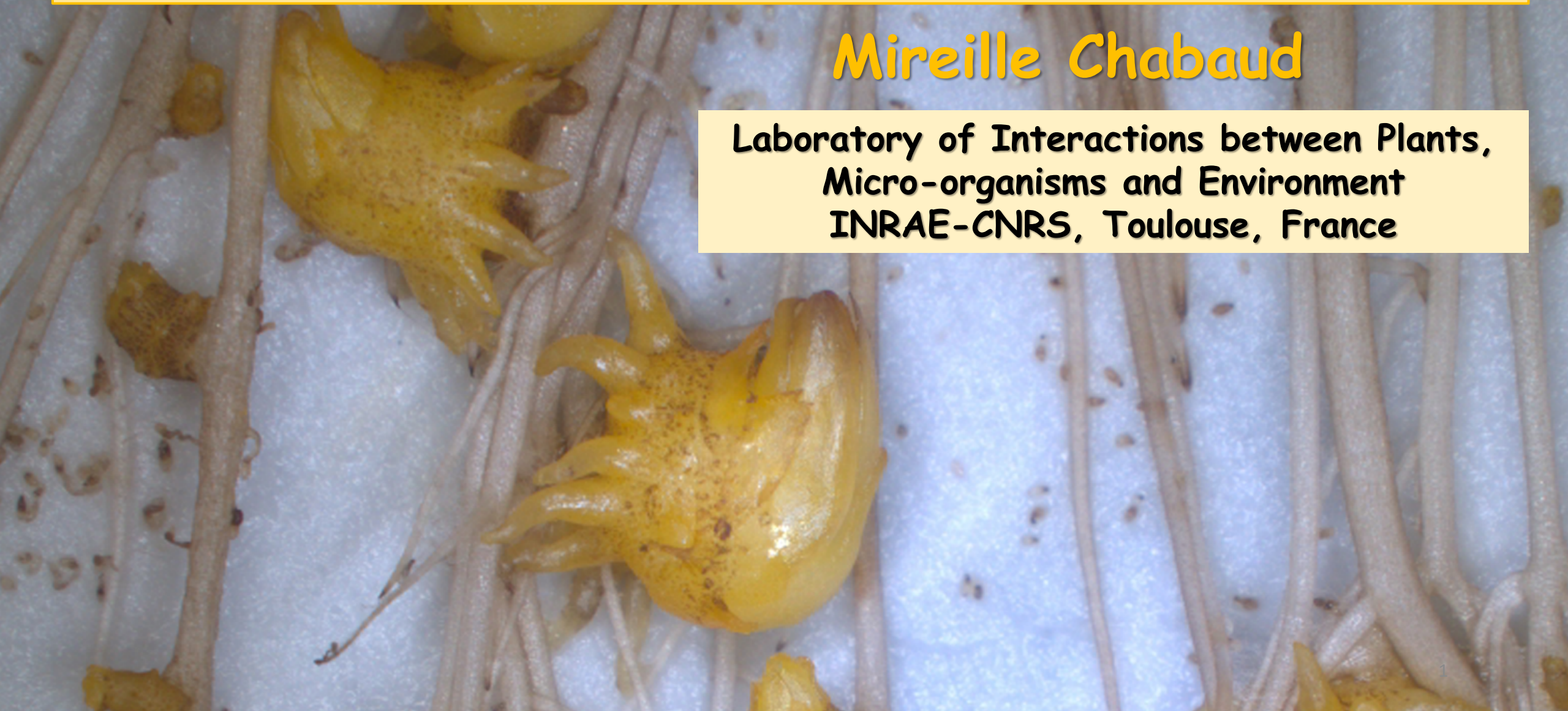


# Exploitation of *Helianthus* genetic diversity for broomrape resistance in sunflower

Mireille Chabaud

Laboratory of Interactions between Plants,  
Micro-organisms and Environment  
INRAE-CNRS, Toulouse, France

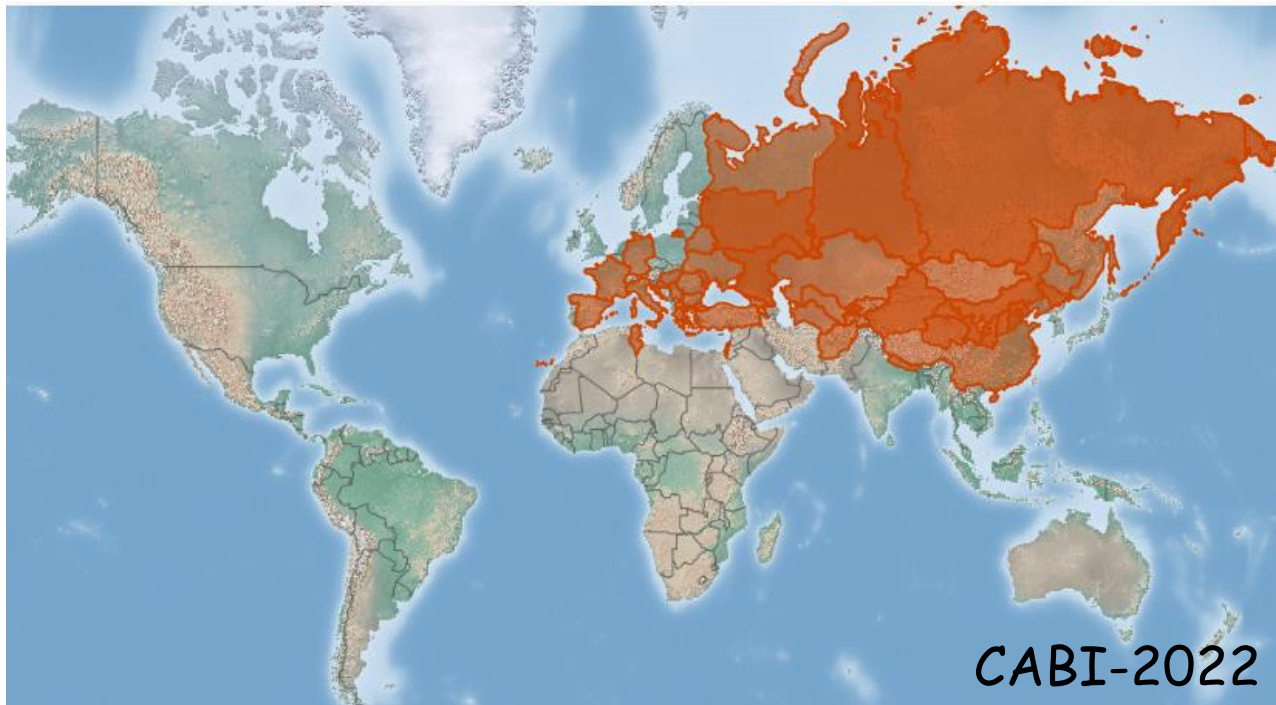


# Broomrape (*Orobanche cumana*): an obligate parasitic plant, a major pest for Sunflower

★ Broomrape geographical distribution overlaps sunflower cultivated areas (with the exception of America)

★ Genetic resistances:  
(*HaOr7*, Duriez et al., 2019 **INRAE** **syngenta** )

*HaOr5* and *Or<sub>DEB2</sub>* under progress

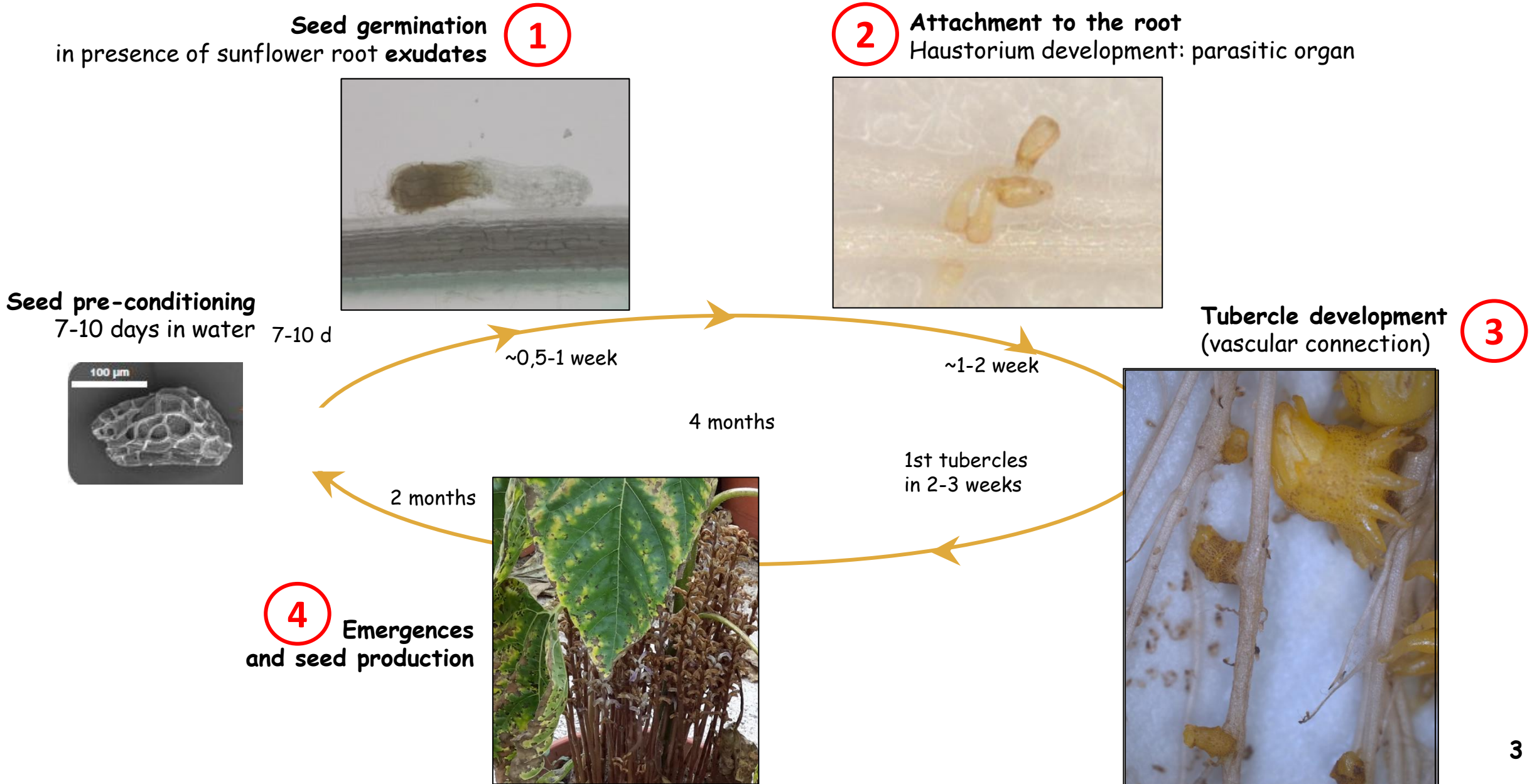


★ Evolution of virulence:  
Races A to G/H

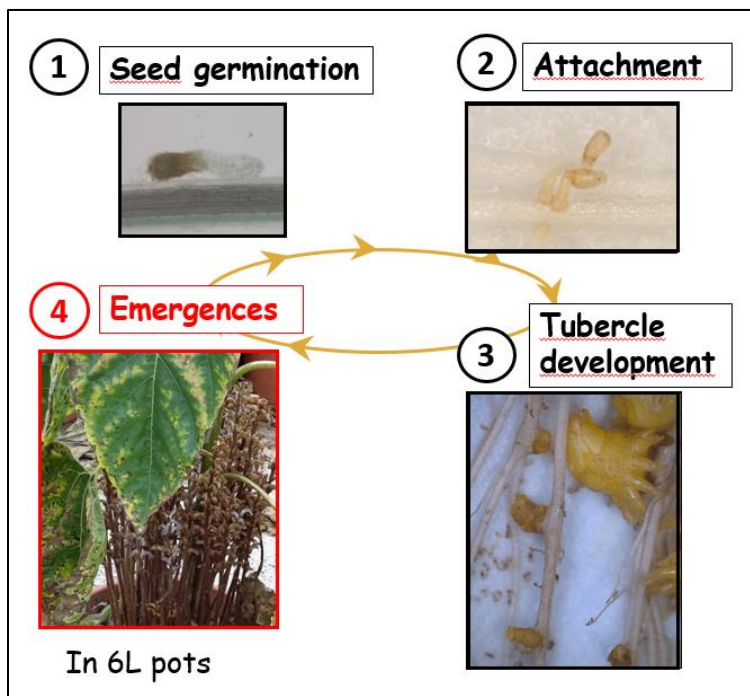


Permanent evolution of races:  
need for new resistances  
affecting various stages of  
the interaction  
toward **pyramidal sustainable**  
resistance

# The biological cycle of the parasitic plant *Orobanche cumana*



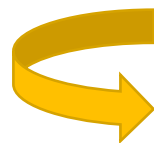
# Wild *Helianthus* : a large reservoir of broomrape resistances



E-BOU (FR); G-ROmania

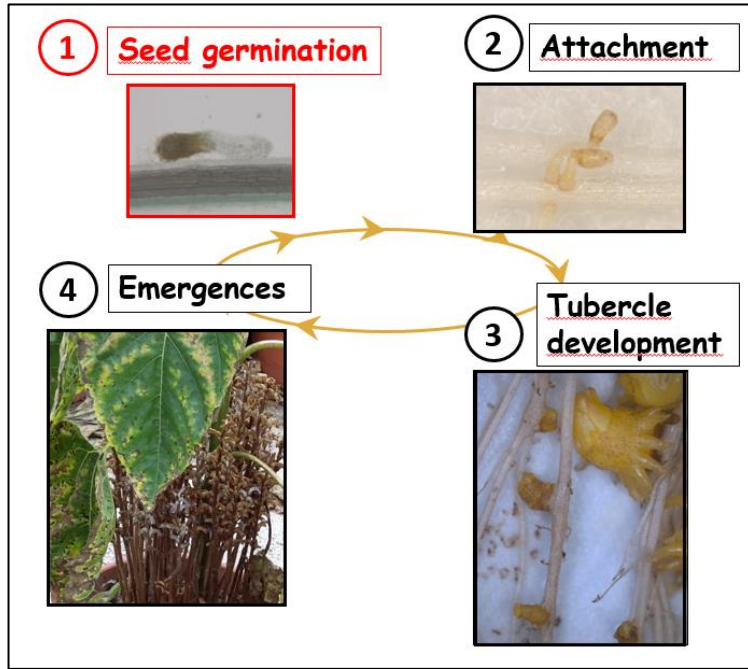


	Late resistance	Resistance	Segregating	Susceptible
6 plants/ accession				
Wild <i>H. annuus</i>	2		3	31
Wild annual <i>Helianthus</i>		16	3	2
		<i>anomalus, bolanderi, debilis, exilis, neglectus, petiolaris, praecox</i>		<i>argophyllus</i>
Wild perennial <i>Helianthus</i>		13	1	
		<i>divaricatus, grosseserratus, nuttallii, pauciflorus, strumosus, tuberosus</i>	<i>winteri</i>	

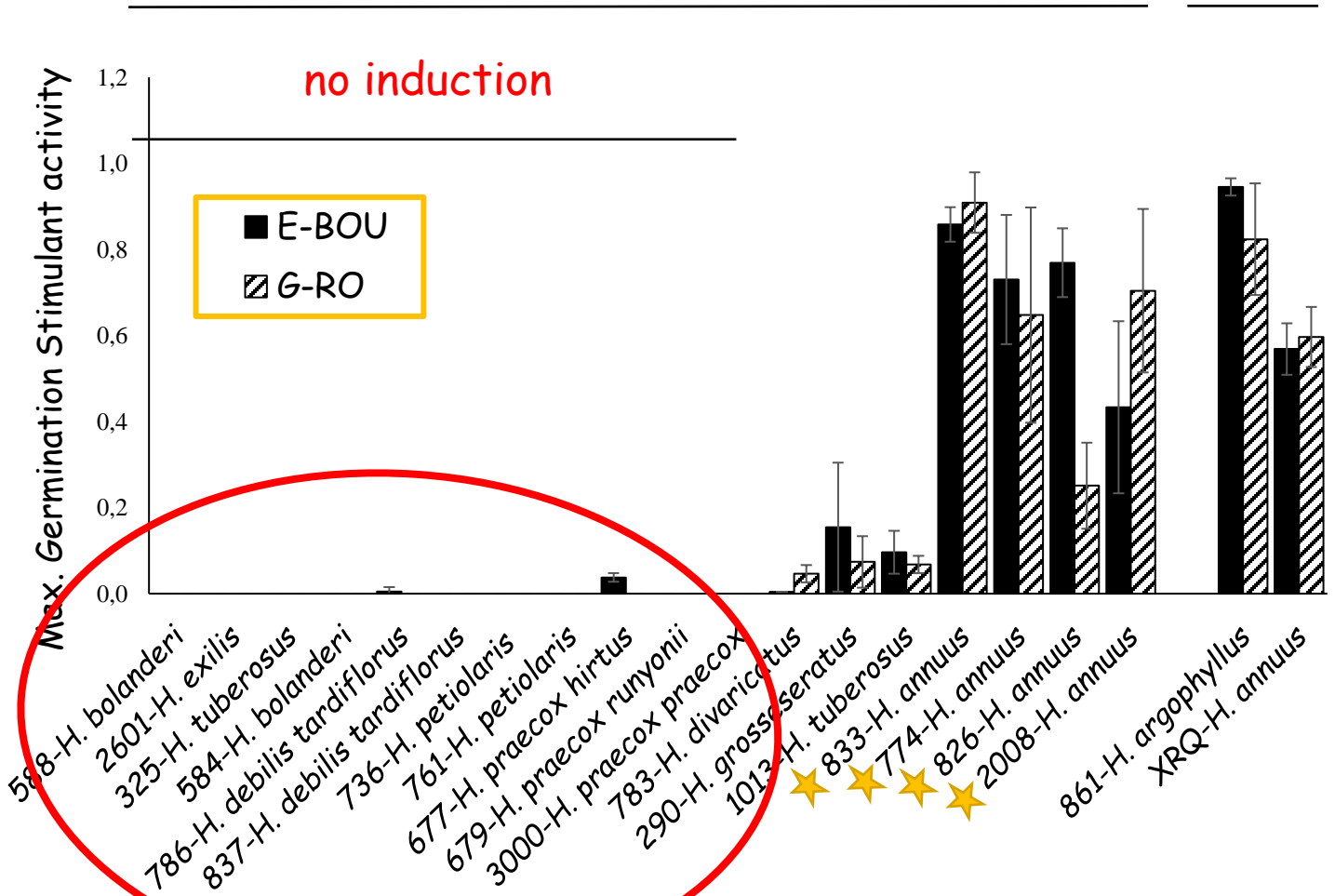


**18 accessions from 9 species** resistant or segregating for resistance used for multiple screenings

# Inactive root exudates in wild *Helianthus* species



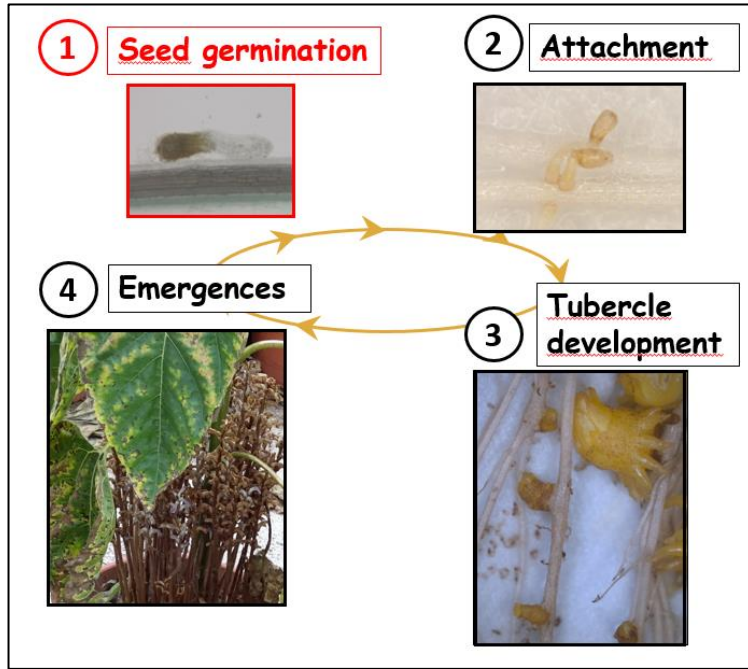
Resistant or Segregating for resistance ★ Susceptible



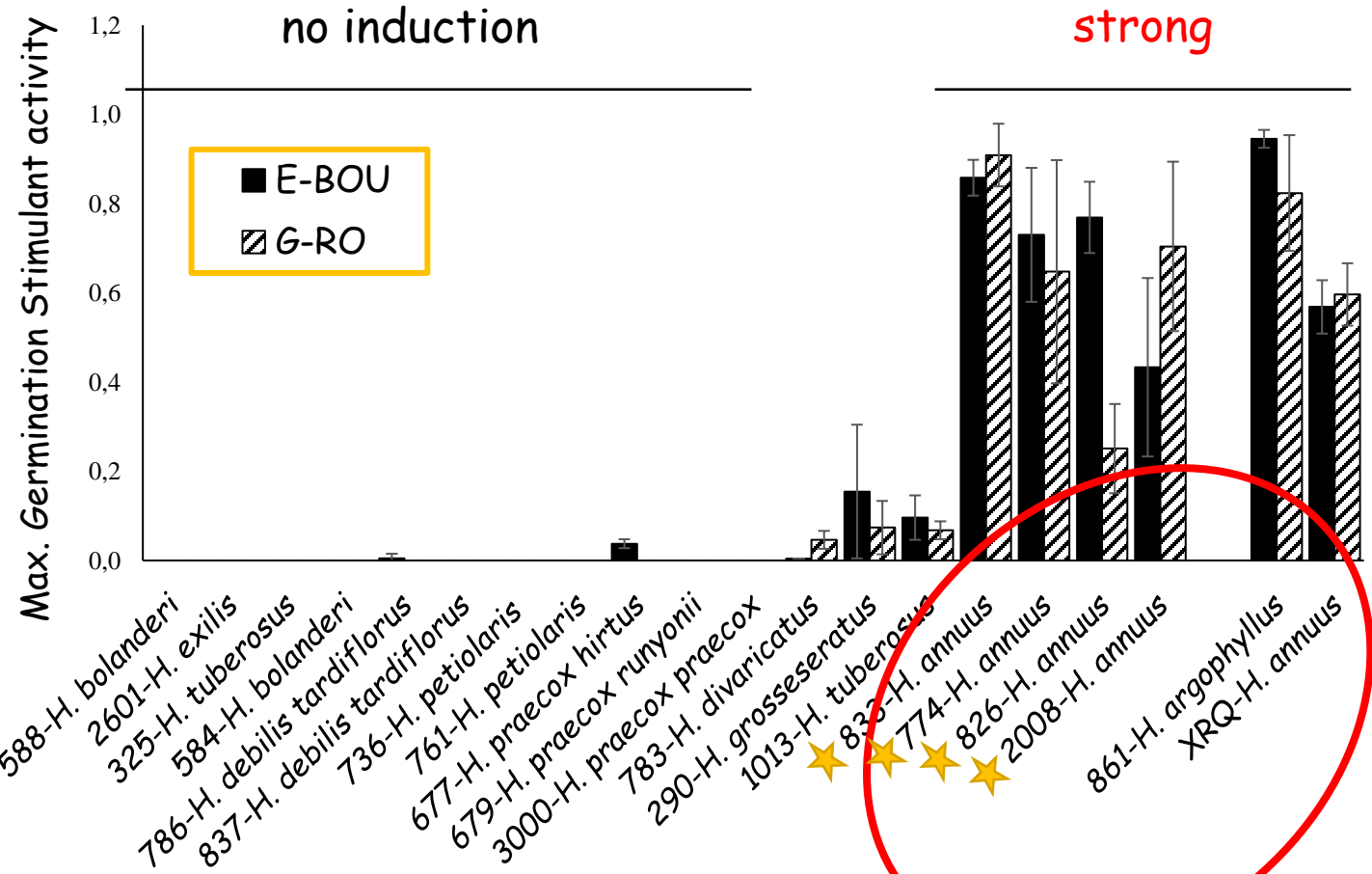
Plants grown in glass beads (6 plants/ accession)  
Root exudate harvests after 3-6 weeks

Pouvreau et al., 2021

# Inactive root exudates in wild *Helianthus* species



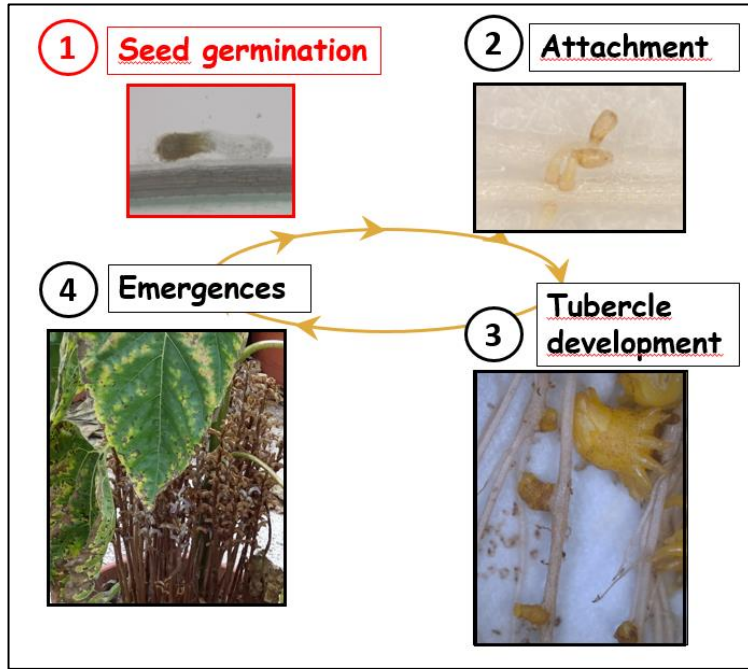
Resistant or SEGregating for resistance ★ Susceptible



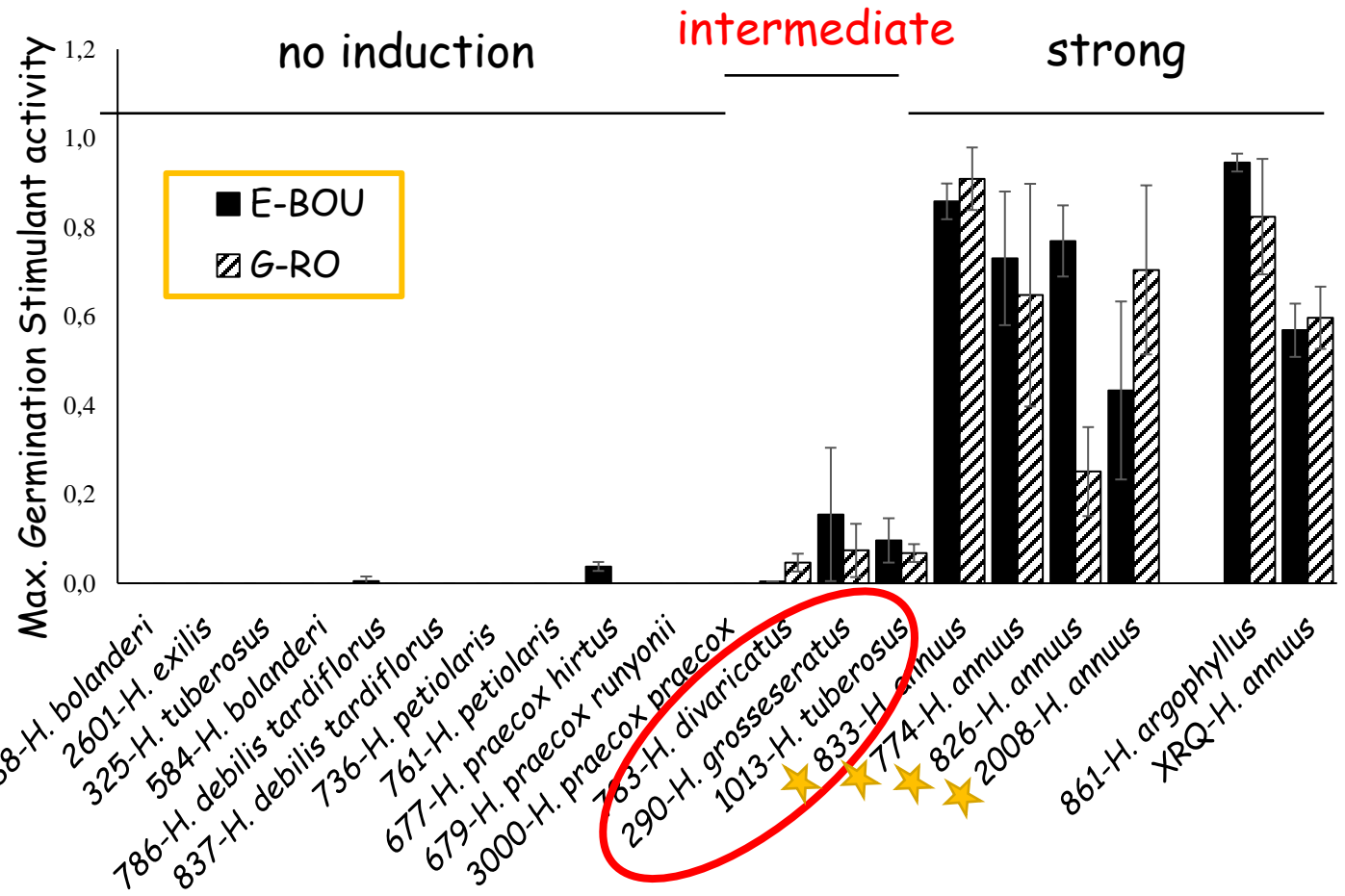
Plants grown in glass beads (6 plants/ accession)  
Root exudate harvests after 3-6 weeks

Pouvreau et al., 2021

# Inactive root exudates in wild *Helianthus* species



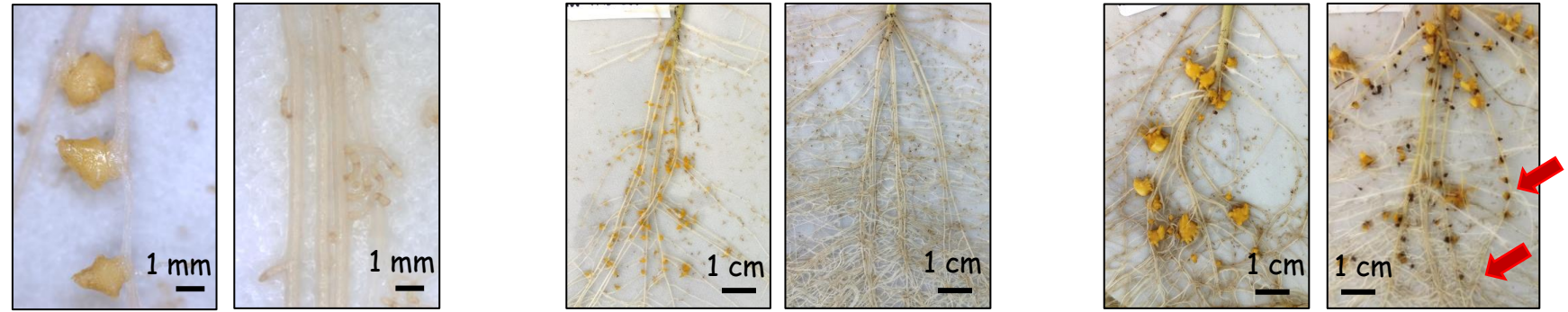
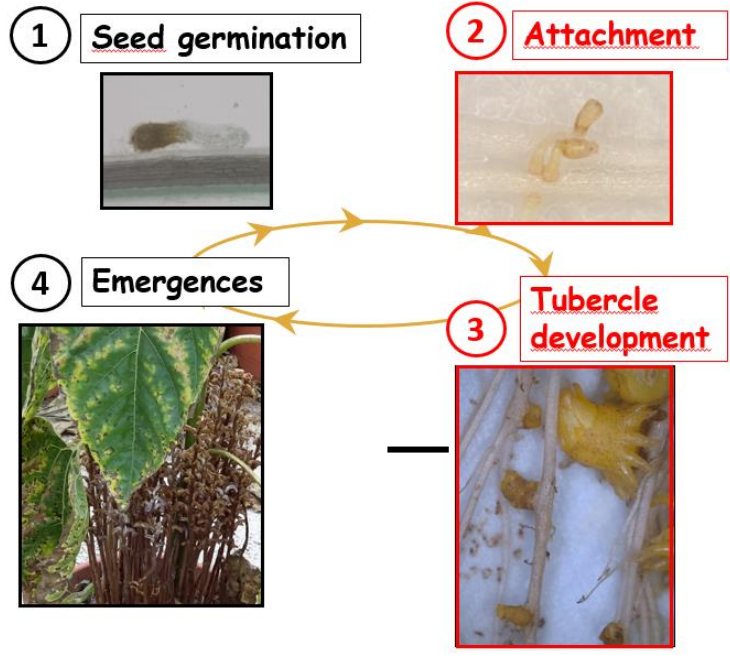
Resistant or Segregating for resistance (★) Susceptible



Plants grown in glass beads (6 plants/ accession)  
Root exudate harvests after 3-6 weeks

Pouvreau et al., 2021

# 4 phenotyping classes at attachment and tubercle stages



Compatible / Incompatible attachments at 14 dai


Number of tubercles at 21 dai

Percentage of necrotic tubercles at 28 dai



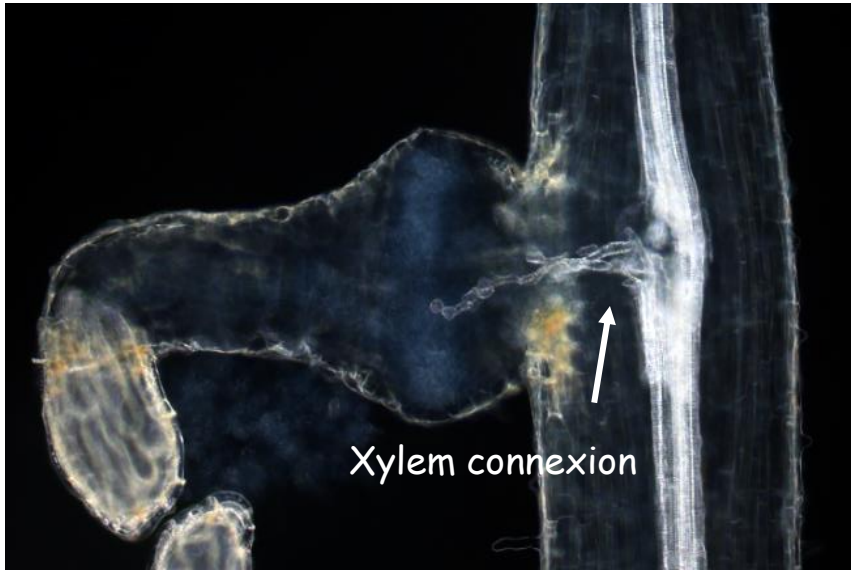
In rhizotrons  
Inoculation with E-BOU (FR)  
-/+ Treatment (GR24 + DCL)

Le Ru et al., 2021

class	Not Treated		Treated		Accessions sequenced  INTERNATIONAL CONSORTIUM ON SUNFLOWER GENOMICS	Number
	attachments	tubercles	attachments	tubercles		
I	-	-	+	-	588 <i>bolanderi</i> , 2601 <i>exilis</i> , <b>325 <i>tuberosus</i></b>	3
II	-	-	+	+	584 <i>bolanderi</i> , <b>786 <i>debilis tardiflorus</i></b> , <b>837 <i>debilis tardiflorus</i></b> , 736 <i>petiolaris</i> , 761 <i>petiolaris</i> , <b>677 <i>praecox</i></b> , , 679 <i>praecox</i> , 3000 <i>praecox</i> ,	8
III	+	-	+	-	<b>783 <i>divaricatus</i></b> , 290 <i>grosseserratus</i> , 1013 <i>tuberosus</i> , 833 <i>annuus</i>	4
IV	+	+	+	+	774 <i>annuus</i> , 826 <i>annuus</i> , 2008 <i>annuus</i>	3

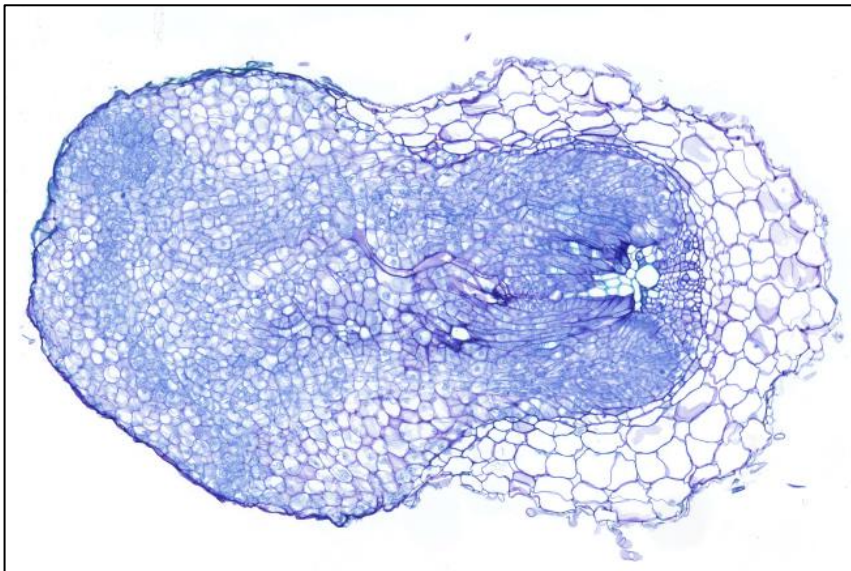


# Similar cytological phenotypes in wild *Helianthus* incompatible attachments

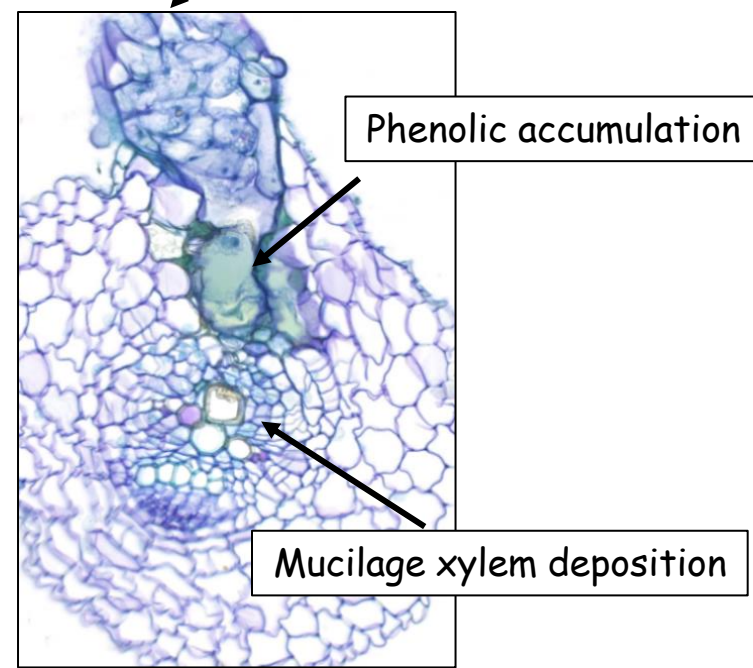
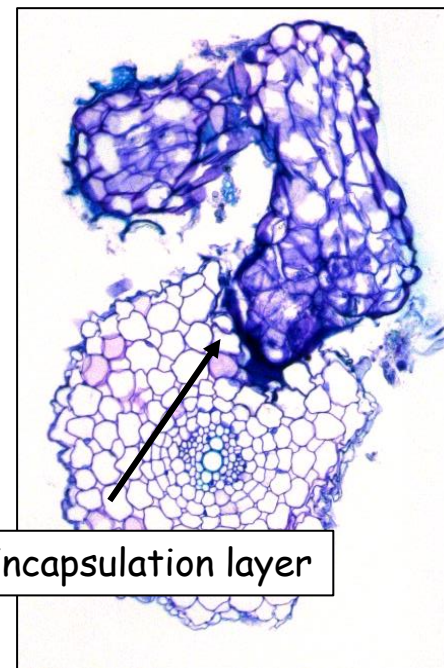


**Incompatible attachments**

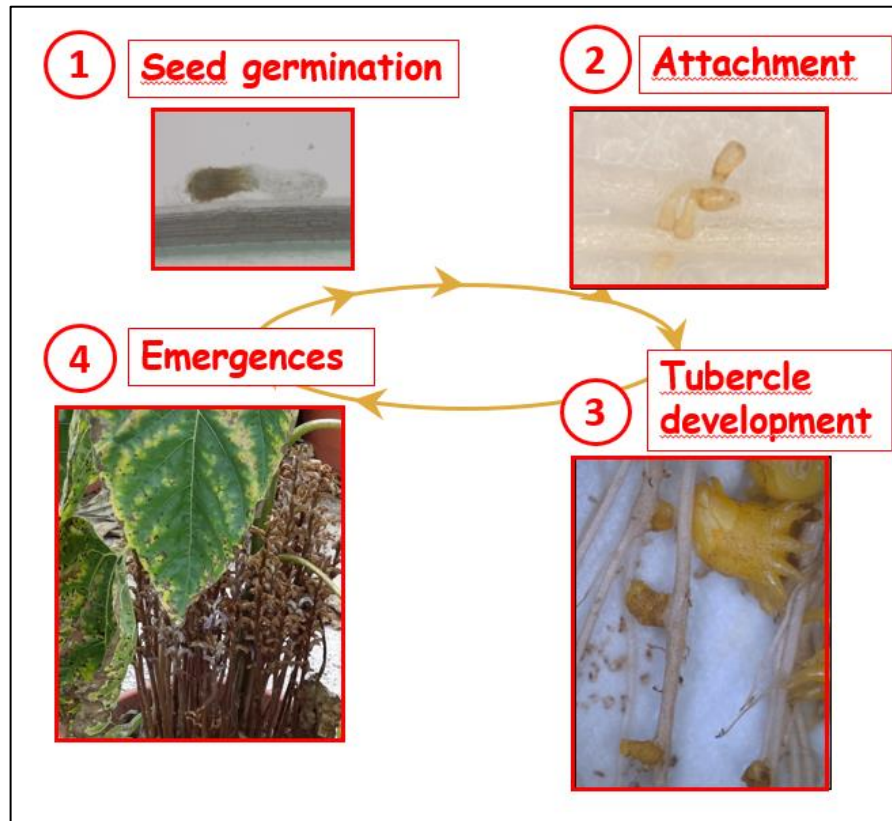
Absence of vascular connexion and parasite vessel differentiation



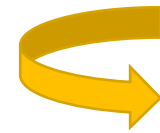
**Compatible attachments**



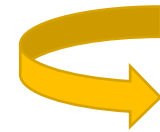
# Conclusions and Perspectives



★ Many resistances in wild *Helianthus* affect all the stages of the interaction with broomrape



Pre-breeding resources for sunflower



Characterization of resistant genes

# Acknowledgments

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## Foundings



