

Limits and Potential of Industrial Hemp in Italy

Stefano Amaducci

Dipartimento di Scienze delle Produzioni Vegetali Sostenibili

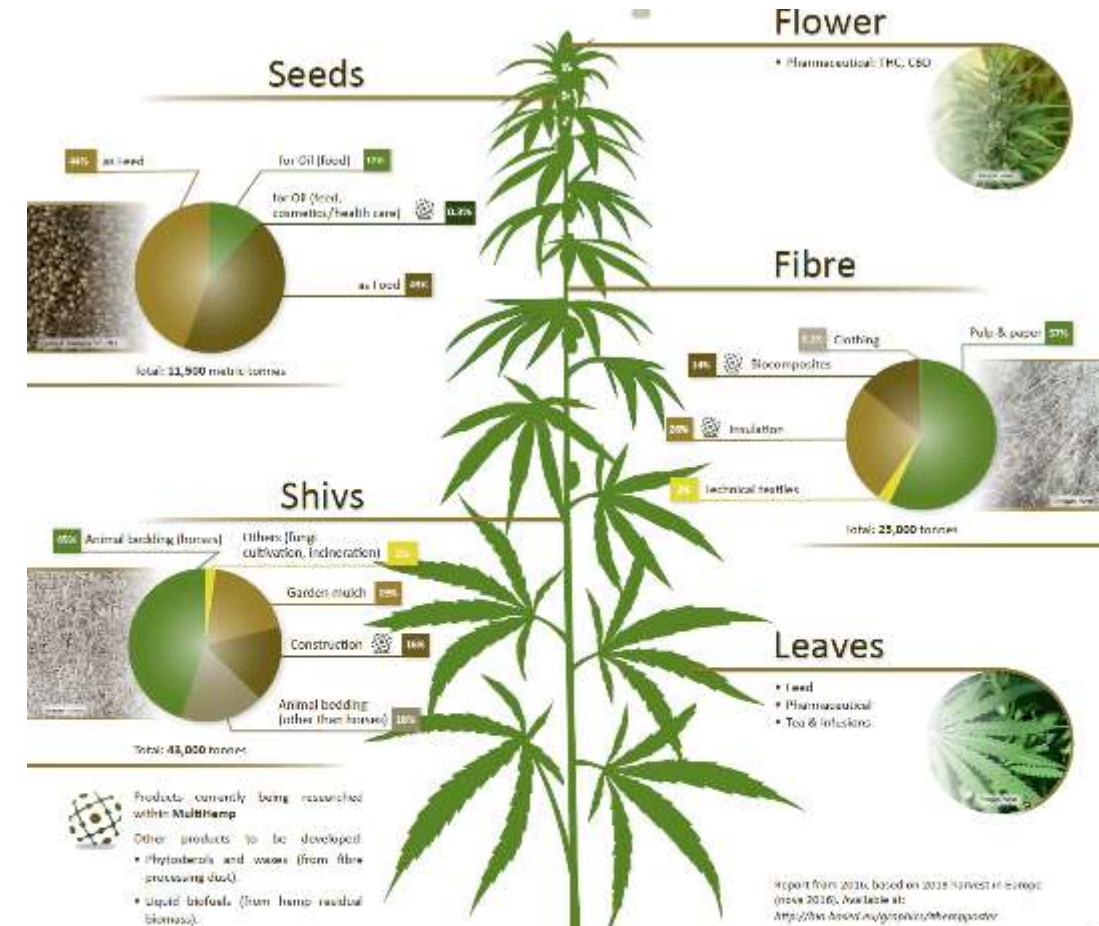
Limits and Potential of Industrial Hemp in Italy



- ✓ **Quality Fiber for Textile;**
- ✓ **Technical Fiber, Shives and Markets;**
- ✓ Hemp Decortication: experiences in Italy and Europe;
- ✓ **Hemp Seed: Food and Cosmetics;**
- ✓ **Industrial Use of Flowering Tops and Extracts;**
- ✓ **CBD and other active principles production: business cases;**
- ✓ Hemp Politics and Regulation outside Europe;
- ✓ Outlook on European and Italian regulation – Round table;

Hemp as a model for the bioeconomy

A natural biorefinery Hemp



MultiHemp

MultiHemp

The MultiHemp project aims at developing hemp genotypes with enhanced traits suitable for diverse cultivation environments and to provide improved feedback for a wide array of innovative and products generated within an integrated bioeconomy. For more information, see <http://www.multiphemp.eu>.

The MultiHemp project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 1111840.

FIBRA

The main target of the FIBRA project is to link the research activities carried out in both the European Union and China on natural fibre crops, to provide a long term vision on future common research activities on fibre crops and to improve researchers' training opportunities. For more information, see <http://www.fibra7.net>.

The FIBRA project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 311961.



MultiHemp

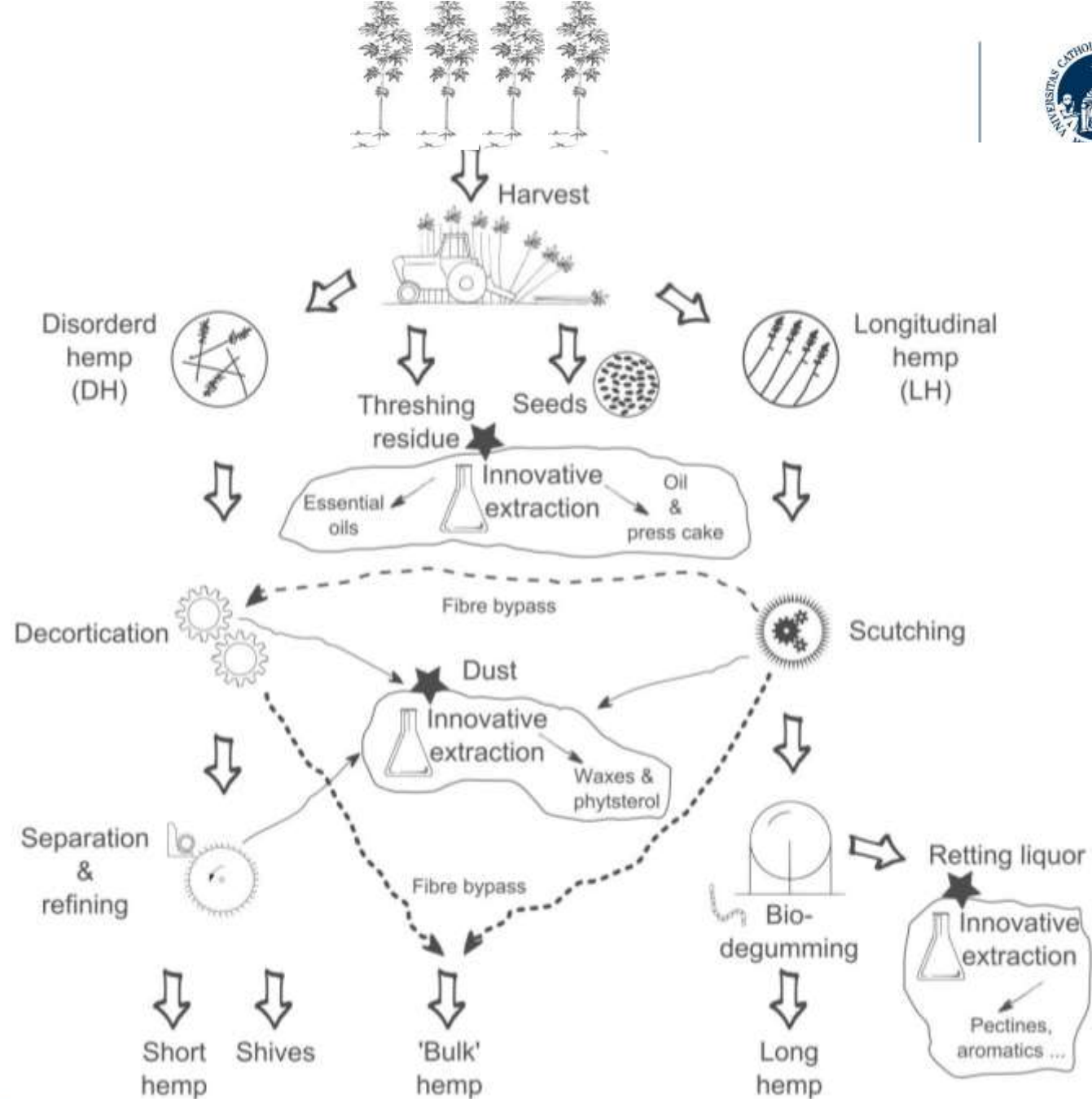
Biorefinery concept

Key aspects:

Mechanisation of harvesting
... and fibre separation

Innovative extraction process

Innovative varieties



UNIVERSITÀ
CATTOLICA
del Sacro Cuore

- ✓ Exploit and valorise the whole plant in a complete value-chain;
- ✓ It also produces food (good for the food vs fuel debate!);
- ✓ Low input / High Resource Use Efficiency;
- ✓ Additional environmental benefits (marginal, polluted land);
- ✓ Produce innovative, recyclable, sustainable materials ... that have a market!

Limits and Potential of Industrial Hemp in Italy

- ✓ **Quality Fiber** for Textile;
- ✓ Technical Fiber, Shives and **Markets**;
- ✓ **Hemp Decortication**: experiences in Italy and Europe;
- ✓ **Hemp Seed**: Food and Cosmetics;
- ✓ Industrial Use of Flowering Tops and Extracts;
- ✓ CBD and other active principles production: business cases;
- ✓ **Hemp Politics and Regulation outside Europe**;
- ✓ **Outlook on European and Italian regulation** – Round table;



Outcome of the Multihemp stakeholder-meeting



- What are main technical constraints of the hemp value chains?
- What is needed to increase hemp cultivation in Europe to 100,000 hectares?

- ✓ Enlarge the market of hemp products
- ✓ Fibre quality issues (weather dependent, cultivar decorticability and fiber content)
- ✓ Dew-retting model
- ✓ Grading system (mixing different qualities)
- ✓ Mechanisation of harvest (reduce harvesting time to target favorable conditions)
- ✓ Long term cultivation sustained by contracts/ size of the processing plant
- ✓ New varieties (dual purpose, improved quality, cannabinoids, seed yield, etc)

Limits and Potential of Industrial Hemp in Italy

Multipurpose, dual purpose or just a seed crop?

Are there suitable Italian varieties?

Have we got an effective cultivation system?

Retting or no retting?

Harvesting?

Fibre extraction technology?



Hemp phenology



Latvia



Italy

Finola

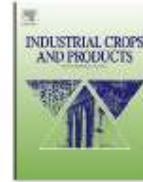
Multipurpose hemp for industrial bioproducts and biomass

Industrial Crops and Products 87 (2016) 33–44

Contents lists available at ScienceDirect

Industrial Crops and Products

journal homepage: www.elsevier.com/locate/indcrop

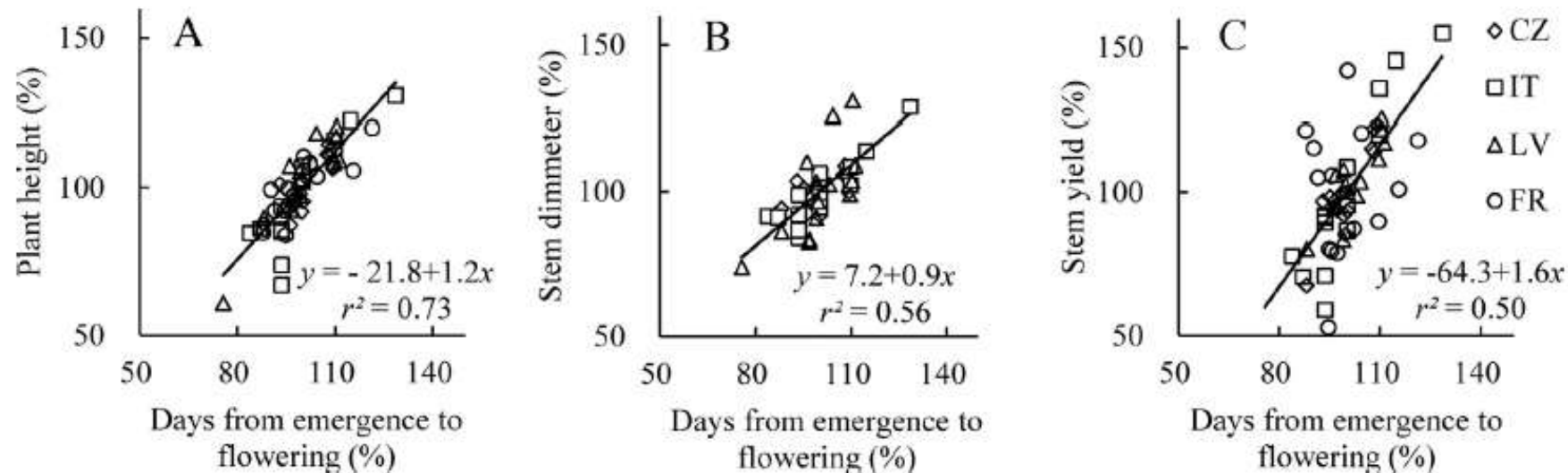


Comparing hemp (*Cannabis sativa* L.) cultivars for dual-purpose production under contrasting environments

K. Tang^{a,b}, P.C. Struik^a, X. Yin^a, C. Thouminot^c, M. Bjelková^d, V. Stramkale^e,
S. Amaducci^{b,g}

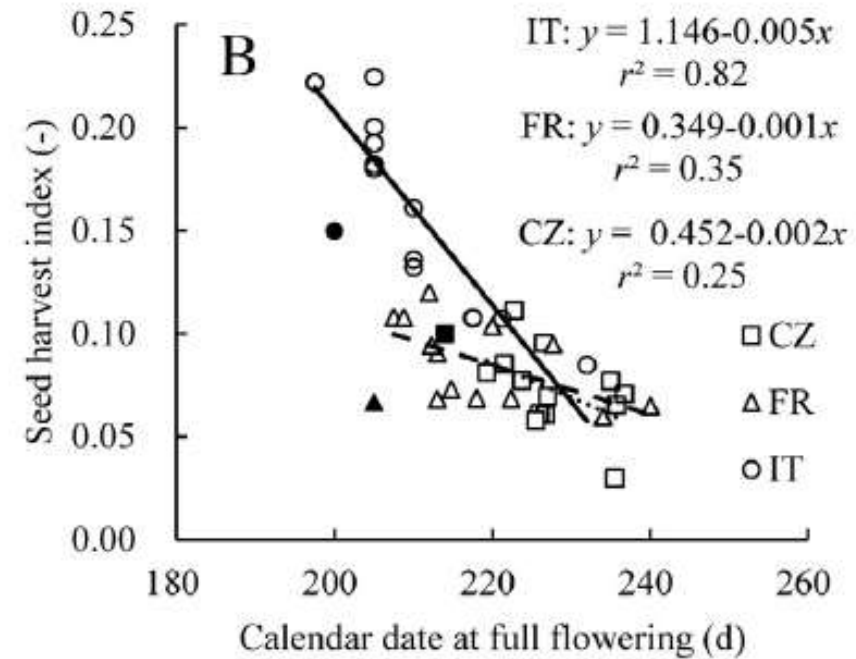
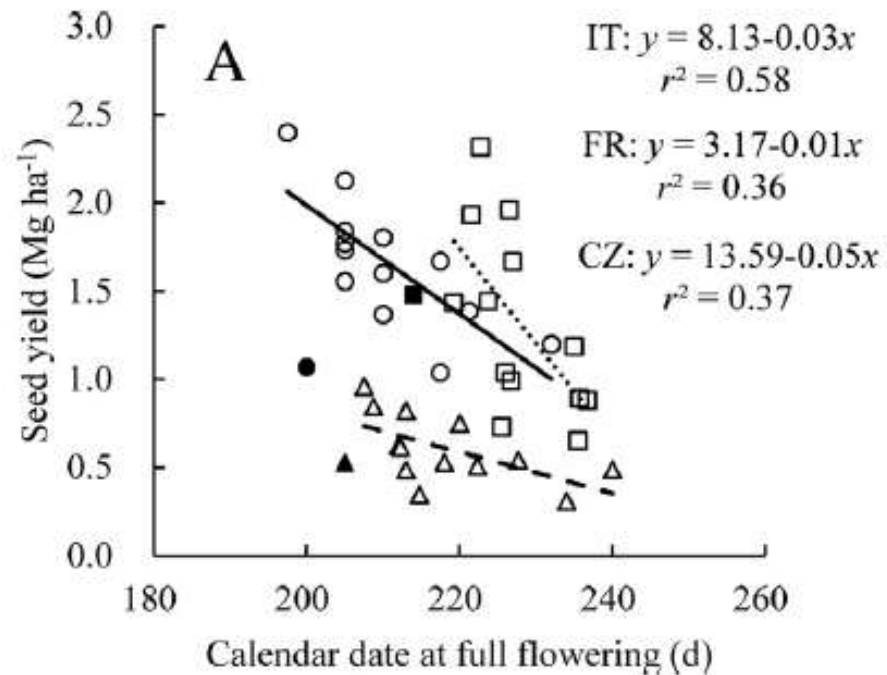


The longer is the vegetative phase,
the higher is biomass yield...



Multipurpose hemp for industrial bioproducts and biomass

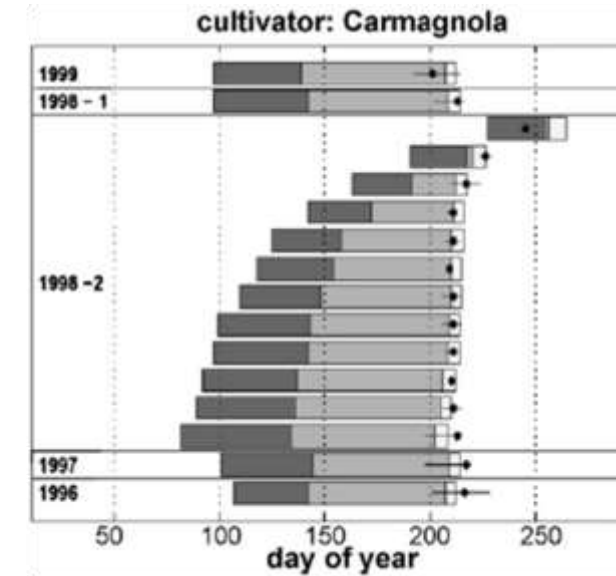
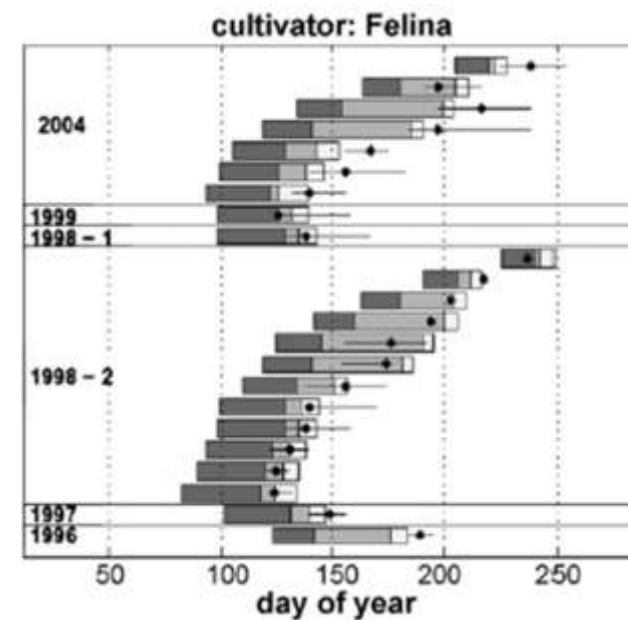
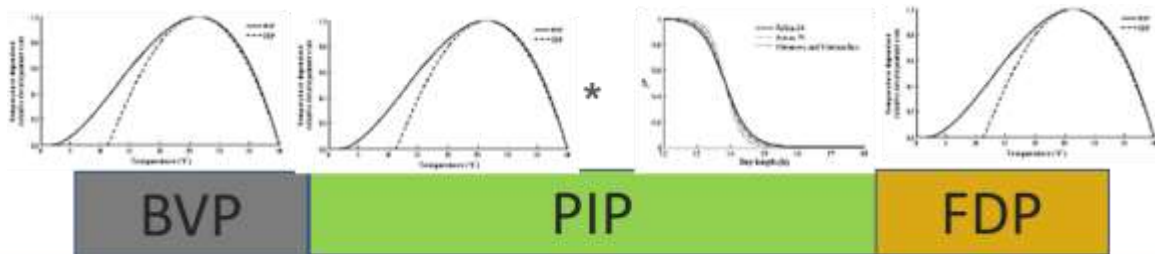
... the lower is seed yield.



Availability of suitable genotypes for multi-dual or single purpose

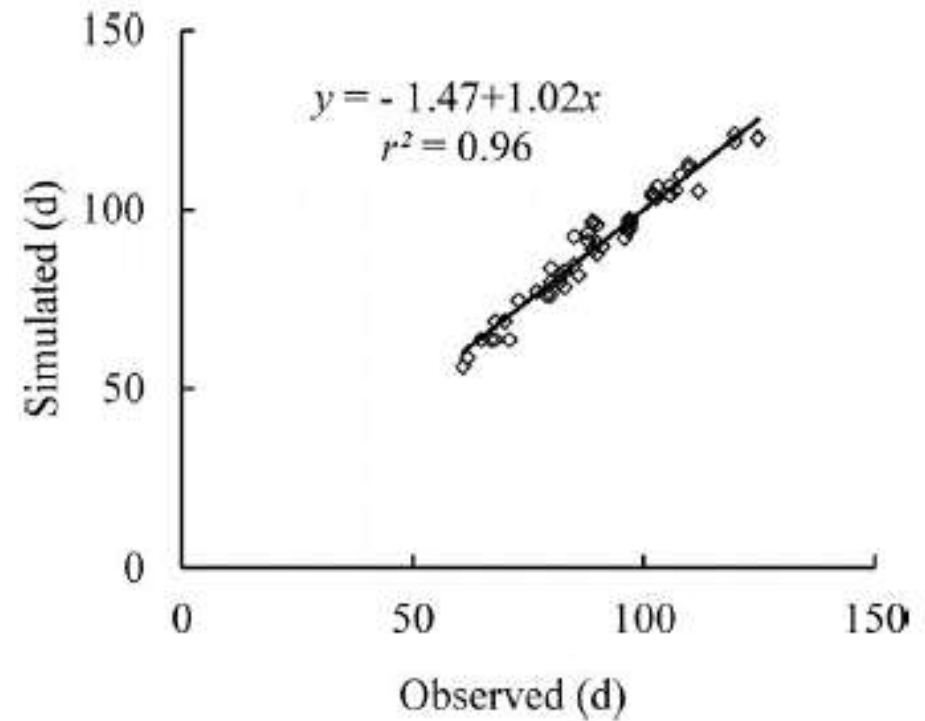
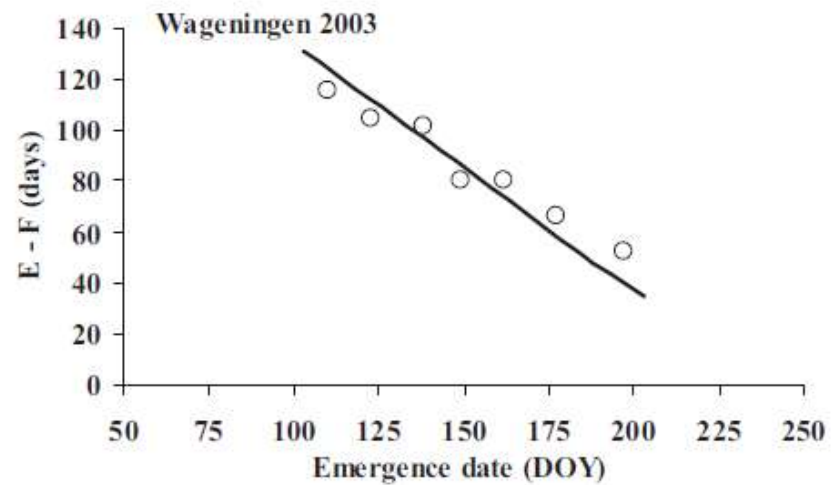
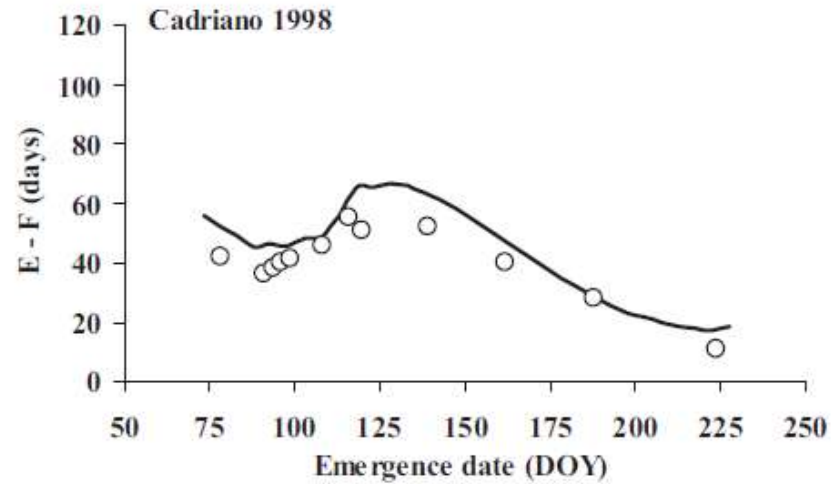
- Sensibility to photoperiod
- Biomass quality

$$R_{\text{dev}}(x) = \begin{cases} \frac{fT(1)}{D_1} & x = 1 \\ \frac{fT(2)fP}{D_2} & x = 2 \\ \frac{fT(3)}{D_3} & x = 3 \end{cases}$$



Hemp phenology

Felina 34 (Calibration)



Determination of hemp seeds production...is a difficult task!

- High within plot variability (flowering time and plant height)
- Inhomogeneous seed maturity
- Cross pollination limit the possibility to study seed quality
- Bird predation



Determination of hemp seeds production...is a difficult task!

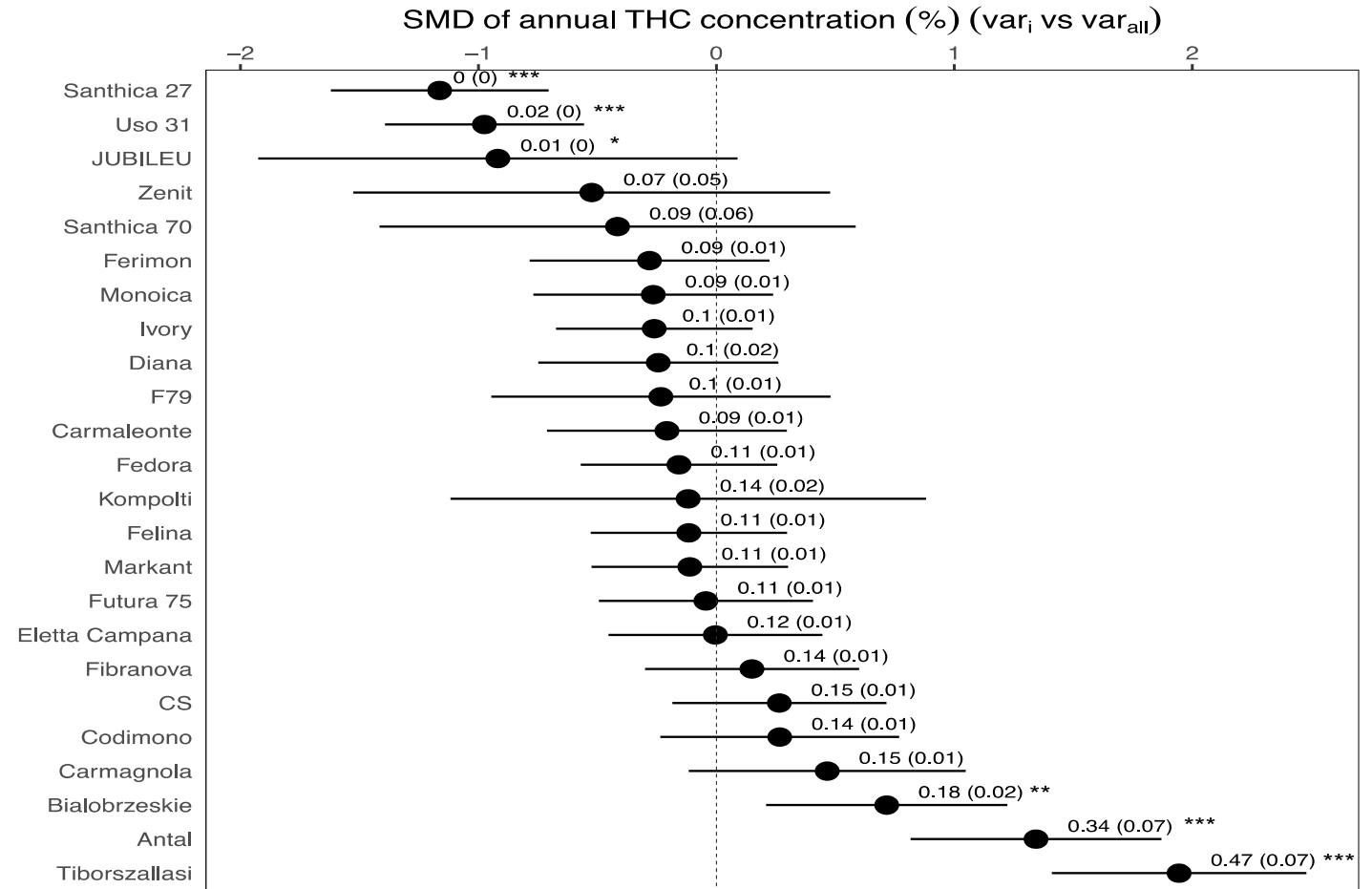


Commercial varieties oil content &

Variety	Total oil content (%)	
FIL	37.64	±
E68	36.41	±
F12	35.58	±
UFR	34.78	±
F75	34.74	±
F32	34.47	±
F79	34.40	±
MAR	34.25	±
BIA	34.17	±
F17	34.12	±
UDE	34.06	±
MON	33.51	±
S27	33.08	±
JUB	32.85	±
DIA	32.64	±
CS	32.53	±
KOM	32.05	±
ELE	31.53	±
KCD	31.28	±
CML	31.25	±
TIB	30.73	±
IVO	24.87	±

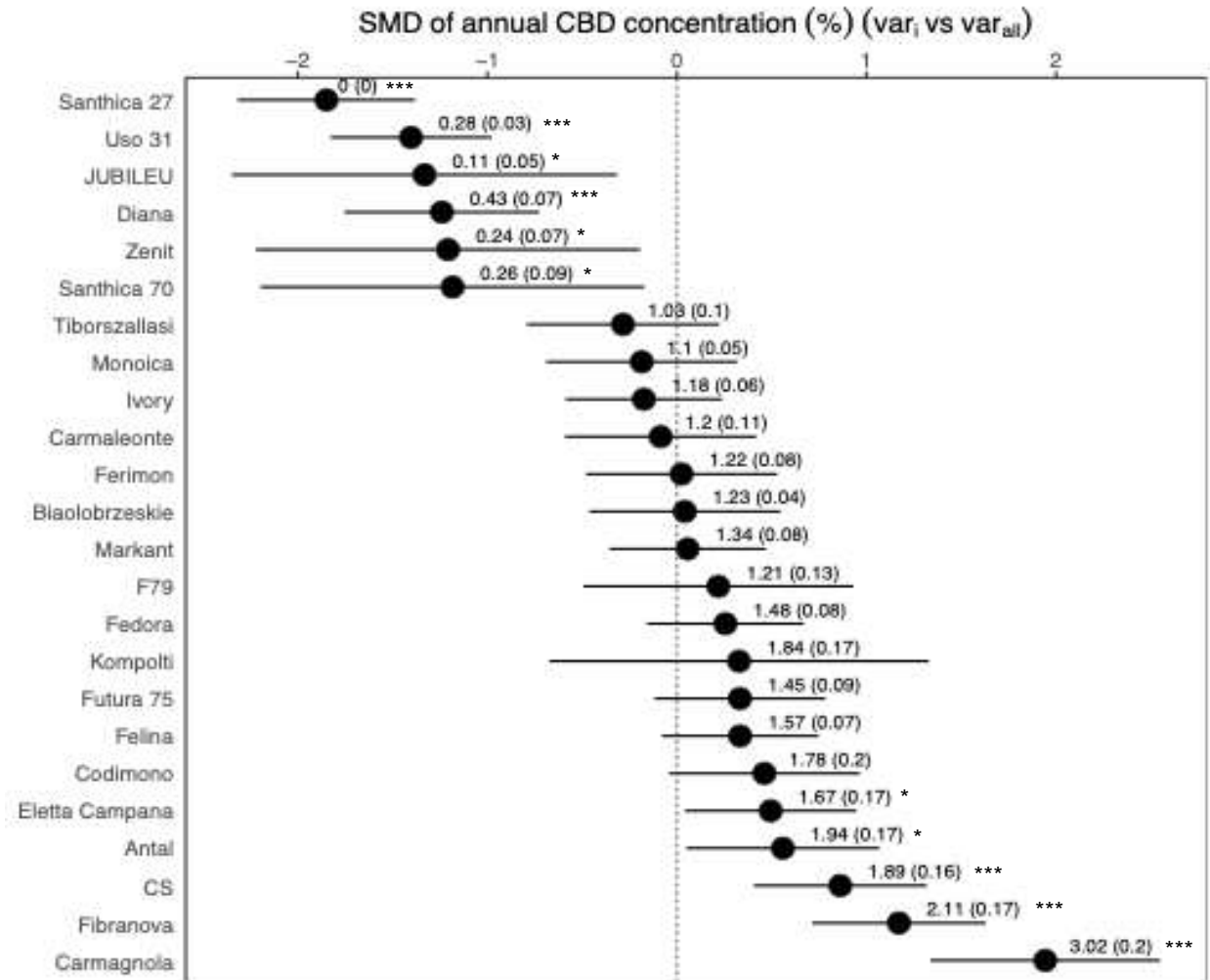
Commercial varieties oil & cannabinoid content

Variety	Total oil content (%)	
FIL	37.64	±
E68	36.41	±
F12	35.58	±
UFR	34.78	±
F75	34.74	±
F32	34.47	±
F79	34.40	±
MAR	34.25	±
BIA	34.17	±
F17	34.12	±
UDE	34.06	±
MON	33.51	±
S27	33.08	±
JUB	32.85	±
DIA	32.64	±
CS	32.53	±
KOM	32.05	±
ELE	31.53	±
KCD	31.28	±
CML	31.25	±
TIB	30.73	±
IVO	24.87	±

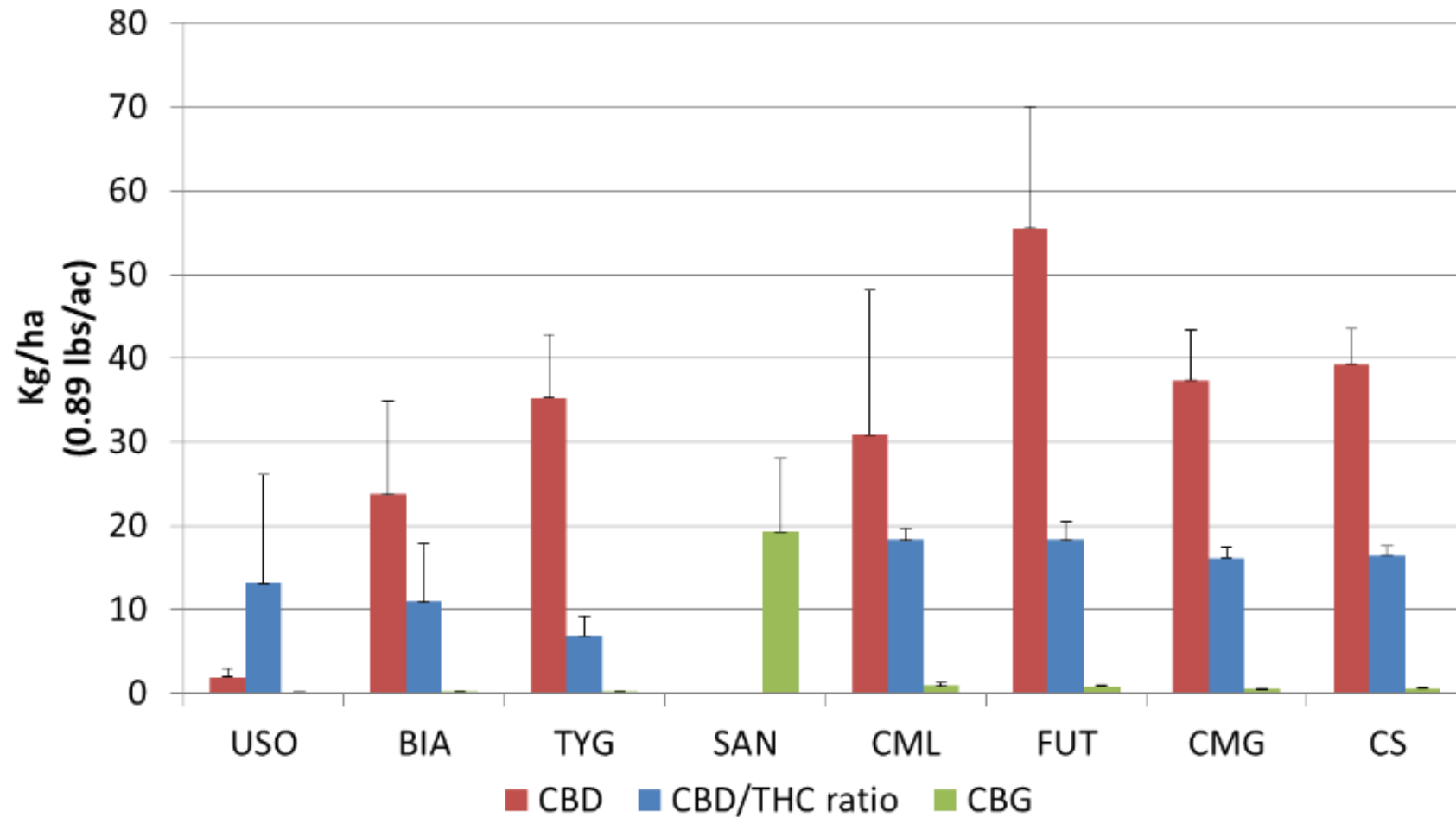


Commercial varieties oil & cannabinoid content

Variety	Total oil content (%)	
FIL	37.64	±
E68	36.41	±
F12	35.58	±
UFR	34.78	±
F75	34.74	±
F32	34.47	±
F79	34.40	±
MAR	34.25	±
BIA	34.17	±
F17	34.12	±
UDE	34.06	±
MON	33.51	±
S27	33.08	±
JUB	32.85	±
DIA	32.64	±
CS	32.53	±
KOM	32.05	±
ELE	31.53	±
KCD	31.28	±
CML	31.25	±
TIB	30.73	±
IVO	24.87	±



Potential cannabinoid yield in the threshing residue

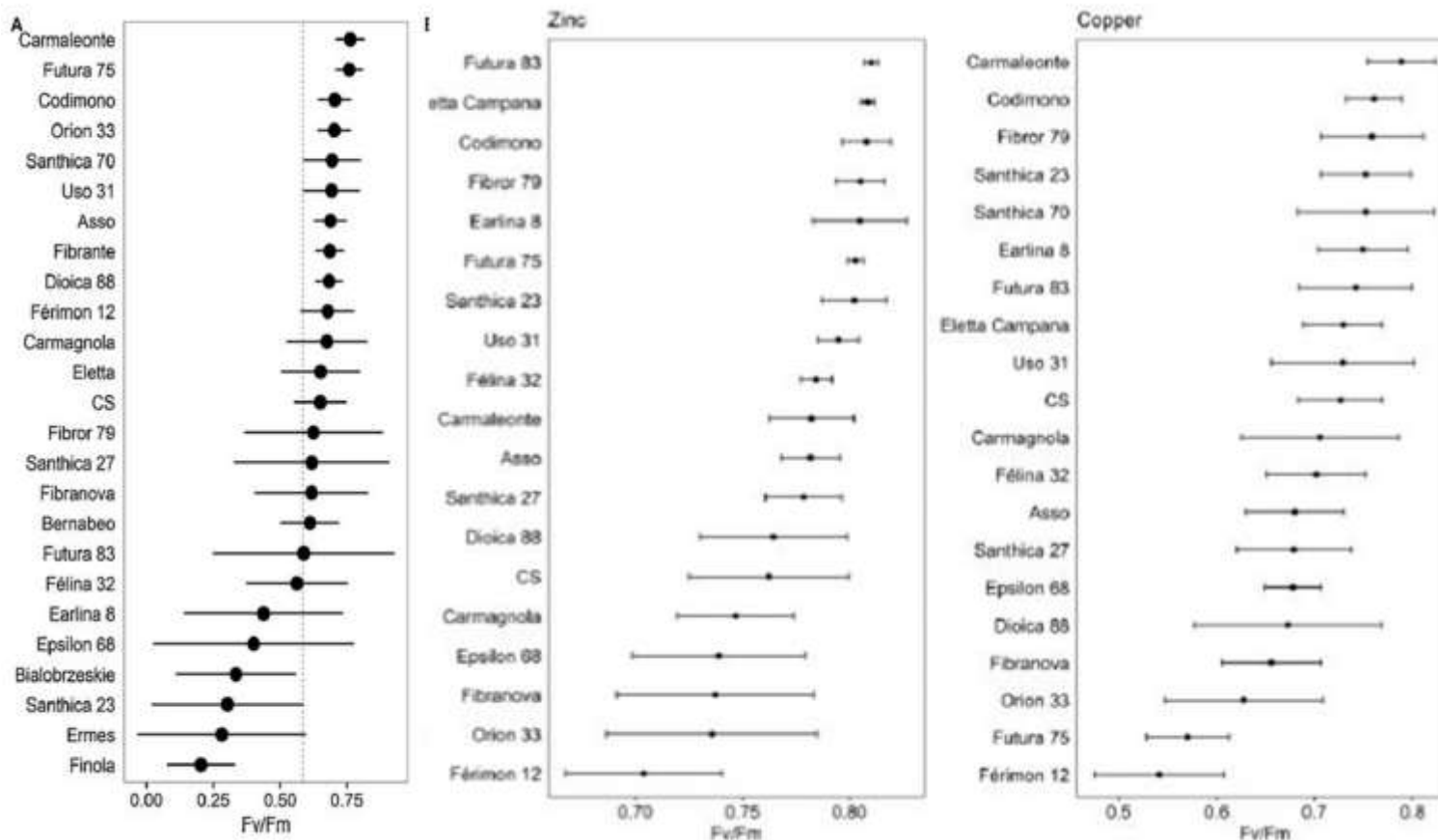


GRACE activities to assess hemp potential in marginal environments

- ✓ Cultivation in mountain area
- ✓ Genotype screening for osmotic stress tolerance
- ✓ Genotype screening for heavy metal tolerance
- ✓ Review: adapting hemp cultivation to marginal environments

Suitability to marginal environment

Evidence of genetic variability in European germplasm for Stress tolerance



Osmotic stress

HM stress

Codimono

Fibror 79

Carmaleonte

Carmaleonte

Futura 75

Eletta Campana

Santhica 70

Futura 83

Férimon 12

Codimono

Industrial Crops & Products 170 (2021) 113774



ELSEVIER

Contents lists available at ScienceDirect

Industrial Crops & Products

journal homepage: www.elsevier.com/locate/indcrop

Ranking 26 European hemp (*Cannabis sativa* L.) cultivars for osmotic stress tolerance and transpiration efficiency

Henri Blandinières*, Martina Leoni, Andrea Ferrarini, Stefano Amaducci

Suitability to marginal environment



REVIEW |  Open Access |  

Adapting the cultivation of industrial hemp (*Cannabis sativa* L.) to marginal lands: A review

Henri Blandinières  Stefano Amaducci

First published: 01 June 2022 | <https://doi.org/10.1111/gcbb.12979>

- Productivity susceptible to HM (greenhouse scale studies)
- Tolerance to drought depends on soil characteristics / crop phase
- In marginal conditions multipurpose applications are limited:
 - To dual purpose in mountain area;
 - To stem only in HM contaminated lands;

... and the fibre?

Yellow varieties are easier to decorticate



Musio S, Müssig J and Amaducci S (2018) Optimizing Hemp Fiber Production for High Performance Composite Applications. *Front. Plant Sci.* 9:1702.

- **Product development and commercialization**
Innovative products, Marketing (LCA)
- **Breeding for improved genotypes**
Photoperiod sensitivity, stress tolerance, end use destination (fiber, seeds, secondary metabolites)
- **Mechanization and fiber separation**
Fiber extraction (Retting)
Harvesting (adapted to Italian conditions)
- **Business model**
Large or small scale?