Réseaux FAIR 202
Essais internationaux de provenances de chêne-liège

RÉSULTATS ENTRE 9 ET 14 ANS APRÉS PÉPINIÈRE

Journées techniques du liège, Ramatuelle 1-2 Octobre 2015

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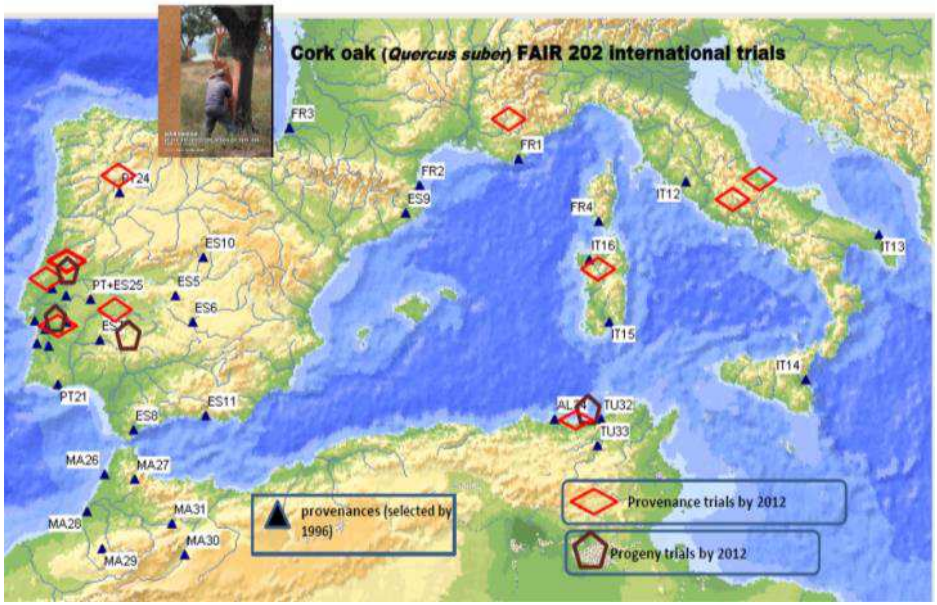

Characterization of the international network FAIR 202 of provenance and progeny trials of cork oak on multiple sites for further use on forest sustainable management and conservation of genetic resources

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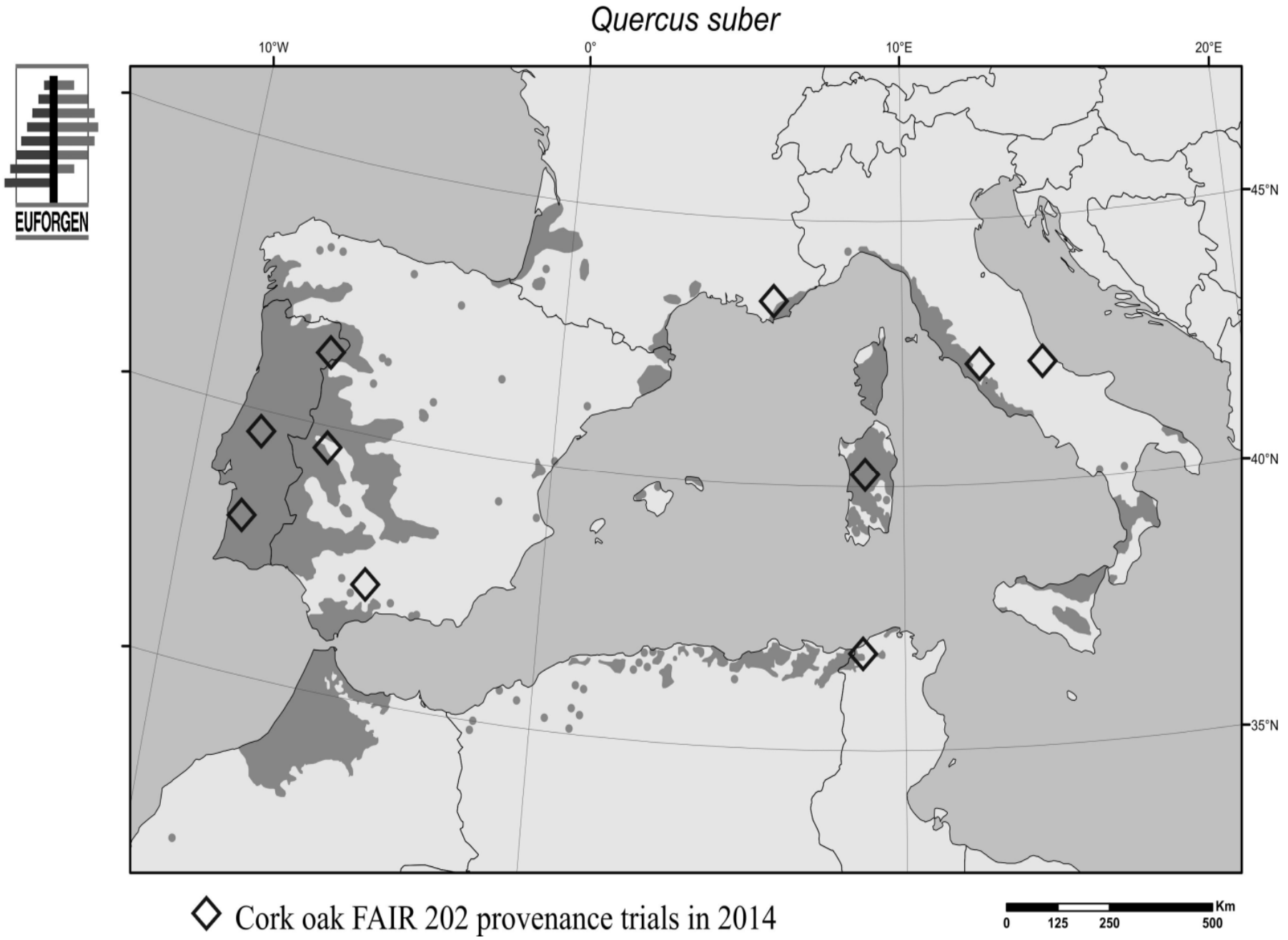
INVITATION de Prof SANDRO DETTORI et FINANCEMENT de UNIVERSITÉ DE SASSARI


Quercus suber
10°W
0°
10°E
20°E
45°N
40°N
35°N
Cork oak FAIR 202 provenance trials in 2014
Km
0
125
250
500

essais FAIR 202- provenances

Code international

France

Var, Les Maures	FR1
Pyrenees Orientales Le Rimbaut	FR2
Soustons Landes	FR3
Corse Sartene	FR 4

Espanhe

Cañamero	ES 5
Fuencaliente	ES 6
Jerez de los Caballeros	ES 7
Castellar de la Frontera	ES 8
Santa coloma de Farnes	ES 9
Sierra de Guadarrama	ES 10
Haza de Lino	ES 11

Italie

Tuscania	IT 12
Brindisi	IT 13
Cagliari (Santadi)	IT 14
Sassari (Villanova Monteleone)	IT 15
Catania	IT 16

Marocco

Rif Atlantique, Boussafi	MA 26
Rif Occidentale Ain Rami	MA 27
Maâmora, Kenitra	MA 28
Maamora, Ain Johra	MA 29
Plateau Central, Oulmès	MA 30
Rif Oriental Bab Azhar	MA 31

Portugal + Esapnhe

Alent.B.Baixa+Srra San Pedro	PT+ES-25

Portugal

Ponte de Sor	PT 17
Quinta da Serra	PT 18
Alcacer do Sal	PT 19
Azaruja	PT 20
Santiago do Cacem	PT 21
S.Bras de Alportel	PT 22
Monte Branco	PT 23
Romeo	PT 24

Tunisia

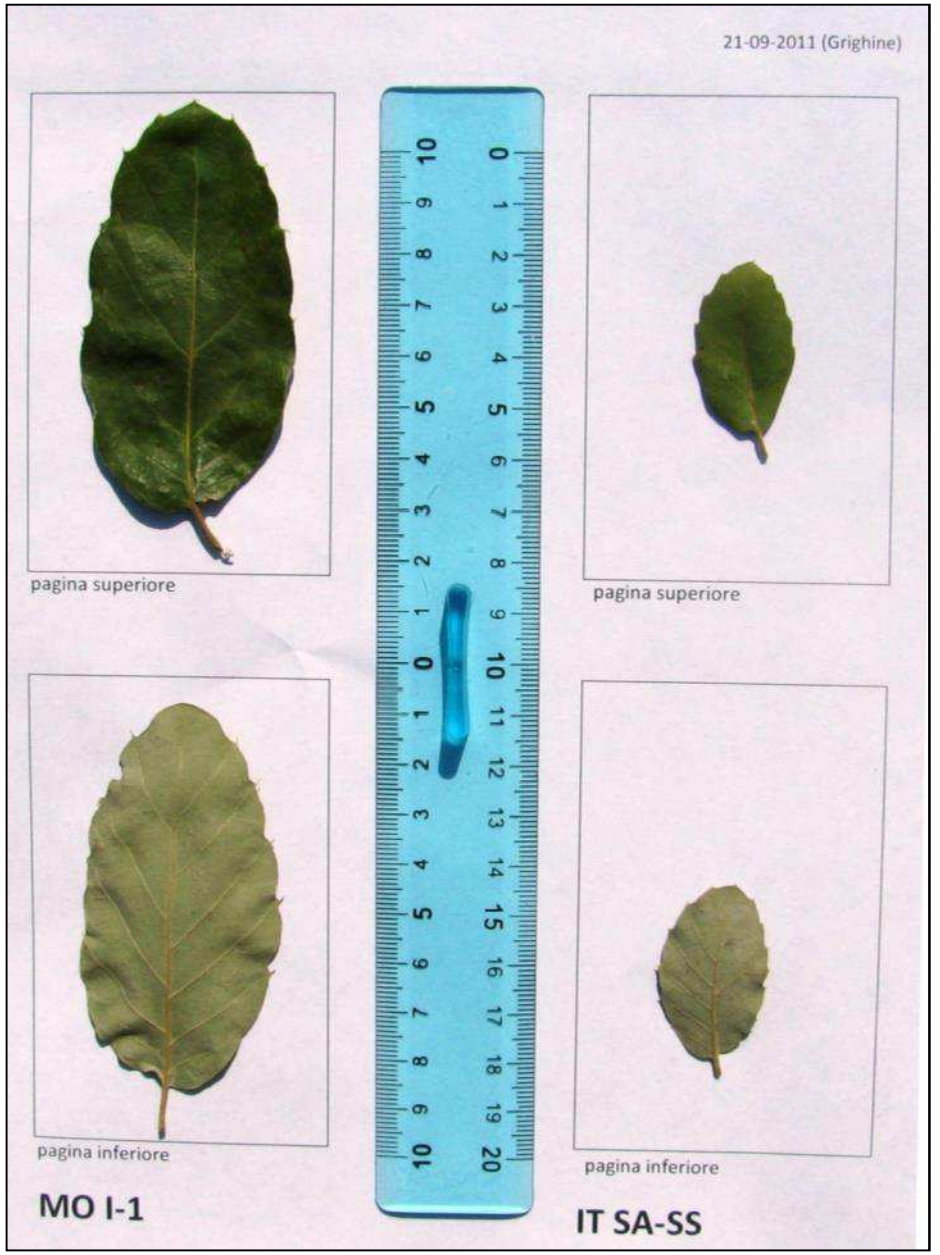
B Fernana	TU 32
Mekna	TU 33

Algerie

Guerbes	AL34

Essai chêne-liège FAIR 202
Sardaigne, Grighine, 2011

Photos, cortoisie de Sandro Dettori



Essai chêne-liège FAIR 202
TUNISIE, Tebaba

Courtoisie
de A. Khaldi

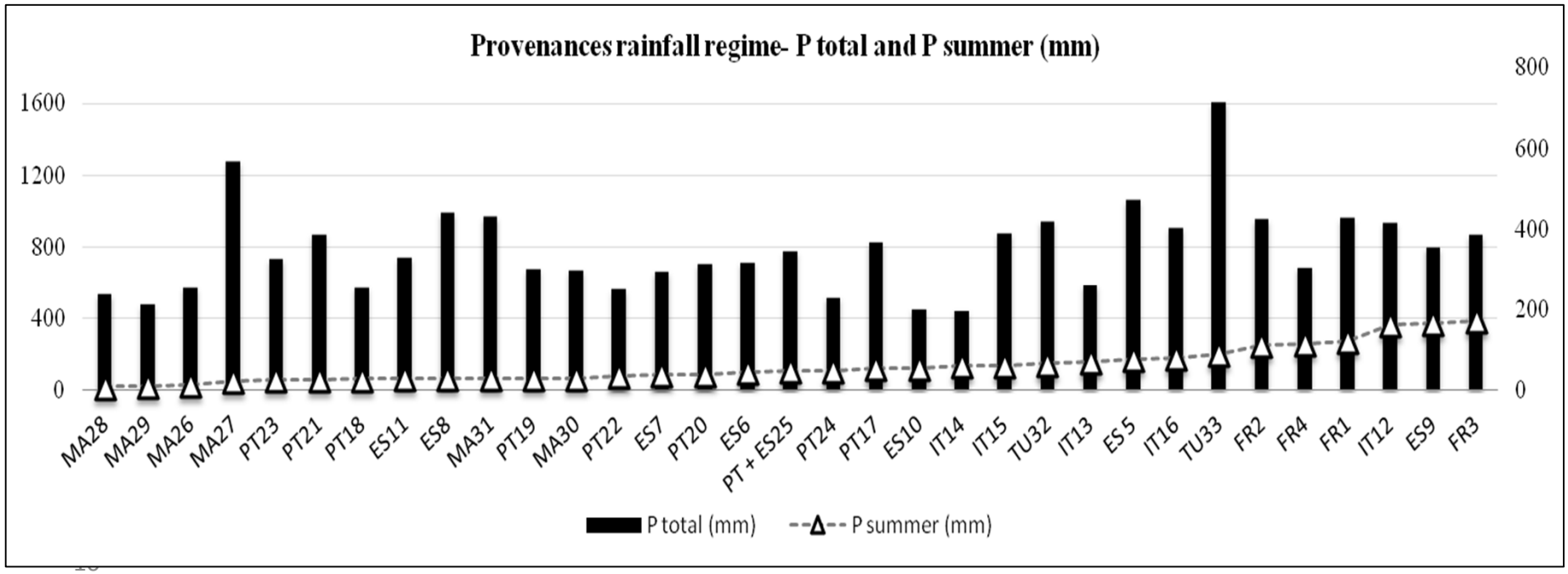
Essai chêne-liège FAIR 202
Espagne, Jaen. Selladores, 2007

Courtoisie
de S. Iglésias

MONTE FAVA, Portugal

ESSAI	t (◦C)	T (◦C)	P total (mm)	P summer (mm)	Q2	sol
France, Les Maures	1,6	29	**975**	**181**	**123,2**	Gneiss migmatiques et amphibolitiques
Italy, Sardinia, Grighni	4,7	32,4	**672**	**28**	**83,1**	Lithic xerorthents
Italy, Lazio, Roccarespampani	2,4	31	**868,7**	**108,7**	**104,7**	Cromic luvisols
Portugal, Mogadouro	0,7	28,6	**554,7**	**60,3**	**69**	sandy/clay
Portugal, Monte Fava	4,3	31,3	**556,6**	**42,7**	**70,8**	sandy
Tunisia, Tebaba	11,1	25,6	**948**	**65**	**224**	pseudo-gley

ESSAI	t (◦C)	T (◦C)	P total (mm)	P summer (mm)	Q2
France, Les Maures	1,6	29	975	181	123,2
Italy, Sardinia, Grighni	4,7	32,4	672	28	83,1
Italy, Lazio, Roccarespampani	2,4	31	868,7	108,7	104,7
Portugal, Mogadouro	0,7	28,6	554,7	60,3	69
Portuga, Monte Fava	4,3	31,3	556,6	42,7	70,8
Tunisia, Tebaba	11,1	25,6	94	65	224



Principaux résultats

France, Les Maures

Observation sur les caractères quantitatifs en 2008 à 11 ans

L´´essai inclues 33 provenances, except PT24

- Mortalité en 2008 était faible-11.28%. Cepandant la croisance, evalue par hauteur moyenne c'est la plus bas parmi tous les essais- 48.73 cm
- Mortalité plus élevé -PT23 -20.8%, (PT+ES) 25 -22.2%
- Mortalité plus bas-ES8, ES7, MA31, PT19 – 5.6%. La provenance local FR1 (Var, Les Maures) avait une mortalité dessus de la moyenne, mais encore faible pour une plantation de chêne-liège.
- La croissance plus élevé se vérifie dans les provenances de Tunisie et Portugal. Tous les provenances Françaises montre une croissance très pareille , légèrement sous la moyenne. Les provenances de Tunisie T32, T33, que vient de climat plus humide et doux que Les Maures ont réussient une croissance supérieure à la moyenne.
- Les arbres gardent habitudes plagiotropes et ceci est le seul essai où ce problème se produit.

cm

Principaux résultats

Italie, Grighini, Sardinia

L'essai inclues 27 provenances et en tenant compte de la performance combinée de survie et de croissanc est le meilleur essai à ce jour Le site est chaud et sec.
Field observation at this trial has taken place regularly since plantation.
In 2010, at age 13, the trial mean mortality was the lowest among all trials-6.6% and growth assessed by mean height was 273 cm, which is very good for cork oak (Fig. 3b).
The highest mortality took place at MA26- 14.3%, yet it is a low value for cork plantation ate age 13.
In 2010 the provenances MA27, TU32, ES6, AL34, PT+ES 25, TU33, MA29, MA30, ES5, PT23, PT20, PT19 showed an above average-growth contrasting with the under-average growth of all Italian provenances IT1 IT14, IT15, IT13, IT16.
It is worth noting the good growth performance of the provenances of high rainfall regime MA27, TU33 (Fi 1) at the quite dry and hot conditions of Grighini (Table 2) which may be an evidence of fast adaptation to dryer conditions.
The correlation height *vs* DBH is high $R^2 = 0.8387$

2.2.2 Roccarespampani**,** Lazio

A field survey was performed to assess the percentage of survival of the provenances. Results generally showed a poor resistance of the species to the local environmental conditions. Only 54.88% of the plants survived after the last measurement in 2006. This would be caused both by the unfavourable climatic regime, with long-period of summer aridit cold winter winds, and the edaphic conditions of a portion of the trial characterized by high concentration of clay. Moreo the unexpected occurrence of badgers seriously damaged part of the field, being a further negative impact for the plants' persistence and growth."
Provenance growth was assessed by mean height in 2006, at age 9 from germination in nursery (Fig. 3c). The mean height the same age is lower than at the trial of Monte Fava, Portugal which is probably due to the environmental site growing conditions.

Principaux résultats

Italie, Grighini, Sardaigne

L'essai inclues 27 provenances et en tenant compte de la performance combinée de survie et de croissance c'est le meilleur essai à ce jour. C'est l'essai ou les observations de terrain ont été plus fréquentes. Le site est chaud et sec.

En 2010, à 13 ans, le taux moyenne mortalité était le plus bas parmi tous les essais-6.6%. La croissance évaluée par hauteur moyenne était de **273 cm**, ce qui est très bon pour le chêne-liège

La mortalité plus élevé c'est à MA26- 14.3%, quand même faible pour une plantation de chêne-liège à l'âge 13.

Il est à noter la bonne performance de croissance des provenances de forte pluviométrie **MA27**, **TU33** aux conditions très sèches et chaudes de Grighini qui peuvent être une preuve de l'adaptation rapide à des conditions plus sèches.

La corrélation hauteur *vs* DHP c'est éleve-R^2 = 0.8387

cm

Principaux résultats

ITALIE, Roccarespampani, Lazio

Les résultats ont montré en général une mauvaise résistance des espèces aux conditions environnementales locales, notamment le sol argileux. La mortalité en 2006 était 45% .

Provenance de la croissance a été évaluée par la hauteur moyenne en 2006, à 9 ans, de la germination à la maternelle(Fig. 3c). La hauteur moyenne pour le même âge est inférieur au essai de Monte Fava, Portugal ce que se doit probablement aux conditions environnementaux du site . Ceci est le seul site de plantation où la provenance FR3 a une croissance supérieure à la moyenne, à tous les autres essais, il se classe en dessous de moyenne.

cm

Principaux résultats

Portugal Mogadouro, Quinta da Nogueira

By 2010 at this provenance trial the mortality was 26% (Fig. 3d). On survival behaviour, the French provenances had the lowest survival while Italian provenances had the higher survival. The mortality is mainly due to rats.

In 2009 provenances were assessed for growth. The mean height of the trial -241 cm (Fig. 3d) is not correlated with survival. Results show that the provenances ES8, ES5, ES9 and PT 20 that are from more humid climates (Fig. 1) are on the top growing group despite the drier climate profile of the plantation site (Table 2). On the other hand, IT13 that comes from a climate similar to the trial region is the one with the lowest growth. Provenance from wet climate FR3 and IT16 seem to have less adaptability to drier climate.

Significant differences between populations were observed for survival and height. Provenances were also observed over 3 years (2011-2013) on bud burst behaviour and no significant differences ($p<0.05$) were found

cm

Principaux résultats

Portugal, Monte Fava

This trial is being regularly assessed but last processed data are from 2006, (age 9). More recent data are the basis of the PhD thesis of Teresa Sampaio in progress.
At Monte Fava trial in 2006 all Moroccan provenances had a growth above mean (Fig 3e) while all French provenances show a growth under the mean (Table 3).
The Tunisian provenance TU33, the one that grows on the highest precipitation regime (Fig1), shows however a growth performance slightly above average; ES9 which is a provenance of low summer drought shows a growth performance slightly under the mean at the dry summer profile of Monte Fava.
If these results remain at older age fast adaptation to dryer conditions shall be considered.
WUE was evaluated by δ13C on 11 trees per provenance. Results revealed significant differences between provenances but no correlation between height and WUE was found. Yet it must be emphasized that the Morocco provenance MA31 showed a very good growth and a good WUE (Nunes *et al.* 2008).

cm

Principaux résultats

Spain

Studies conducted in 2005 at the common garden experiment at Monfrague National Park, in western Spain compared thirteen Spanish provenances that includes the seven Spanish provenances selected by the EU Concerted Action FAIR 202 (Ramirez-Valiente *et al.,* 2010).. Provenances were compared using total height and correlation of phenotypic traits potentially related to drought tolerance: leaf size, specific leaf area (SLA), nitrogen leaf content (Nmass) and carbon isotope discrimination (D13C).

The populations showed to be exceptionally differentiated at the locus QpZAG46 and evidence of linkage between locus QpZAG46 and genes encoding for leaf size and growth in cork oak was found.

The same authors also found that *Q. suber* seedlings originating from sites characterized by more intensive droughts exhibited significantly higher survival rates than those from regions where drought is less severe i.e. not all populations are equally vulnerable to climate change (Ramirez-Valiente *et al.,* 2009).

The study foresee that under the ongoing climate change, all Iberian *Q. suber* populations are expected to incur more intensive drought periods, but Northern populations poorly adapted to dry conditions under a drier future climate will likely have lower survival

Principaux résultats

Tunisie

On a study conducted by Khouja *et al.,* 2010 at the trial of Tebaba, Nefza, it is described that by 2005/ 2006 the trees began to show signs of decline. The study could identify that attacks were mainly due to the endophytes fungi *Biscogniauxia mediterranea* and *Discula quercina*, some new at the Tunisian cork oak pest scenario. 28 % of the trees at the trial had the crowns totally or half-dead (560 in a total of 2340 at the moment of the field observations). The study revealed variability among provenances in terms of susceptibility to the pathogen fungi. The rate of the attacks was uneven among provenances ranging from 27% to 63 %. The Tunisian provenance Mekna (TU32) was the most sensitive and the Spanish provenance Moréna (ES7) was the less affected. (Khouja *et al.,* 2010).

On the study by Ennajeh *et al.* (2013) at the same trial it was found that the survival of provenances felt significantly in 2011, close to half from 2004 to 2011 (Fig. 3f), The provenance PT23 (Santiago de Cacem) had the highest mortality after the pathogen fungi attack but the provenances IT13 and IT15 (Sassari, Cagliari) had low mortality. Growth evaluated by height varied from 124.6 to 101.9 cm being the trial's mean 114.66 cm (Fig. 3f). The Tunisian provenance TU33 shows a good growth at age 14 (2011) and the susceptibility to the pathogen attack was considerable high (44.9%) although lower than for TU32 which mortality reached 52.2%.

Provenance growth behaviour is also compared among trials assessed by mean height (cm) and compared to the mean height of the trial (Table 3). cm

The comparison highlights the persistently above-mean behaviour of the provenances PT20

Provenances de locaux beaucoup plus humides (notamment **MA27**, **TU33**) démontre capacité de adaptation très bonne (évaluer par croissance en hauteur) en locaux de pluviométrie substantiellement plus bas.

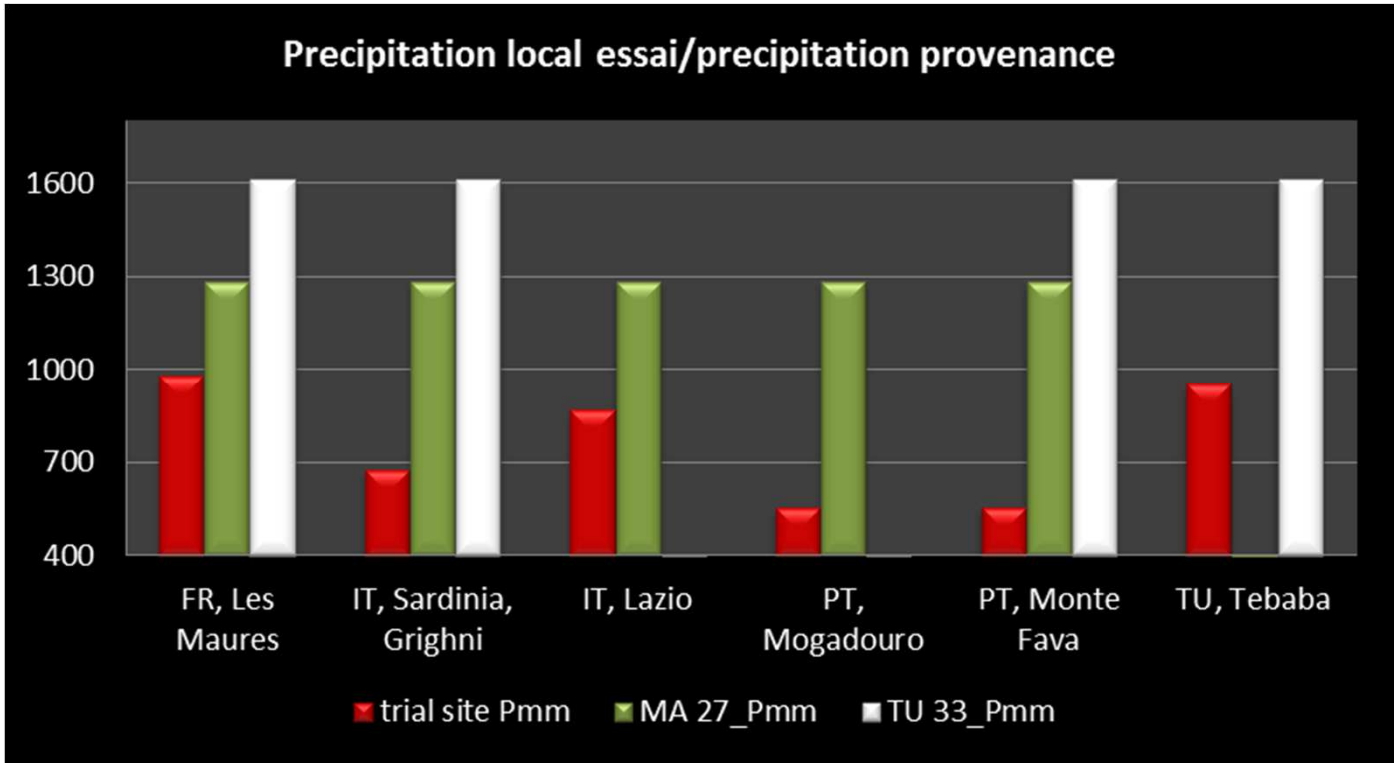
ADAPTATION RAPIDE AUX CHAGEMENTS CLIMATIQUES ?

PT20¤	Côvo,·Ponte·Sôr¤	A¤	A¤	A¤	A¤	U¤	U¤
PT23¤	S.·Cacem,·Monte·Branco¤	A¤	A¤	A¤	U¤	A¤	U¤
MA27¤	Rif·Occidental·I.2¤	A¤	A¤	A¤	A¤	A¤	U¤
MA28¤	Maâmora·III.1¤	A¤	X¤	X¤	A¤	A¤	X¤
MA29¤	Maâmora·III.1¤	A¤	A¤	A¤	A¤	A¤	A¤
MA30¤	Plateau·Central·III.2¤	A¤	A¤	A¤	A¤	A¤	U¤
TU32¤	Mekna,·Aïn·Sobh¤	A¤	A¤	A¤	U¤	U¤	A¤
TU33¤	Fernana,·Aïn·el·Baya¤	A¤	A¤	U¤	U¤	A¤	A¤
AL34¤	Guerbés¤	U¤	A¤	U¤	A¤	A¤	A¤

CHENE-LIEGE FAIR 202 ESSAIS –Provenances T33 MA27 origine de locaux pluvieux se comporte (croissance en hauteur) au dessus de la moyenne en sites ou la précipitation annuelle est ½ même 1/3

CHANGEMENT CLIMATIC PREDICTES AUGMENTATION de SÈCHERESSE dans LA MEDITTERANNEE

- ADAPTATION DANS UNE GÉNÉRATION VERS SÈCHERESSE ?

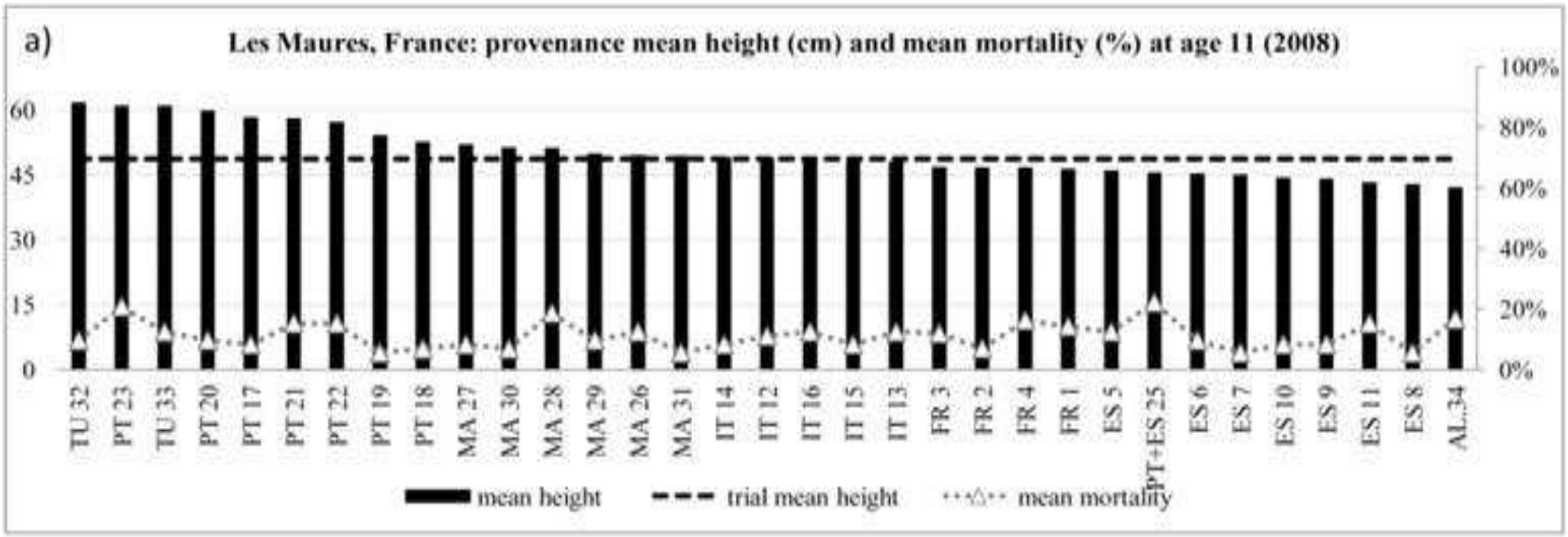


France, Les Maures

Dernières mesures en 2008

Il faut remesurer des que possible

Plagiotropie- simplement OUI /NON



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