Classification of wine grape cultivars according to susceptibility to Botrytis cinerea in Chile and France : effects of fruit maturity and cluster compactness

Carolina Pañitrur-de La Fuente, Héctor Valdés-Gómez, Jean Roudet, Mauricio Lolas, César Acevedo-Opazo, Marc Fermaud

CLASSIFICATION OF WINE GRAPE CULTIVARS ACCORDING TO SUSCEPTIBILITY TO B*otrytis cinerea* IN CHILE AND FRANCE: EFFECTS OF FRUIT MATURITY AND CLUSTER COMPACTNESS

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XVII INTERNATIONAL BOTRYTIS SYMPOSIUM

23rd – 28th October, 2016, Hotel Santa Cruz Plaza, Santa Cruz, Valle de Colchagua, Chile.

Yield

Quality

INTEGRATED PEST MANAGEMENT

Human health

Environment

PRESENTATION OUTLINE

- INTRODUCTION:
  Botrytis bunch rot of grapes: Damage and Control

- CLASSIFICATION OF WINE GRAPE CULTIVARS :
  According to susceptibility to *Botrytis cinerea* in Chile and France

- EFFECTS OF FRUIT MATURITY AND CLUSTER COMPACTNESS:
  On the ranking of susceptibility to *Botrytis cinerea*

- CONCLUSIONS AND PERSPECTIVES


INTRODUCTION

Botrytis bunch rot of grapes (BBR): Damage and control

Agraz situación para los productores de uva en Chile: producción cayó 30% y pérdidas superan los US$220 millones

por EL MOSTRADOR MERCADOS | 11 mayo 2016

La uva vinífera habría sido golpeada por las intensas lluvias que cayeron en la zona central de Chile durante abril, así como los bajos precios internacionales, de acuerdo a la Sociedad Nacional de Agricultura.

Esta tarde la Sociedad Nacional de Agricultura (SNA) comunicó el complejo momento que atraviesan los productores de uva en el país.

El gremio, que calificó la vendimia de quienes trabajan la uva vinífera como una situación "muy compleja", apunta a las fuertes lluvias que golpearon a la zona central de Chile durante abril, así como los bajos precios internacionales de la uva.

Dicha situación habría dejado al proceso de recolección de la uva con una fuerte caída en la producción de 30%, lo que equivaldría a unos 400 millones menos de litros de vino para esta cosecha.

De acuerdo a la SNA, la producción final de vinos para este 2016 sería de sólo unos 800 millones de litros, lo que traería pérdidas a la industria por sobre los US$220 millones para los productores del fruto.

Especialmente preocupante es el caso de la botrytis, pues esta tiende a dejarse por lo que todavía el efecto que pueda tener está por verse.

esperado

Tweet

Botrytis bunch rot of grapes

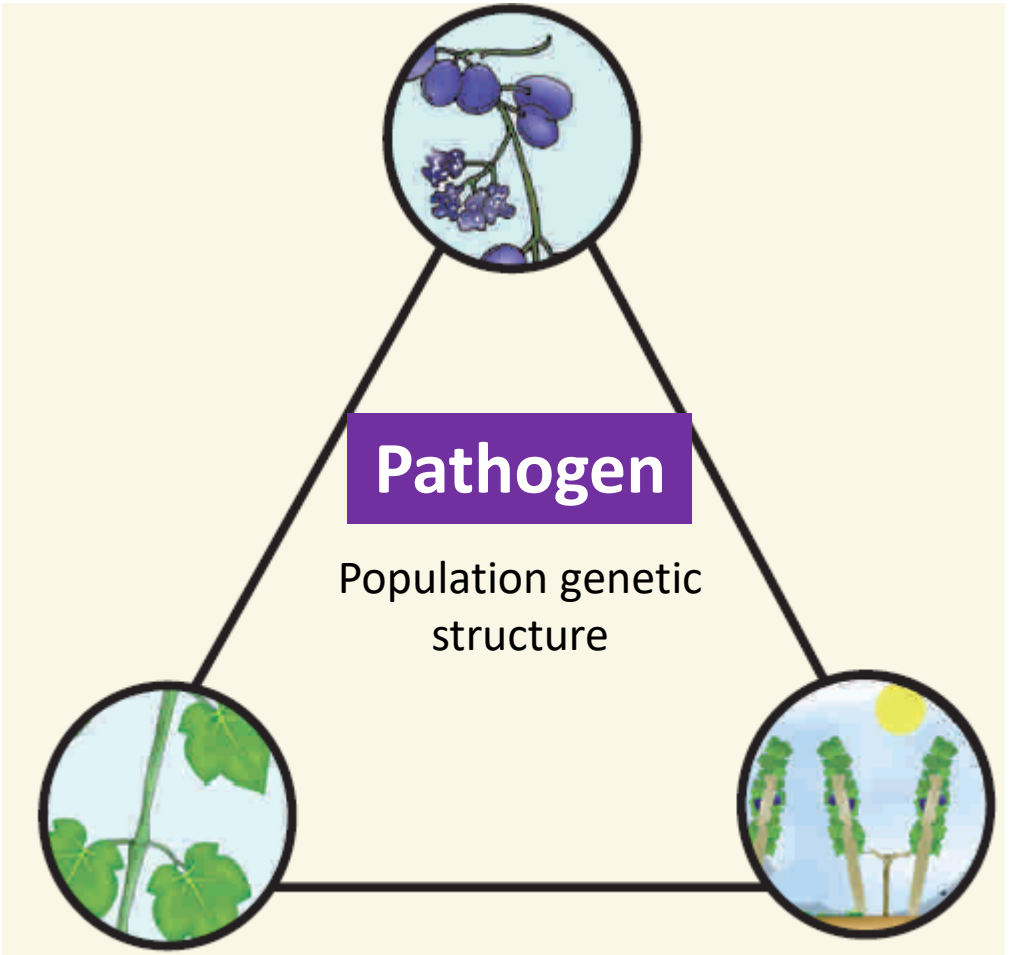
Control

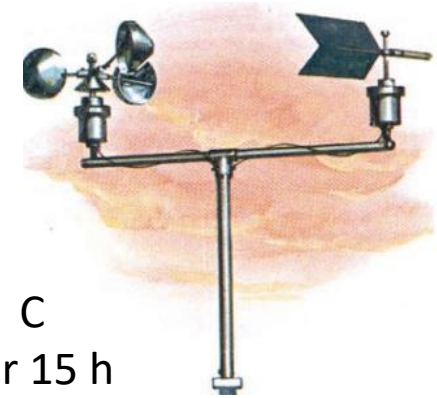
- **Cultural** → ↓ Favorable conditions for disease development
- **Biological** → Importance: interest in safer products
- **Chemical** → More widely used during the last 60 years

GRAPEVINE CULTIVAR

Genetic and Phenotypic traits:

- ✓ Clusters compactness
- ✓ Morphological, anatomical and chemical features of the berry skin

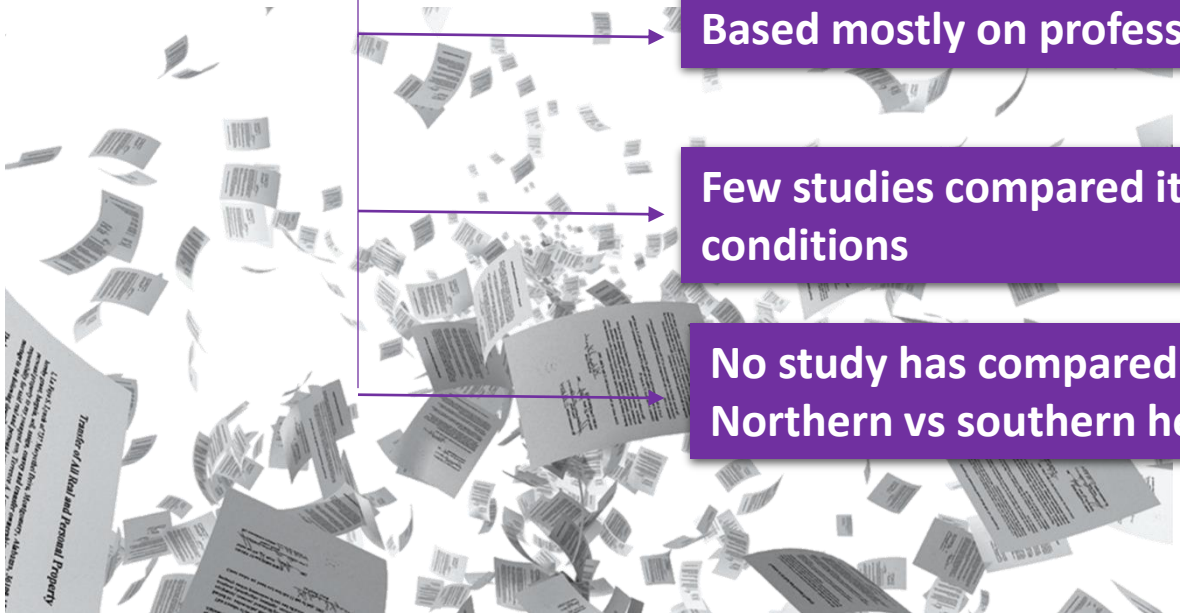




T° : 15-25 ° C
RH: >90% por 15 h

GRAPEVINE CULTIVAR → Essential management indicator in Integrated Pest Management (IPM)

Classification according to their susceptibility to BBR in literature



- Based mostly on professional experience, rather than experimental data
- Few studies compared it under the same environmental and management conditions
- No study has compared it in contrasting climatic and cultural conditions (eg. Northern vs southern hemisphere)

MAIN OBJECTIVE:

To classify and compare the susceptibility to *B. cinerea* between different wine grape cvs in two contrasting climatic and cultivation conditions

SECONDARY OBJECTIVE:

To relate the fruit maturity with the resulting susceptibility ranking to *B. cinerea*

CLASSIFICATION OF WINE GRAPE CULTIVARS

According to Susceptibility to Botrytis cinerea in Chile and France

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Classification of wine grape cultivars

Materials and Methods

- Chile (Maule Region) and France (Bordeaux Area)
- Seasons 2011 to 2015
- 3 grapevine collections

- ✓ 1 Grapevine collection "Panguilemo"
- ✓ 19 cultivars
- ✓ 2 Seasons (2013-14 and 2014-15)

- ✓ 2 Grapevine collections: "Tour Blanche" (TB) and "Grande Ferrade" (GF)
- ✓ 33 cultivars
- ✓ 3 Seasons (2011,2012 and 2014)

13 COMMON CULTIVARS

- Cab. Franc
- Cab. Sauvignon
- Chardonnay
- Cot
- Gewürztraminer
- Grenache noir
- Merlot
- Mourvèdre
- Petit Verdot
- Pinot noir
- Roussanne
- Sauvignon blanc
- Syrah

Classification of wine grape cultivars

Materials and Methods

❖ EXPERIMENTAL CONDITIONS

	France		Chile
Property	Tour Blanche	Grande Ferrade	Panguilemo
Experimental Period	2011, 2012, 2014	2011	2013-14, 2014-15
Vineyard planting year	1995	2009	2006
Rootstock	3309	SO4	Own-rooted
Location (WGS84)	44°32′N, 0°21′W	44°47′N, 0°34′W	35°22’ S, 71°36’ W
Spacing (m x m)	1.8 x 0.9	1.8 x 1.0	2.0 x 1.0
Trellis/Pruning system	VSPSystem[a]/ Two-bilateral		
Irrigation system	Non-irrigated	Non-irrigated	Drip irrigation (one dropper per plant with a flow rate of 4 L / h)

Classification of wine grape cultivars

Materials and Methods

- ❖ EVALUATIONS:
- ✓ Climatic characterization
- ✓ Disease susceptibility assessment
- ✓ Statistical analyses

Classification of wine grape cultivars

Materials and Methods

❖ EVALUATIONS:

✓ **Climatic characterization** ⟶

- ✓ Automatic weather station
- ✓ Temperature, Relative Humidity and precipitation
- ✓ Second season in Chile: vines were moistened.

✓ Disease susceptibility assessment

✓ Statistical analyses

Classification of wine grape cultivars

Materials and Methods

Highly Resistant (HR)=0-2.5%;
Resistant (R)=2.51-10%;
Intermediate (I)=10.1-25%;
Susceptible (S)=25.1-50%
Highly Susceptible (HS)= 50.1-100%.

❖ EVALUATIONS:

✓ Climatic characterization

✓ **Disease susceptibility assessment** ⟶

- ✓ Incidence and Severity at harvest (22°Brix)
- ✓ Susceptibility index (SI)

✓ Statistical analyses

$$SI = \frac{Severity\ (\%) for\ cultivar\ in\ question}{Highest\ severity\ (\%) recorded\ in\ the\ season\ and\ in\ the\ most\ rotted\ cultivar} X\ 100$$

Classification of wine grape cultivars

Materials and Methods

❖ EVALUATIONS:

✓ Climatic characterization

✓ Disease susceptibility assessment

✓ **Statistical analyses** ⟶

- ✓ ANOVA using the PROC GLM procedure; test (LSD) (severity and incidence data)
- ✓ Cluster Analysis (severity data)
- ✓ Box Plot Analysis (Susceptibility Index data)

Results

✓ Climatic characterization

FRANCE

humid and temperate conditions

↓

Favored the growth and development of *B. cinerea*

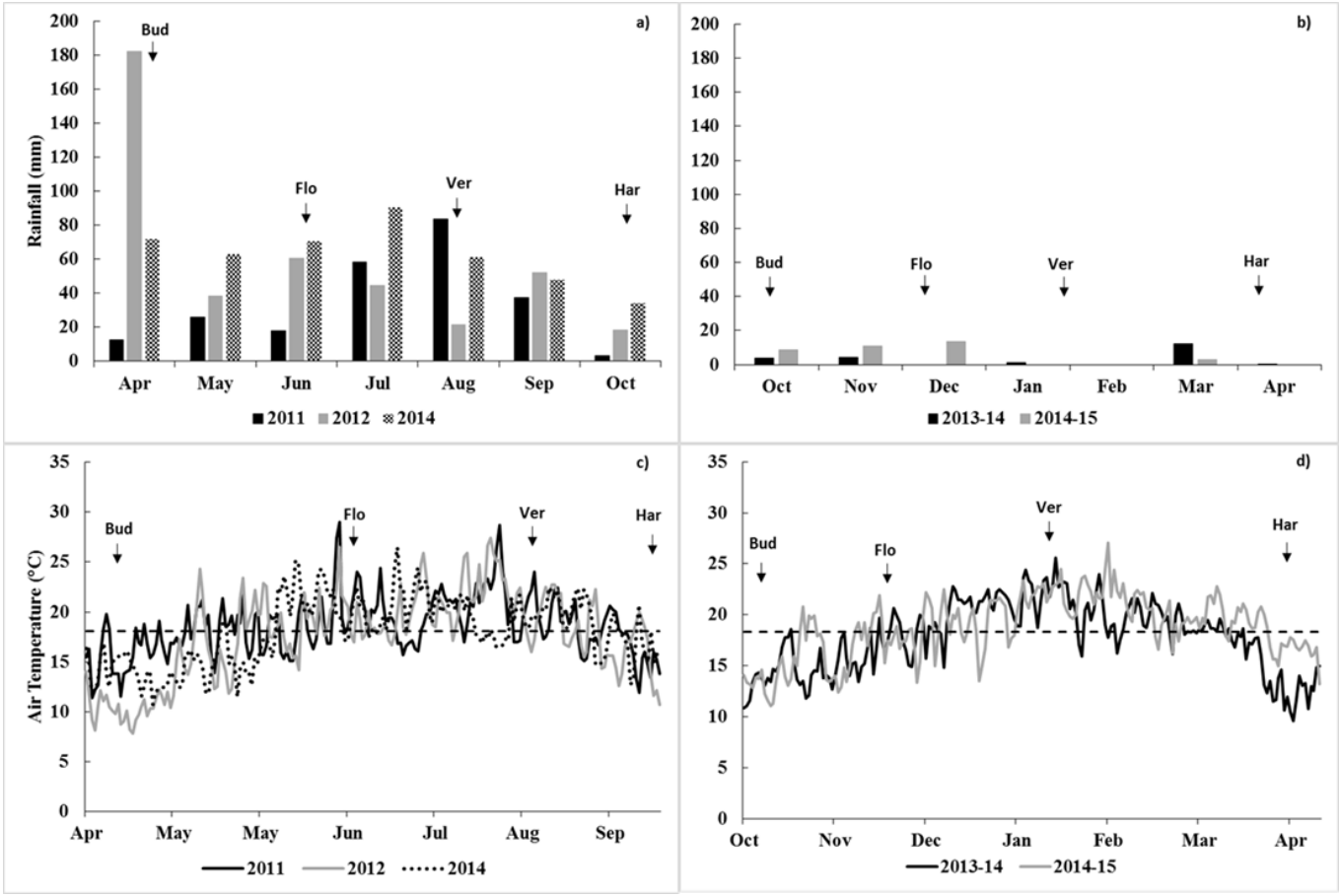


Fig. 1. Monthly means for rainfall (mm) in France (a) and Chile (b), and mean air temperature (°C) in France (c) and Chile (d) during all seasons. The horizontal dotted line in (c) and (d) represents the mean air temperature (°C) in each season. Bud= Budbreak; Flo= Flowering; Ver= Veraison; Har= Harvest.

CHILE

Dry and temperate conditions

↓

Not conducive to disease development

Results

✓ Disease susceptibility assessment

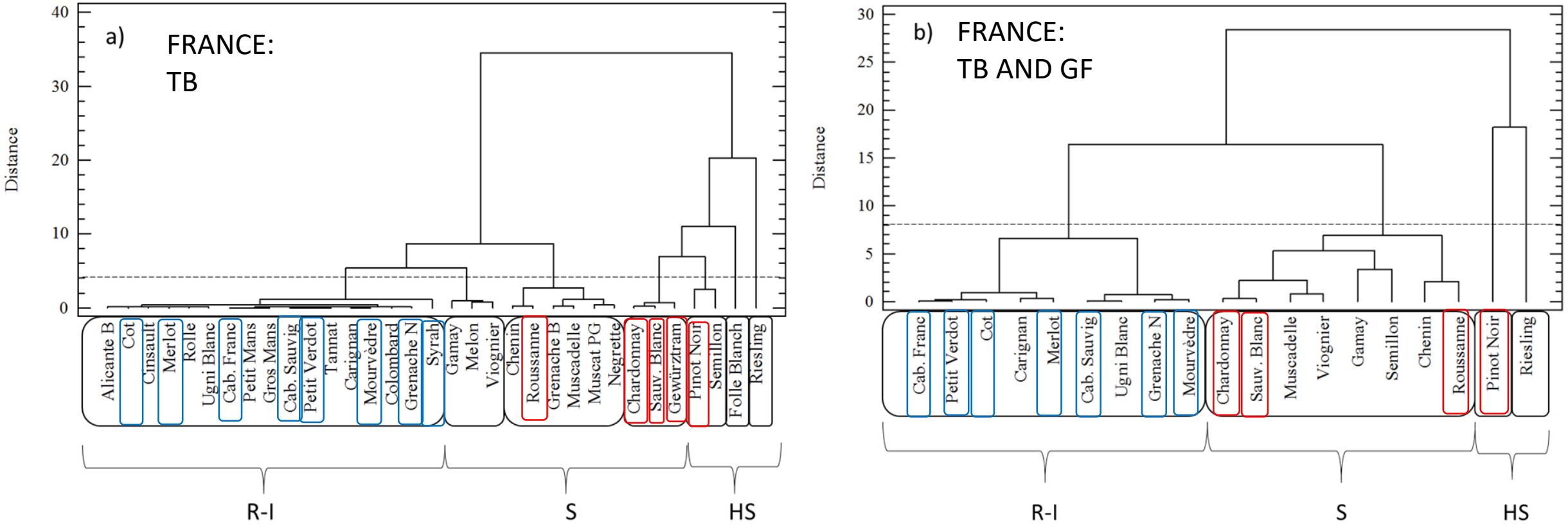
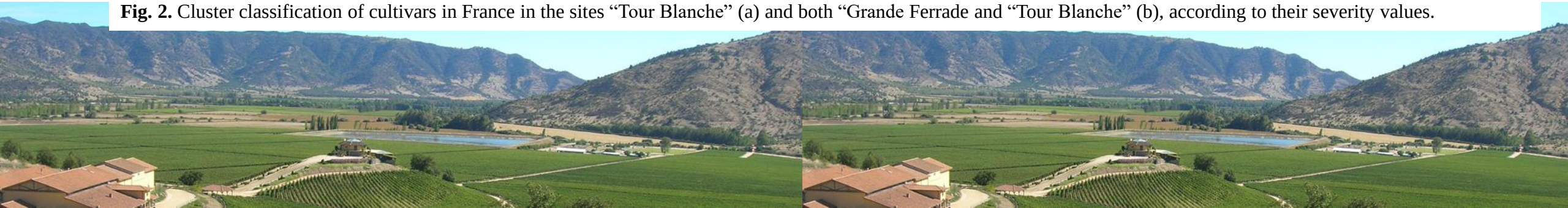


Fig. 2. Cluster classification of cultivars in France in the sites "Tour Blanche" (a) and both "Grande Ferrade and "Tour Blanche" (b), according to their severity values.



Results

- ✓ **Disease susceptibility assessment**

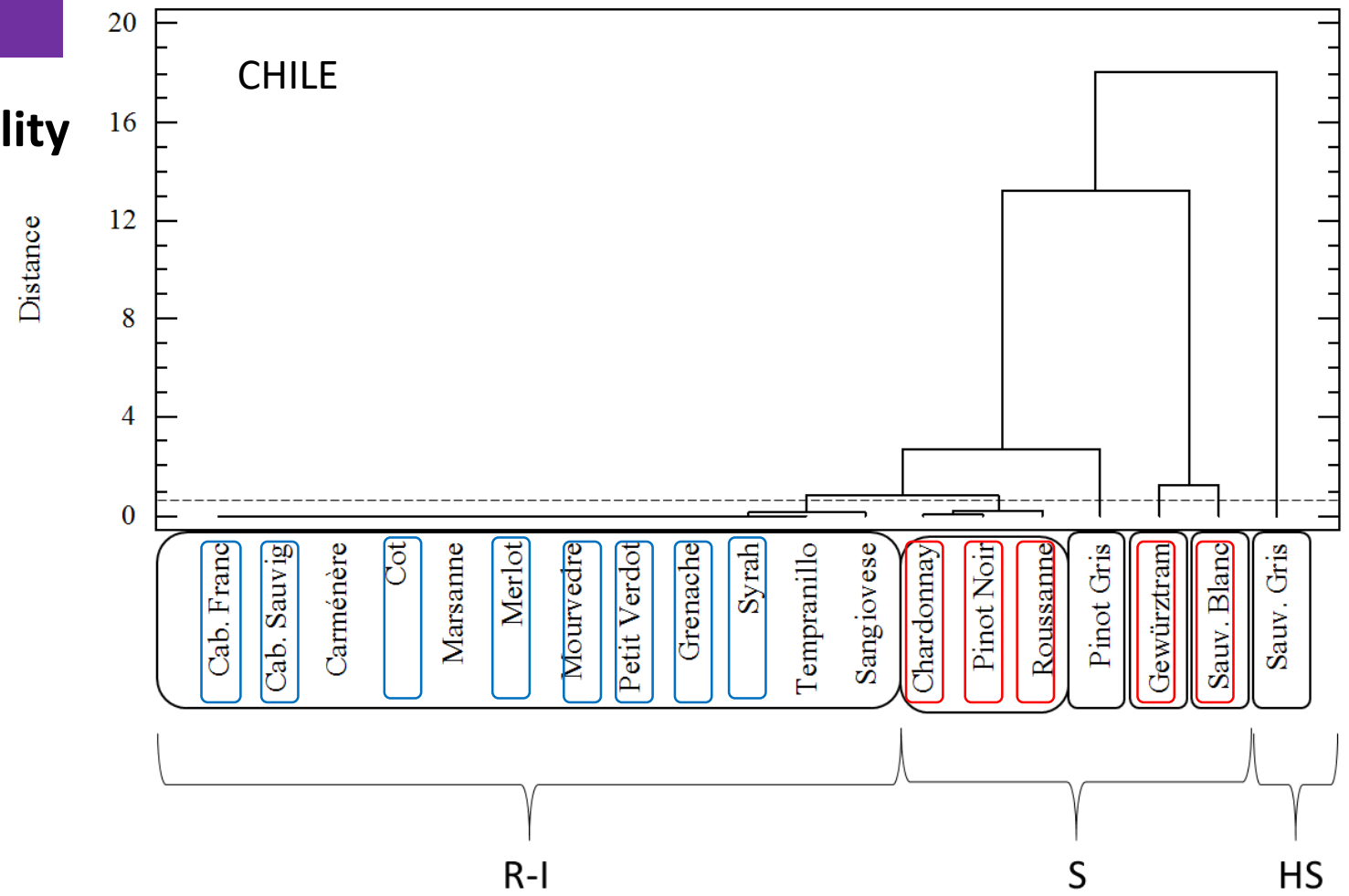
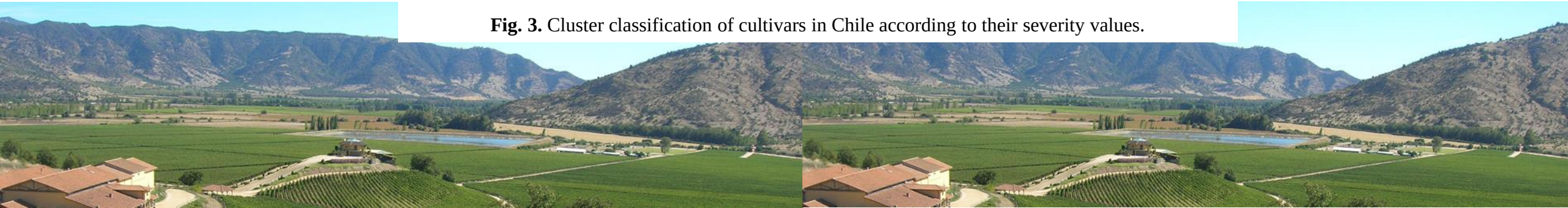


Fig. 3. Cluster classification of cultivars in Chile according to their severity values.



Results

RANKING SUSCEPTIBILITY

✓ **Disease susceptibility assessment**

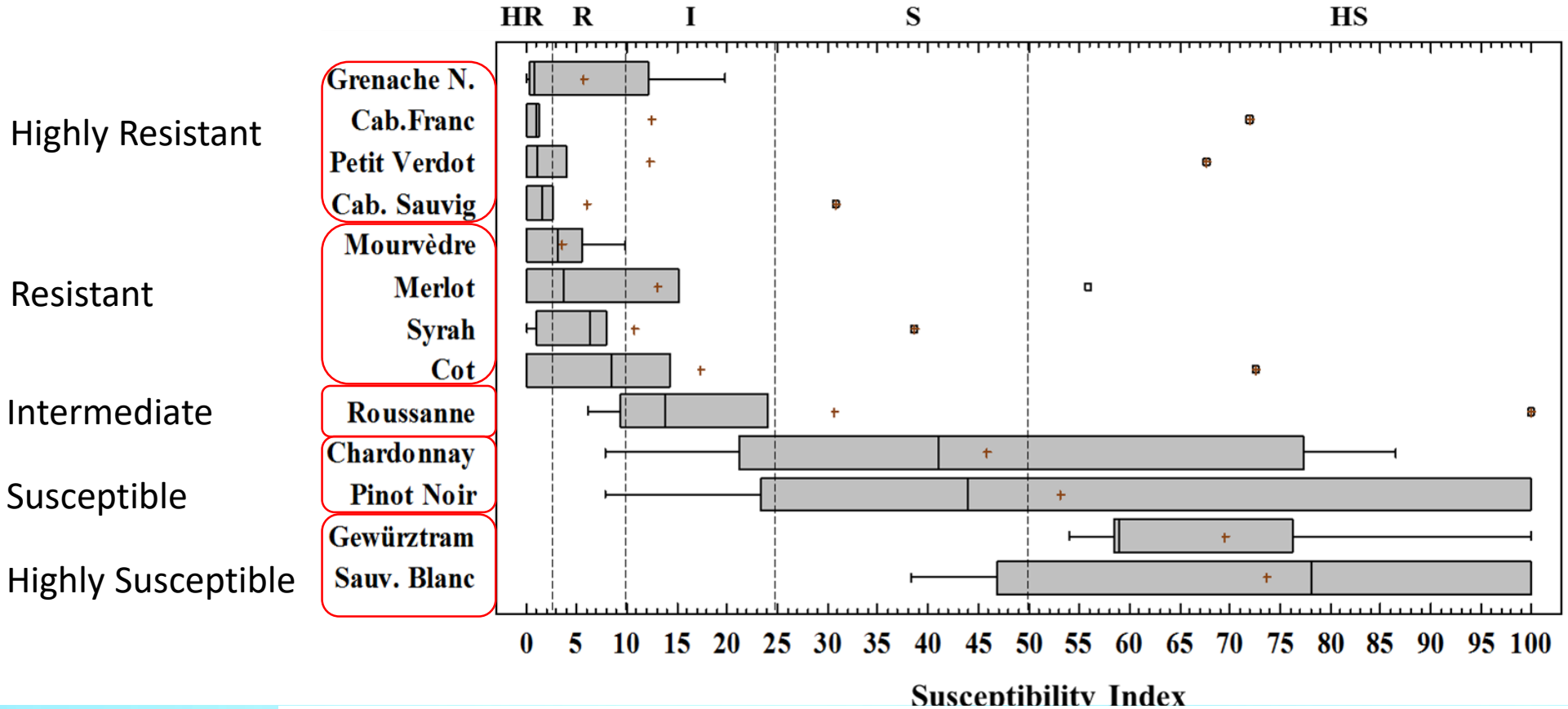
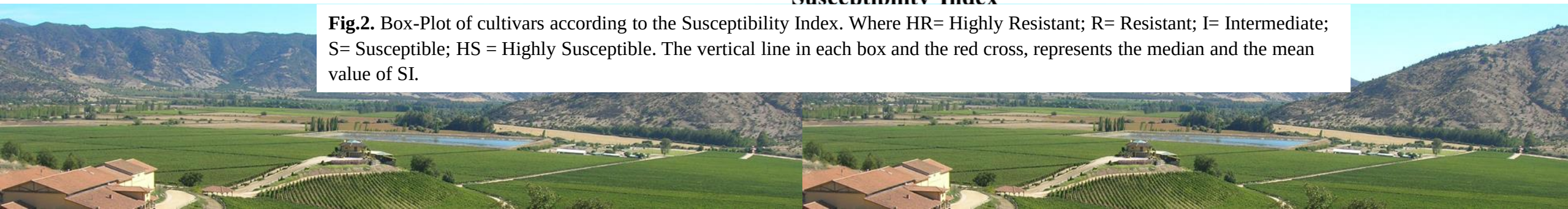


Fig.2. Box-Plot of cultivars according to the Susceptibility Index. Where HR= Highly Resistant; R= Resistant; I= Intermediate; S= Susceptible; HS = Highly Susceptible. The vertical line in each box and the red cross, represents the median and the mean value of SI.



Results

RANKING SUSCEPTIBILITY

✓ Disease susceptibility assessment

Cultivar	a	b	c	d	e	f	g	h	Mean lit.	Our res.	Sd lit.	Sd res.
Grenache Noir	4	3	-	-	4	-	3	4	4	0	0.5	1.0
Cabernet Franc	3	-	-	-	-	-	4	1	3	0	1.5	1.6
Petit Verdot	0-1	-	-	-	-	-	1	1	1	0	0.3	1.6
Cabernet Sauvignon	2	-	0	1	1	0	1	1	1	0	0.7	1.2
Mourvèdre	-	-	-	-	-	-	1	-	1	1	-	0.5
Merlot	3	-	-	-	-	-	3	3	3	1	0	1.5
Syrah	2	-	1	3	3	-	-	2	2	1	0.8	1.2
Cot	3	-	-	-	-	-	3	3	3	1	0	1.5
Roussanne	4	-	-	-	-	-	-	4	4	2	0	1.2
Chardonnay	4	-	2	2	3	-	3	3	3	3	0.8	1.2
Pinot Noir	3	4	2	3	4	-	-	3	3	3	0.8	1.3
Gewürztraminer	4	-	-	-	-	-	1	4	3	4	1.7	0
Sauvignon Blanc	4	-	4	3	4	-	1	4	3	4	1.2	0.5

a= Dubos (2002), b=Dry and Gregory (1990), c= Orffer (1979), d=Jackson and Schuster (1987), e=Robinson (1986), f=Marois et al. (1992), g= Galet (1988), h= ACTA (1980); 0= highly resistant, 1= resistant, 2= intermediate, 3= susceptible, 4= highly susceptible; Mean lit= Mean of literature source, Our res= Resultats of our study; Sd lit= standard deviation of literature sources, Sd res= estándar deviation of our results.

Agronomic conditions

↓

plant, pathogen, environment

↓

Climate and microclimate
Canopy density
Cluster compactness
Mineral and water nutrition
Grape training systems
Winter pruning
Cracks
Clone and rootstock

EFFECTS OF FRUIT MATURITY AND CLUSTER COMPACTNESS

On the ranking of susceptibility to Botrytis cinerea.

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Effects of fruit maturity and cluster compactness

Materials and Methods

❖ EVALUATIONS:

✓ Fruit Maturity

✓ Cluster compactness

✓ Statistical analyses

Effects of fruit maturity and cluster compactness

Materials and Methods

❖ EVALUATIONS:

✓ Fruit Maturity → ✓ Maturity index (F_{Mat})

✓ Cluster compactness

✓ Statistical analyses

$$F_{Mat} = F_{B.c\ assessment} - F_{veraison}$$

$F_{B.c\ assessment}$ = Timing of the *B. cinerea* assessment

$F_{veraison}$ = Timing of veraison for each cultivar (GFV model of *Parker et al 2011, 2013)*

Critical degree-day sum (above 0°C) calculated from the 60th (France) and 242th (Chile) day of the year to the dates of *B. cinerea* assessment and veraison.

In order to remove the effect of each season ←

$$F_{Mat\_adj} = F_{Mat} for\ each\ cultivar - F_{Mat}\ Petit\ Verdot$$

Effects of fruit maturity and cluster compactness

Materials and Methods

❖ EVALUATIONS:

✓ Fruit Maturity

✓ Cluster compactness

✓ Statistical analyses

→

✓ 40 clusters per cultivar
✓ visual scale from 1 to 6

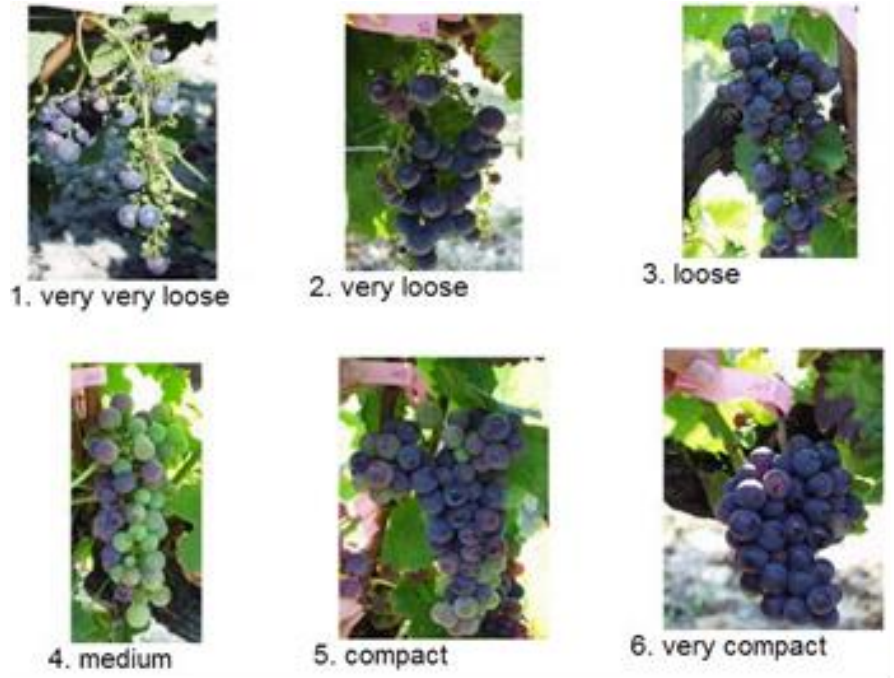

Fig. 3. Visual scale of compactness of cluster.

Effects of fruit maturity and cluster compactness

Materials and Methods

❖ EVALUATIONS:

✓ Fruit Maturity

✓ Cluster compactness

✓ Statistical analyses ⟶

- ✓ Correlation analysis
- ✓ nonlinear model

Effects of fruit maturity and cluster compactness

Results

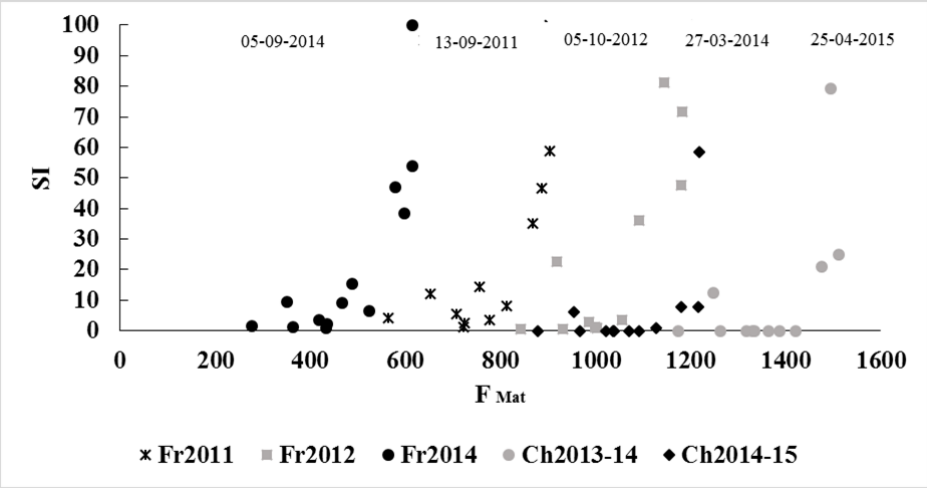

Fig.4. Relationship between Maturity of cultivars (F Mat) and Susceptibility to BBR (SI), assessment at different dates, in France and Chile.

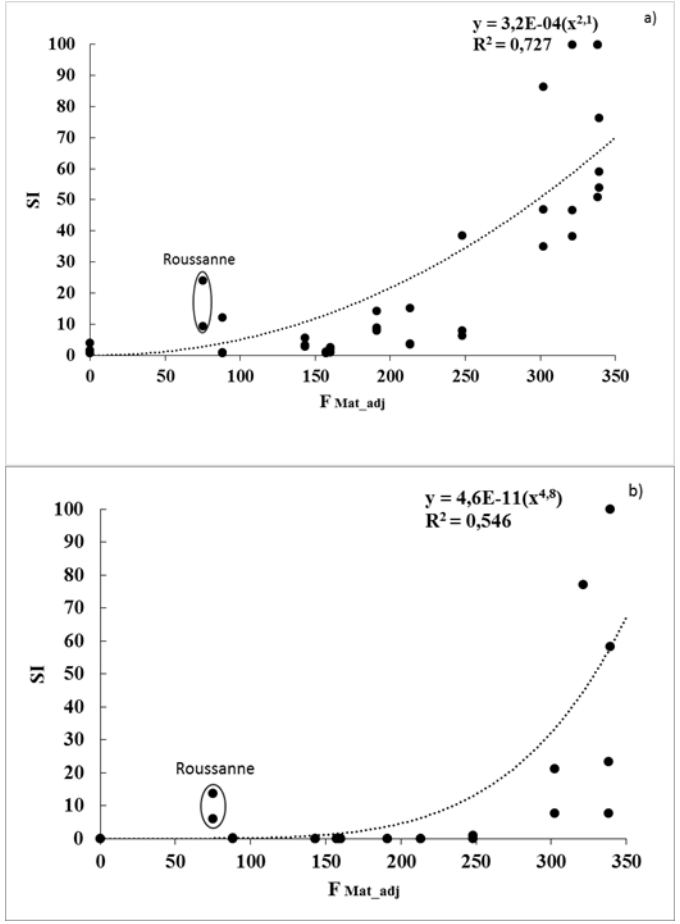

Fig.5. Relationship between Maturity of cultivars (F Mat_adj) and Susceptibility to BBR (SI) in both sites: France (a) and Chile (b) during all study seasons.

1)Fruit maturity

Effects of fruit maturity and cluster compactness

Results

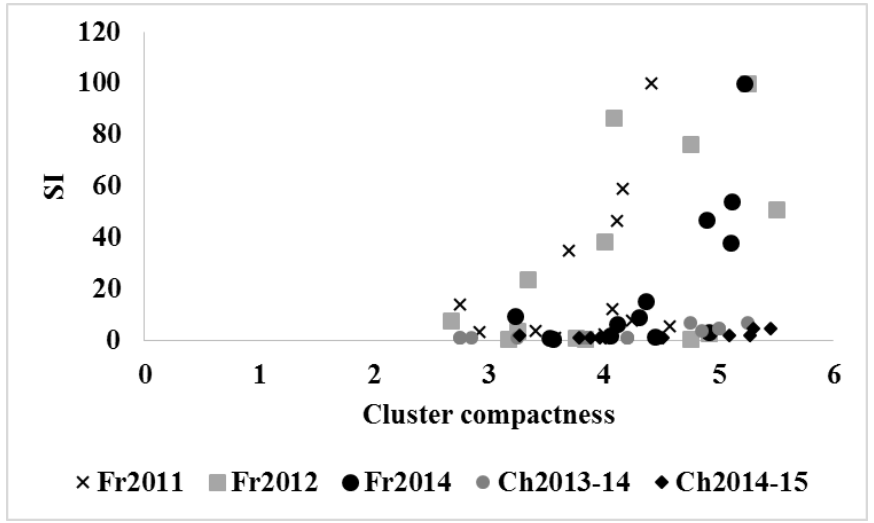

Fig.6. Relationship between Cluster compactness and Susceptibility to BBR (SI) in France and Chile.

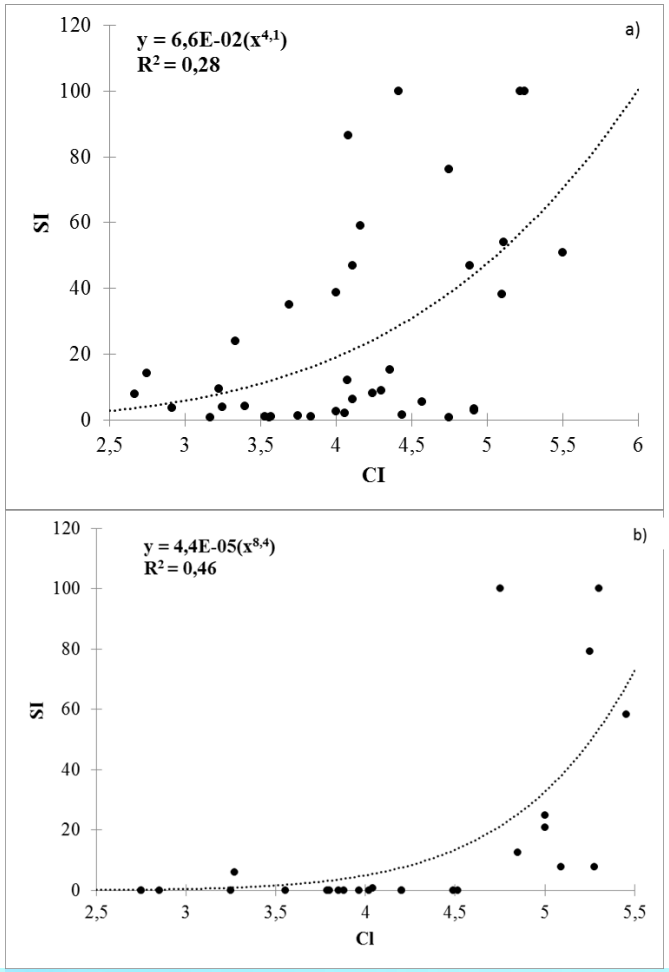

Fig.7. Relationship between Cluster compactness (CI) and Susceptibility to BBR (SI) in both sites: France (a) and Chile (b) during all study seasons.

2)Cluster compactness

Conclusions and perspectives

- ✓ The classification of the wine cultivars according to their susceptibility to *B. cinerea* was similar in both countries, despite the contrasting climatic conditions and management practices.
- ✓ Sauvignon Blanc and Gewürztraminer were the highest susceptible cultivars, whereas Petit Verdot, Cabernet Sauvignon, Mourvèdre and Syrah were rather resistant or highly resistant (in accordance to previous studies).
- ✓ For other cvs. evaluated (Grenache Noir, Cabernet Franc, Merlot, Cot and Roussanne), their ranking differed to some extent from the literature.
- ✓ This difference is presumably caused by variations in agronomic and/or environmental conditions under which the field experiments were carried out (eg. clone, rootstock, cluster compactness related to flower abortion).

Conclusions and perspectives

- ✓ Fruit maturity and cluster compactness, depending significantly on the cultivar, proved to be very important factors governing susceptibility to *B. cinerea.*
- ✓ The susceptibility classification of cultivars remains a key parameter in decision support systems and then, both variables cluster compactness and fruit maturity could be used to support this classification.
- ✓ Further investigation should be conducted to better understand the relationships between susceptibility to *B. cinerea* and other variables (e.g. clone, vigor, rootstock), in order to develop new IPM strategies

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Thanks for your attention!