



UNIVERSITÀ DEGLI STUDI DI MILANO



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Screening for new sources of powdery and downy mildew resistance

WP3 - Task T3.1

Exploiting the genetic diversity in grapevine



Partners involved:

1. UNIMI: Università degli Studi di Milano (IT)
2. ABI: Agrobioinstitute – Sofia (BG)
3. IGA: Istituto di Genomica Applicata - Udine (IT)
4. INRA: Institut National de la Recherche Agronomique - Colmar - (FR)
5. JKI: Julius Kühn-Institut, Institute for Grapevine Breeding – Siebeldingen (DE)

Novel sources for powdery and downy mildew resistance in *eastern V. vinifera* germplasm (*wild* and cultivated)

- Objective

Screening for resistance to the downy and powdery mildew agents in *less common V. vinifera* germplasm

Why eastern germplasm
(Caucasus, North Black Sea region,
Balkans and Central Asia)?

Why wild germplasm?

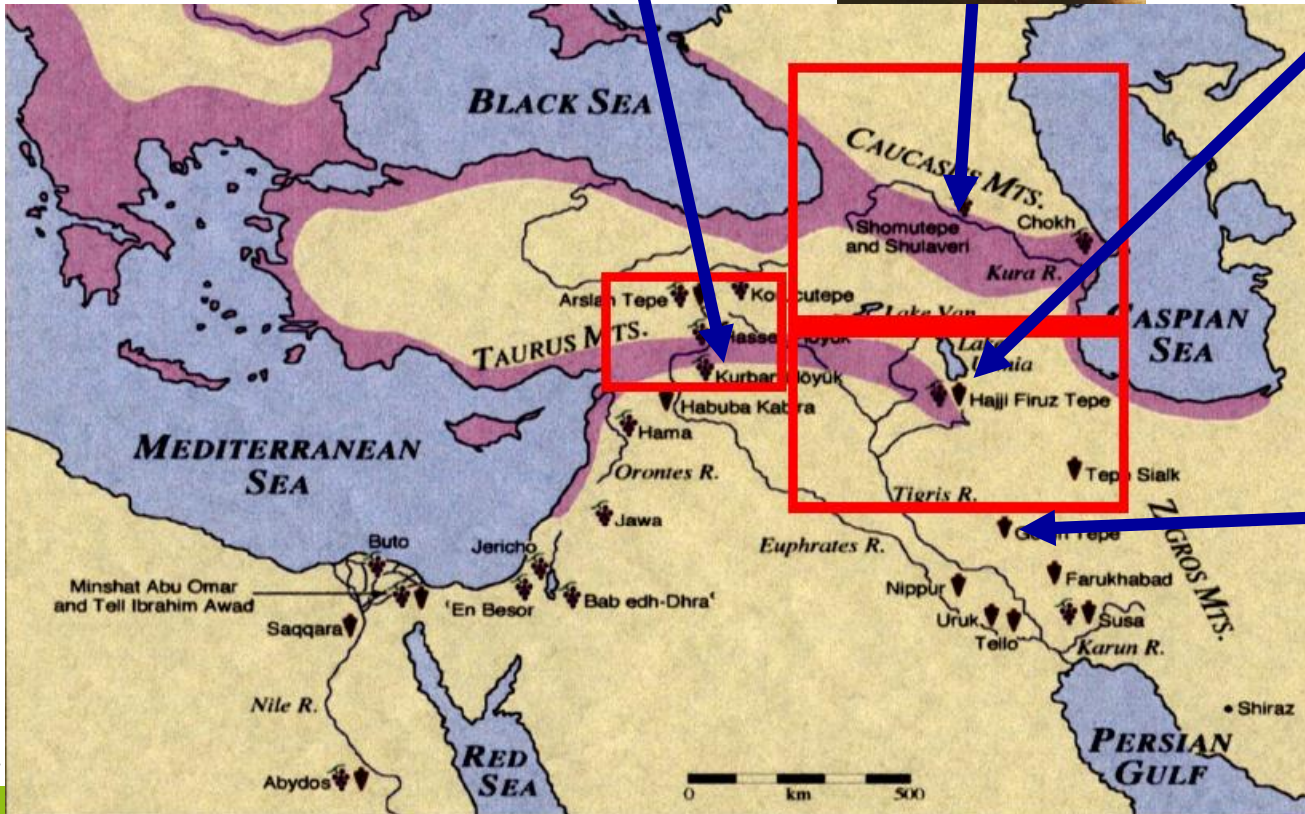
A step back towards the origin of grapevines biodiversity

Since VIII millennium BC
abundant seed (wild)
remains deposits



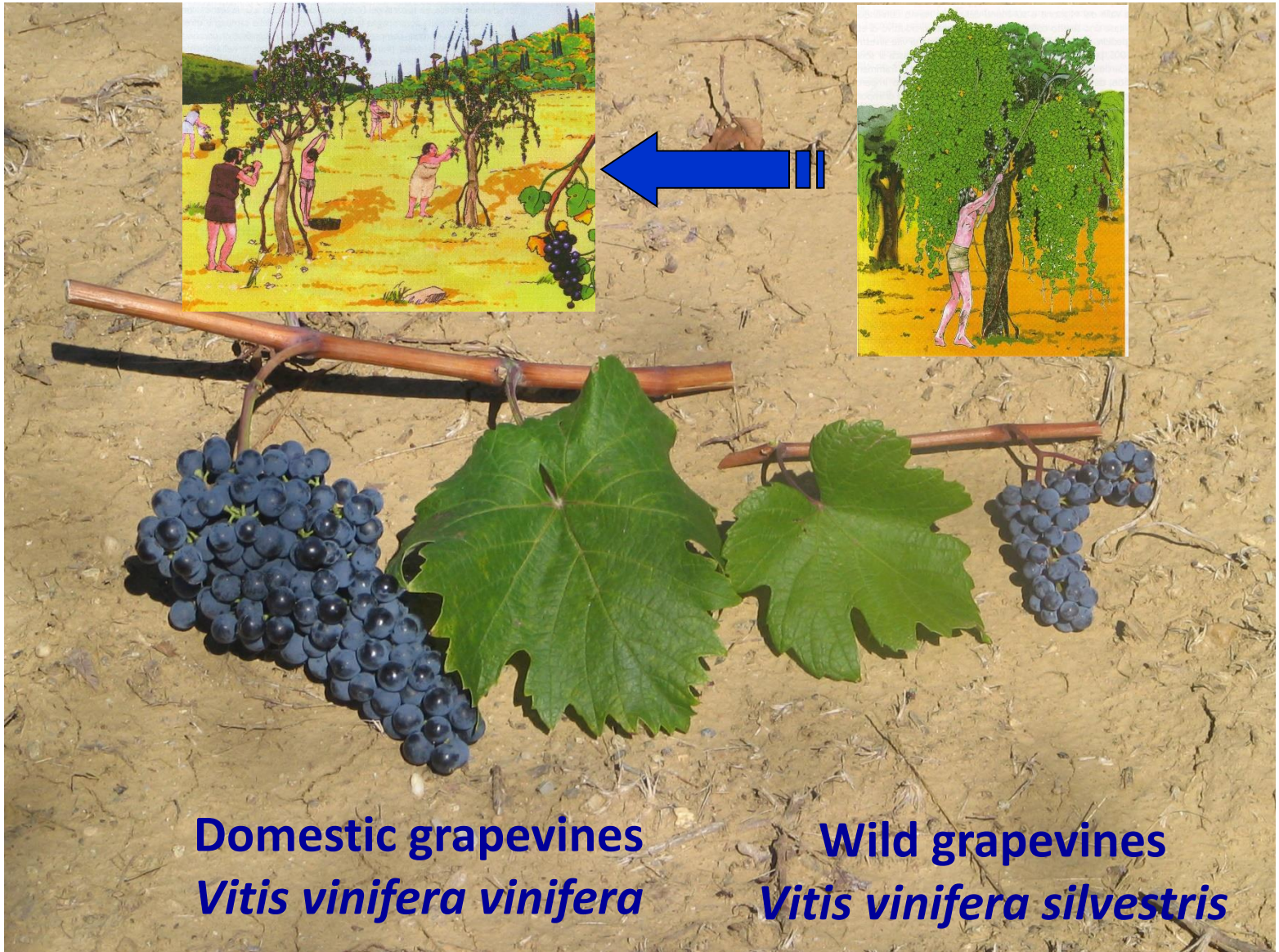
VI-V millennium BC large clay vessel
decorated with grapes bunches

VI millennium (5400-
5000 BC) clay vessel
with tartaric acid traces

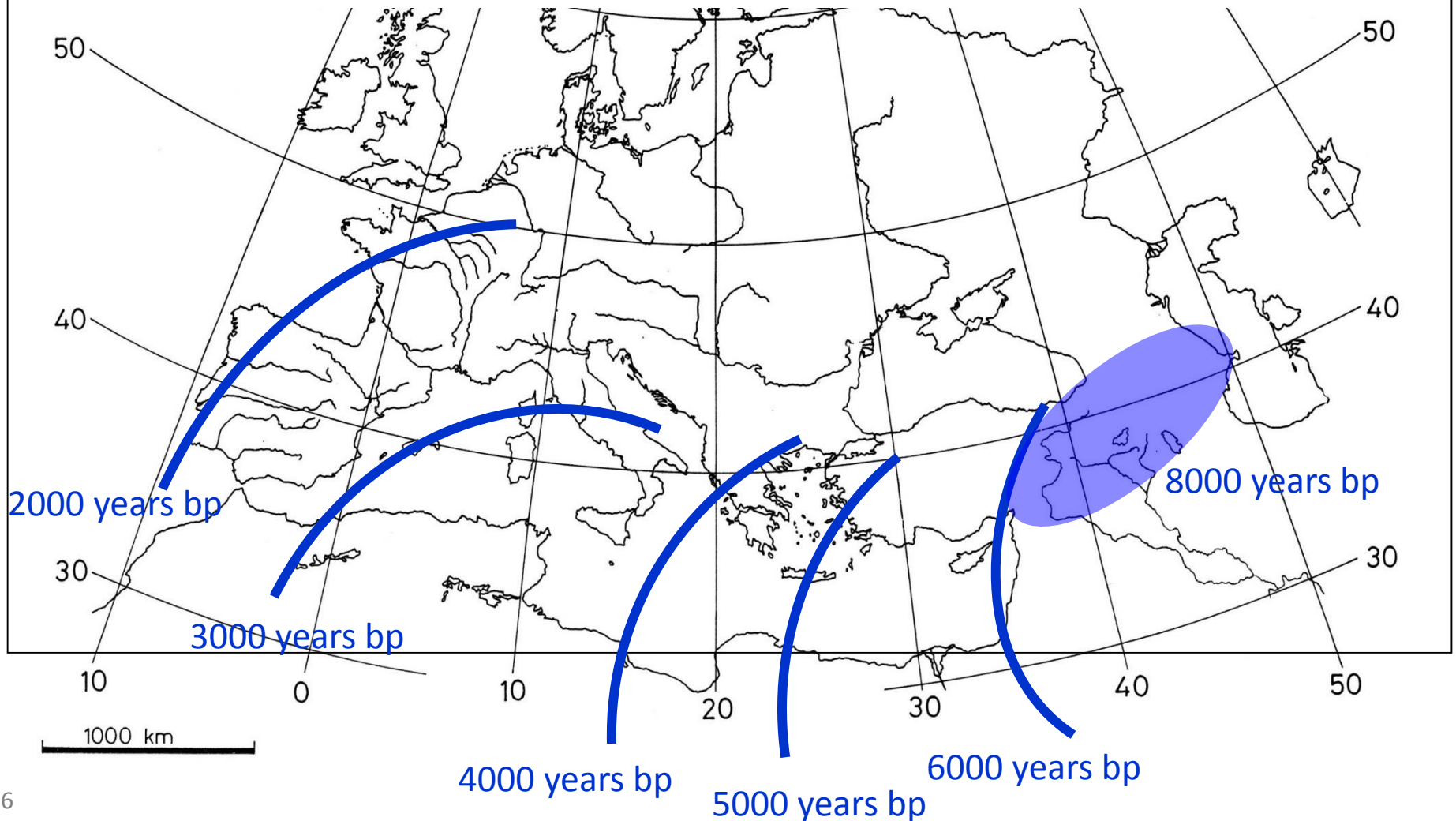


IV millennium (3500-
3100 BC) clay vessel
with tartaric acid traces

From a biological species to a crop species

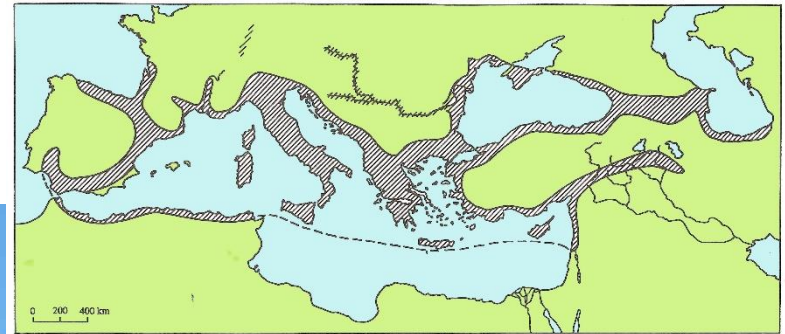


The spreading of viniculture toward west



The wild grapevines genetic pools

Do they possess / evolve (during the last 150 years)
tolerance/resistance against American fungal diseases?



COST Project: GRAPENET

East-West Collaboration for Grapevine Diversity Exploration and Mobilization of Adaptive Traits for Breeding

FA1003

Start date: 04/11/2010

End date: 03/11/2014

The action involved around 250 scientists from 25 Cost countries and 10 non Cost countries, which represent quite all the range of the Old World viticulture.



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Ludger Hausmann⁵ and Reihard Töpfer⁵

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Novel sources for powdery and downy mildew resistance in eastern *V. vinifera* germplasm (wild and cultivated)

WP3 - Task T3.1

Exploiting the genetic diversity in grapevine



- **Downy Mildew** (according to OIV 452-1):
 - Experimental inoculations of leaf disks with *Plasmopara viticola*
 - Natural populations collected in the field and shared among WP3.1 partners
 - Strains isolated from single sporangia (received from WP2)
 - Artificial inoculation of leaf discs with spore suspensions
 - Disease evaluation on 6-9 discs per infection after 5-9 days post inoculation
 - Controls: Kunbarat (R), Regent (R), Pinot Noir (S), Müller Thurgau (S)



Phenotyping platform for disease resistance assays



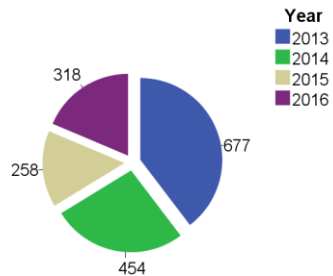
MATERIALS AND METHODS

- **Powdery Mildew** (according to OIV 455):
 - Infections of grapevine potted plants with *Erysiphe necator* in greenhouse
 - Natural infection and forced leaf inoculation
 - Leaf inoculations in laboratory conditions in Colmar phenotyping platform
 - Potted plants derived from wooden cuttings
 - Scoring of symptoms
 - Controls: Kishmish vatkana (R), Pinot Noir (S)



MAIN RESULTS: downy mildew

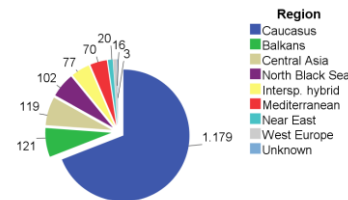
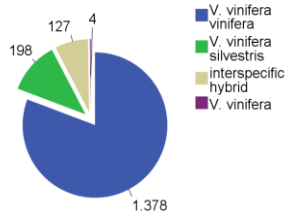
- 1.707 tests with *P. viticola* (including references and replications among years and partners)



MAIN RESULTS: downy mildew

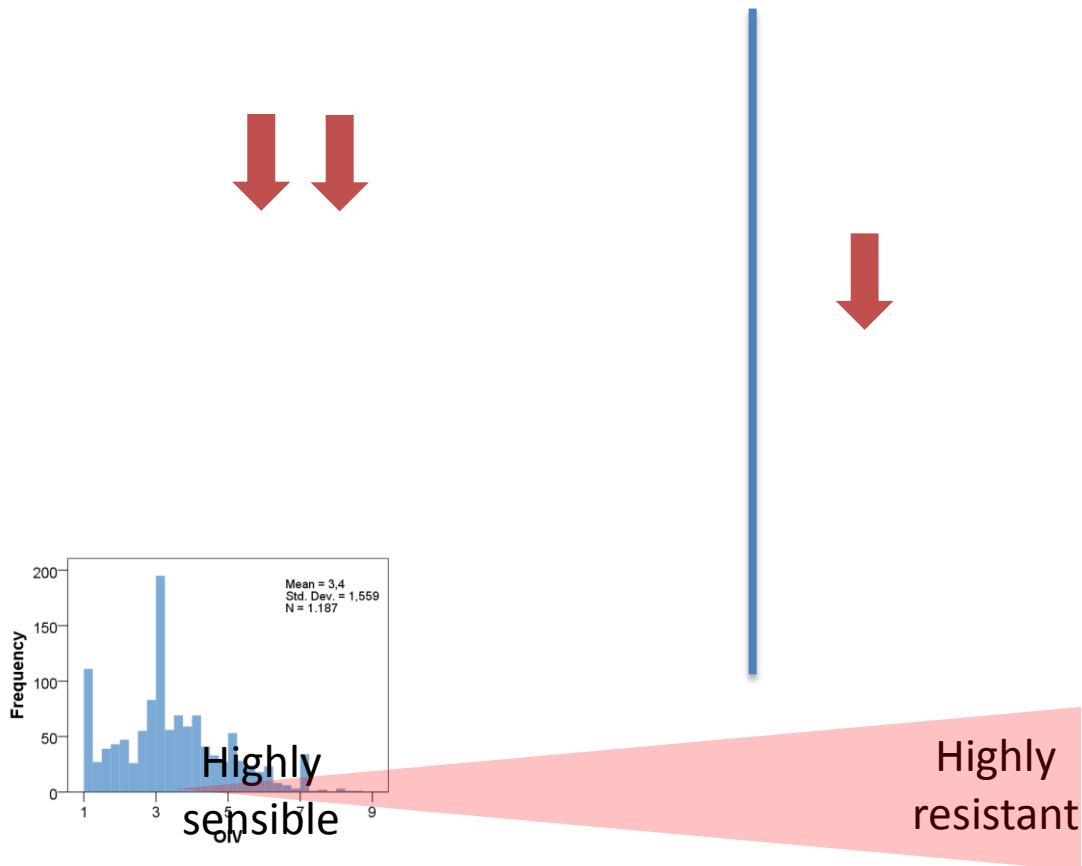
- 1.707 tests with *P. viticola* (including references and replications among years and partners)

11,6%



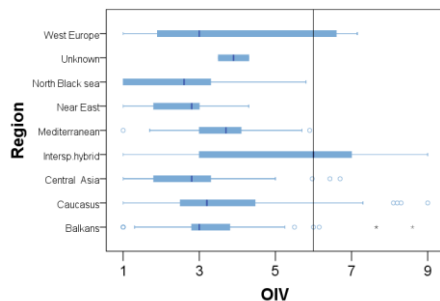
MAIN RESULTS: downy mildew

- 1.187 accessions (including references)
 - Average results for replications among years and partners



MAIN RESULTS: downy mildew

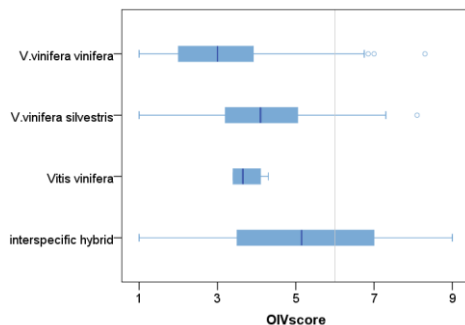
- 1.187 accessions (including references)
 - Average results for replications among years and partners



Resistance selective threshold

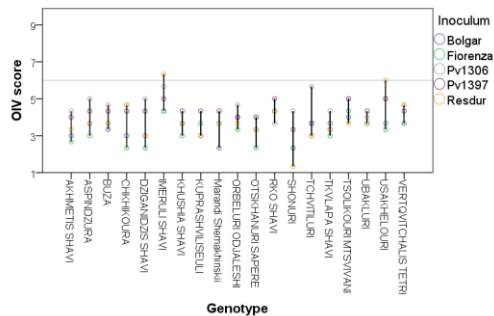
MAIN RESULTS: downy mildew

- 1.187 accessions (including references)
 - Average results for replications among years and partners



MAIN RESULTS: downy mildew

- Behavior of single accessions tested with different inocula
 - Results of the INRA partner (P3)



MAIN RESULTS: downy mildew

- 39 *V. vinifera* accessions resistant to *P. viticola* (OIV > 6)

Partner	Genotype	Vin/silv	Country	Region	OIV score	Tests N
UNIMI	UBAKLURI	<i>V. vinifera vinifera</i>	Georgia	Caucasus	8,3	1
UNIMI	NAKHIDURI 06	<i>V. vinifera silvestris</i>	Georgia	Caucasus	8,1	2
UNIMI	BARISAKHO TURNING 01	<i>V. vinifera silvestris</i>	Georgia	Caucasus	7,3	2
UNIMI	TUSHIS TBEBI 02	<i>V. vinifera silvestris</i>	Georgia	Caucasus	7,2	2
UNIMI	GEOU31	<i>V. vinifera silvestris</i>	Georgia	Caucasus	7,2	3
UNIMI	CHKHAVERI	<i>V. vinifera vinifera</i>	Georgia	Caucasus	7	1
UNIMI	SKRA 01	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6,9	3
UNIMI	Mskhvili Kurdzeni	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,9	2
UNIMI	Kharistvala Meskhuri	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,8	2
UNIMI	Yaghoti white	<i>V. vinifera vinifera</i>	Iran	Central Asia	6,7	3
UNIMI	Almura Tetri	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,7	4
UNIMI	MESAMOTSE KVARTALI 02	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6,6	1
UNIMI	KVETARI 10(2)	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6,6	2
UNIMI	CHKHUTCHESHI	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,5	1
UNIMI	Seura	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,5	1
UNIMI	Bazaleturi	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,5	2
UNIMI	SAMEBIS SERI 02	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6,4	2
UNIMI	Chesm gave	<i>V. vinifera vinifera</i>	Iran	Central Asia	6,4	3
INRA	KVELOURI	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,4	1

MAIN RESULTS: downy mildew

- 39 *V. vinifera* accessions resistant to *P. viticola* (OIV>6)

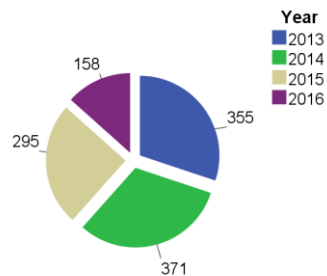
Partner	Genotype	Vin/silv	Country	Region	OIV score	Tests N
UNIMI	LARCHVALI 01	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6,3	3
UNIMI	NINOTMINDA 13	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6,3	1
UNIMI	Adreuli tkhelkana	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,3	3
INRA	DIDSHAVI	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,3	1
UNIMI	Chitistvala kakhuri (bobduri)	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,2	3
UNIMI	TEDOTSMINDA 16	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6,1	1
UNIMI	Khupishij	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,1	3
UNIMI	Tsirkvalis tetri	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,1	3
UNIMI	Dondghlabi Shavi	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,1	4
UNIMI	NAKHIDURI 04	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6	2
UNIMI	PALDO 02	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6	3
UNIMI	SAMEBIS SERI 08	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6	1
ABI	KHATUNY	<i>V. vinifera vinifera</i>	Azerbaijan	Caucasus	6	2
INRA	Sciavtsitska	<i>V. vinifera vinifera</i>	Balkans	Balkans	6	1
UNIMI	Ojaleshi lechkhumis (Orbeluri ojaleshi)	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6	2
UNIMI	Shavkapito	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6	3
UNIMI	Saperavi Khashmis	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6	4
UNIMI	Adreuli Tkhelkana	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6	3
UNIMI	Alexandrouli	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6	3
UNIMI	Chesm gave	<i>V. vinifera vinifera</i>	Iran	Central Asia	6	3

CONCLUSIONS: downy mildew

- Screening
 - 1.707 tests
 - 1.187 accessions
- Some accessions behaved differently
- 39 accessions with leaf degree resistance from medium to very high (>6)
 - 35 from Caucasus (Georgia)
 - 1 from Balkans
 - 3 from Central Asia

MAIN RESULTS: powdery mildew

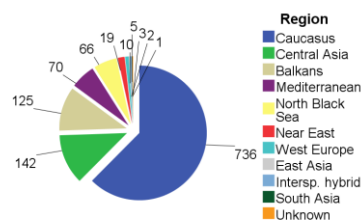
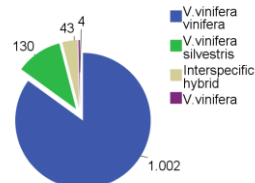
- 1.179 tests with *E. necator* (including references and replications among years and partners)



MAIN RESULTS: powdery mildew

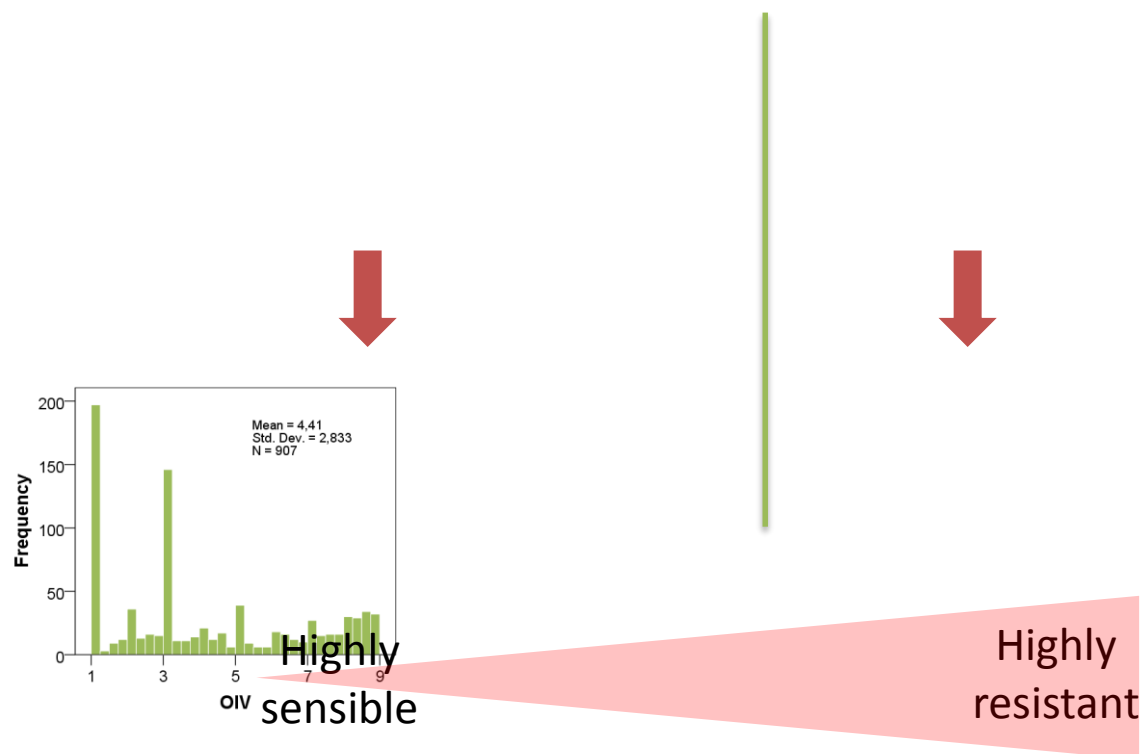
- 1.179 tests with *E. necator* (including references and replications among years and partners)

11,0%



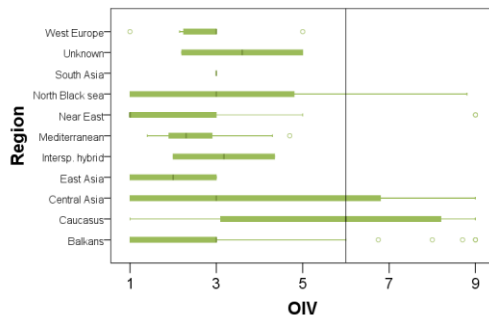
MAIN RESULTS: powdery mildew

- 910 accessions (including references)
 - Average results for replications among years and partners



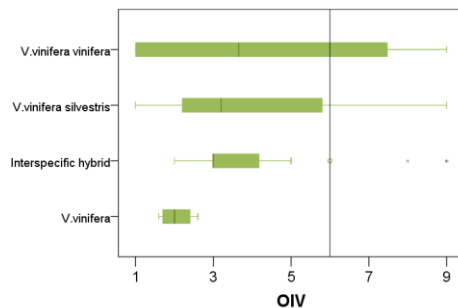
MAIN RESULTS: powdery mildew

- 910 accessions (including references)
 - Average results for replications among years and partners



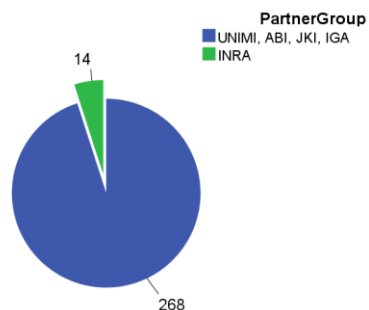
MAIN RESULTS: powdery mildew

- 910 accessions (including references)
 - Average results for replications among years and partners



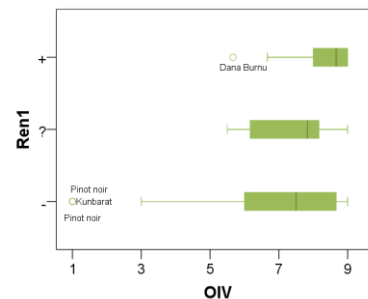
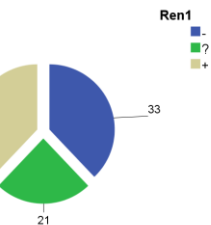
MAIN RESULTS: powdery mildew

- 282 *V. vinifera* accessions resistant to *E. necator* (OIV > 6)



MAIN RESULTS: powdery mildew

- SSR genotyping for Ren1 (ABI, IGA, UNIMI)
 - 87 accessions tested (positive and negative controls included)



CONCLUSIONS: powdery mildew

- Screening
 - 1.179 tests
 - 910 accessions
- 282 accessions with leaf degree resistance from medium to very high (>6)
 - Region
 - 249 from Caucasus (197 Georgia)
 - 20 from Central Asia
 - 10 from North Black Sea
 - 2 from Balkans
 - 1 from Near East
 - 253 *V. vinifera vinifera*
 - 29 *V. vinifera silvestris*

CONCLUSIONS: powdery & downy mildew

26 accessions resistant to both PM and DM agents (P1-P3):

Partner	Genotype	sat/silv	Country	Region	OIV DM	OIV PM
UNIMI	NAKHIDURI 06	<i>V. vinifera silvestris</i>	Georgia	Caucasus	8,1	7,9
UNIMI	SKRA 01	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6,9	9
UNIMI	GEOW31	<i>V. vinifera silvestris</i>	Georgia	Caucasus	7,2	8,7
UNIMI	BARISAKHO TURNING 01	<i>V. vinifera silvestris</i>	Georgia	Caucasus	7,3	8,2
UNIMI	Seura	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,5	9
UNIMI	Yaghoti white	<i>V. vinifera vinifera</i>	Iran	Central Asia	6,7	8,7
UNIMI	Chitistvala kakhuri (bobduri)	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,2	9
UNIMI	Dondghlabi Shavi	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,1	9
UNIMI	Adreuli tkhelkana	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,3	8,7
UNIMI	Alexandrouli	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6	9
UNIMI	Tsirkvalis tetri	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,1	8,9
UNIMI	Almura Tetri	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,7	8,1
UNIMI	Chesm gave	<i>V. vinifera vinifera</i>	Iran	Central Asia	6,4	8,4
UNIMI	Chesm gave	<i>V. vinifera vinifera</i>	Iran	Central Asia	6	8,8
UNIMI	Mskhvili Kurdzeni	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,9	7,8
INRA	Sciavtsitska	<i>V. vinifera vinifera</i>	Balkans	Balkans	6	8,7
UNIMI	TEDOTSMINDA 16	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6,1	8,3
UNIMI	SAMEBIS SERI 02	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6,4	7,8
UNIMI	Adreuli tkhelkana	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6	8
UNIMI	Ojaleshi lechkhumis (Orbeluri ojaleshi)	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6	8
UNIMI	Saperavi Khashmis	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6	8
UNIMI	Shavkapito	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6	7,7
INRA	KVELOURI	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,4	6,8
UNIMI	Kharistvala Meskhuri	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,8	6,3
UNIMI	NAKHIDURI 04	<i>V. vinifera silvestris</i>	Georgia	Caucasus	6	6,4
UNIMI	Khupishij	<i>V. vinifera vinifera</i>	Georgia	Caucasus	6,1	6,3