

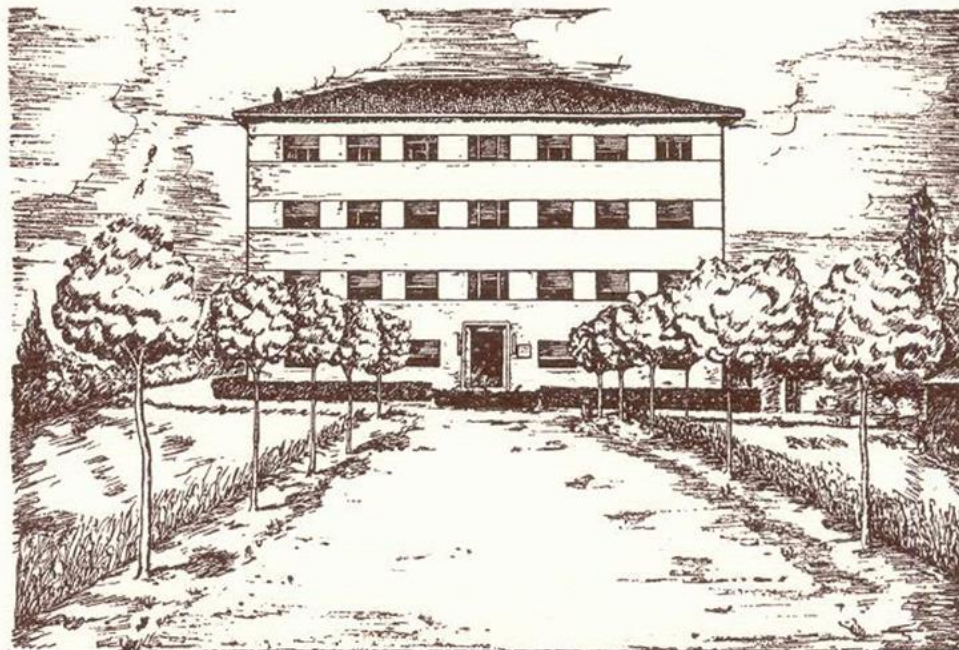
La canapa a Rovigo

Giuseppe Mandolino

*CREA-Centro di ricerca Cerealicoltura e
Colture industriali - Bologna*

Le origini di Rovigo come centro di ricerca

- Nel 1912 venne istituita la Regia Stazione Sperimentale di Bieticoltura; la direzione è affidata Ad Ottavio Munerati (1875-1949);
- nel 1968, si fonde con l'Istituto di Allevamento Vegetale per la Cerealicoltura di Bologna, e diventa Istituto Sperimentale per le Colture Industriali (ISCI)
- Nel 2004, viene integrata nel CRA come Unità Operativa del Centro di ricerca Colture Industriali (CRA-CIN);
- Nel 2015 diviene una delle Sedi del Centro di ricerca Cerealicoltura e Colture Industriali del CREA (CREA-CI)



Stazione Sperimentale di Bieticoltura - Rovigo - A.D. - MCMLIII



Azienda Agricola di 70 ha.

Camere di crescita di sicurezza per
breeding e produzione cannabis
medica

Laboratorio GC e HPLC

Laboratorio fitopatologico

Linea di lavorazione e laboratorio
analisi bietola

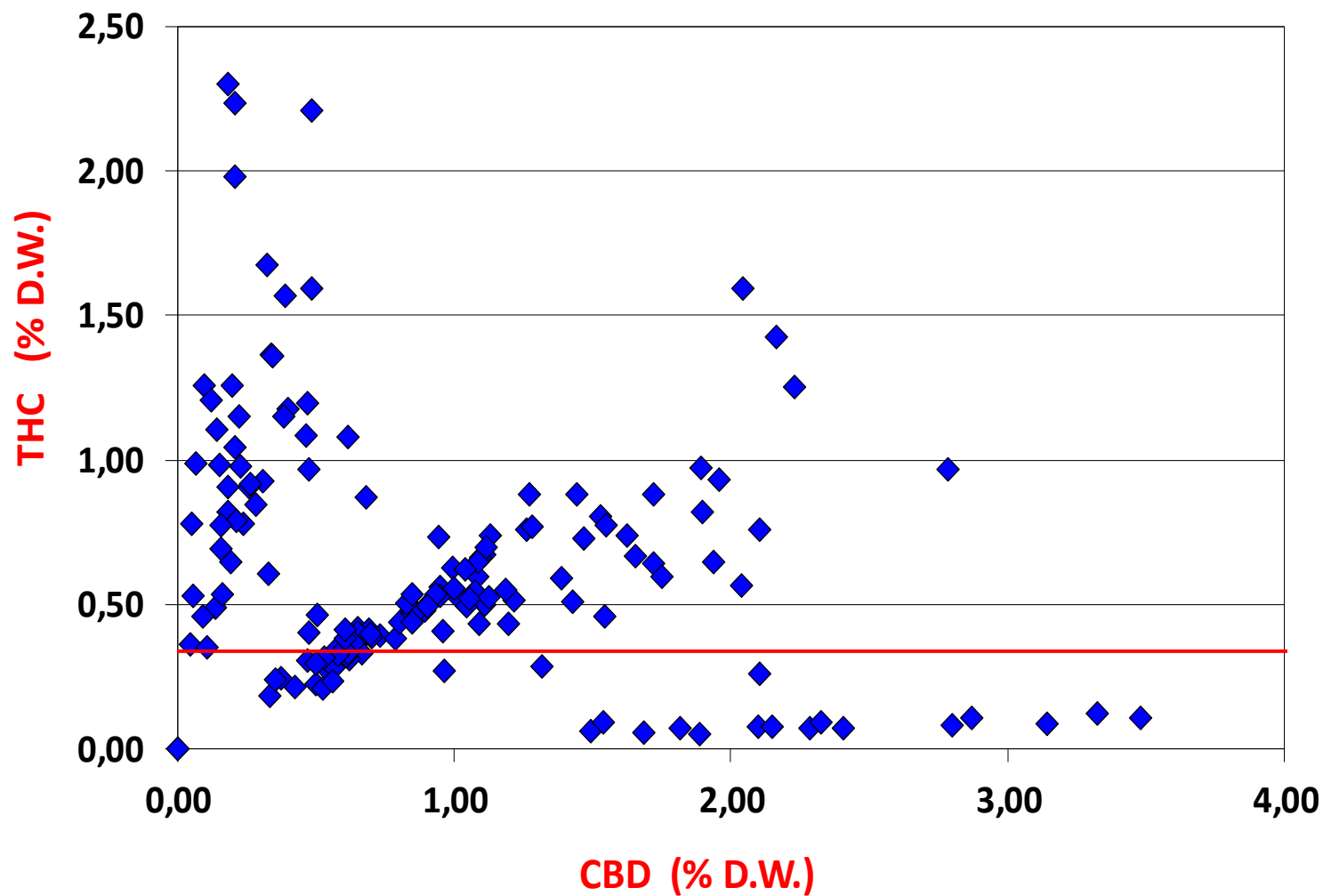


La canapa a Rovigo è iniziata... a Bologna

- **Premessa 1:** *l'allora ISCI (Istituto Sperimentale per le Colture Industriali, con sede a Bologna e sezione operativa periferica a Rovigo) è stato da sempre costituente e/o mantentore delle tradizionali varietà o ecotipi italiane da fibra: Carmagnola, Fibranova, C.S., Eletta Campana*
- **Premessa 2:** *dalla seconda metà degli anni Novanta la comunità europea sostiene la reintroduzione della canapa negli scenari colturali europei elargendo contributi ai coltivatori*
- **Premessa 3:** *il Ministero dell'Agricoltura promuove la ricerca nel settore della canapa allo scopo di recuperare e rendere più adeguate alle normative europee le varietà italiane*



Distribuzione originaria dei chemotipi in una varietà italiana da fibra: ELETTA CAMPANA



2014 Sottoscrizione dell'accordo di collaborazione tra il Ministero della Salute e il Ministero della Difesa che pone l'avvio del Progetto Pilota per la produzione nazionale di sostanze e preparazioni di origine vegetale a base di Cannabis; lo Stabilimento Chimico Farmaceutico Militare (SCFM) di Firenze, quale parte coinvolta del Ministero della Difesa, si rivolge al CRA-CIN (ora CREA-CI) per assistenza tecnica

2015 il CREA presenta al MIPAAF un progetto che ha al suo centro l'attività di supporto al SCFM per la Produzione sperimentale di Cannabis ad uso medicinale

2015 Fornitura ad SCFM di infiorescenze della varietà CREA CINRO (THC/CBD) per definire il processo di lavorazione, macinazione e confezionamento

2015 Iniziano i lavori di adeguamento delle strutture CREA di Rovigo per renderle a norma rispetto alle esigenze di fornitura di talee radicate delle due varietà CREA (CINBOL e CINRO) da fornire ad SCFM per la produzione dei farmaci FM1 ed FM2

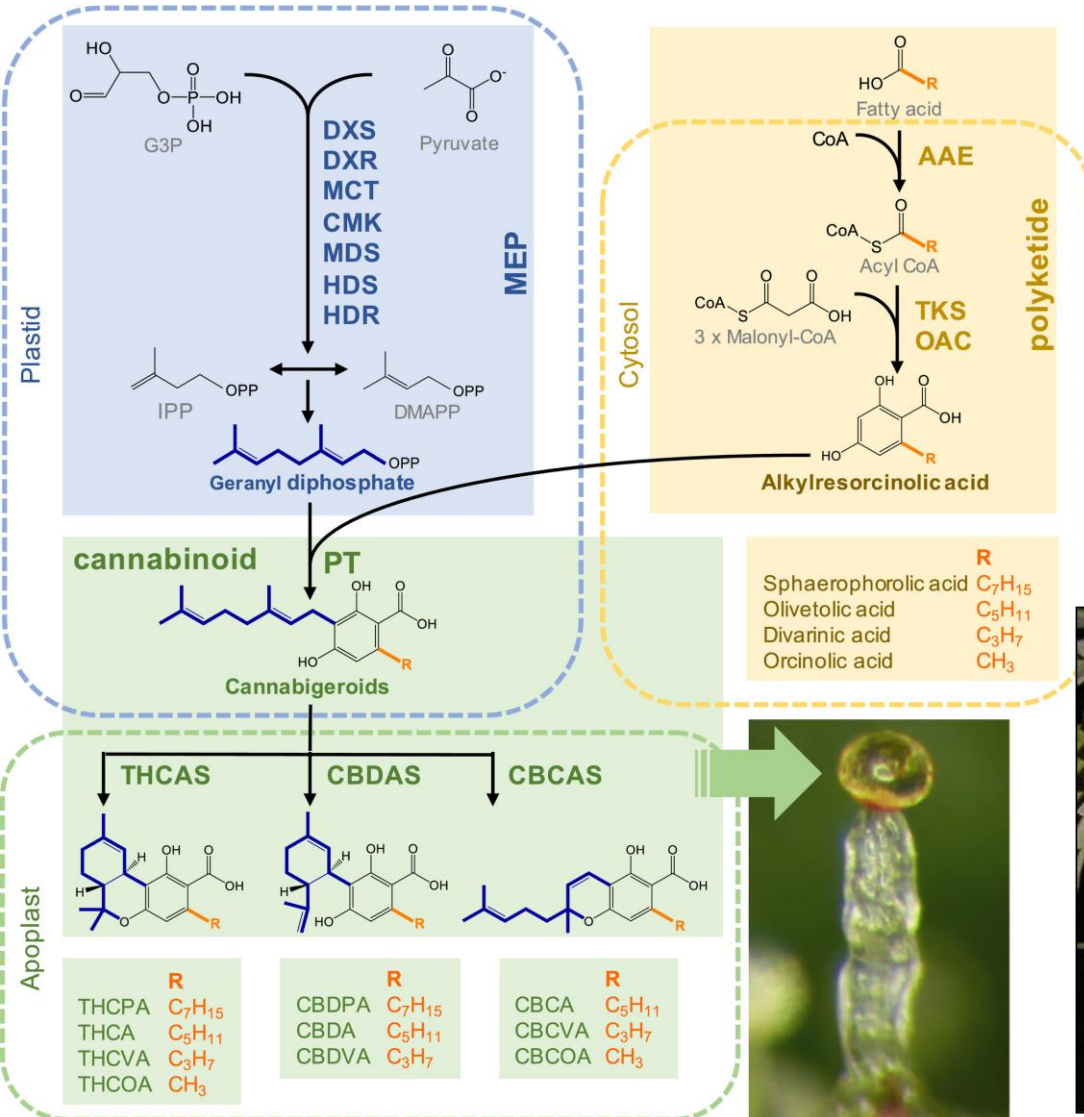
2015 Fornitura di 160 talee che serviranno ad SCFM a preparare le procedure dell'Active Substance Master File (ASMF) da presentare all'AIFA

2016 Fornitura ad SCFM delle prime talee della varietà CINBOL (THC)

2016 Per sostenere finanziariamente l'attività di fornitura di talee, il Mipaaf vara il progetto PROCANAMED (2016-2018)

2017 il CREA avvia le pratiche per l'iscrizione presso l'ufficio brevetti europeo, Community Plant Variety Office (CPVO) per la protezione delle due varietà di Cannabis, con la denominazione di CINRO e CINBOL ad uso medico selezionate, costituite, e conservate in purezza genetica dal centro CREA-CI del CREA ed utilizzate a scopo farmaceutico da SCFM

Sintesi dei cannabinoidi



Da: Hurgobin et al., 2021. Recent advances in *Cannabis sativa* genomics research.

New Phytologist 230: 73-89



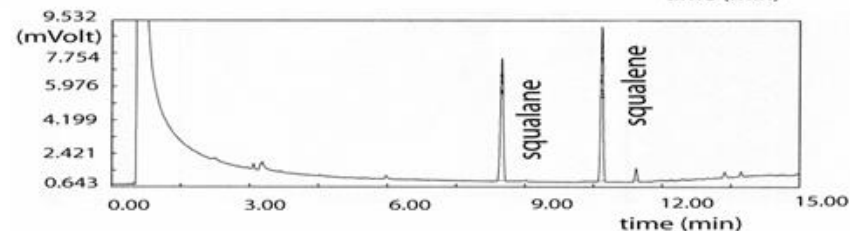
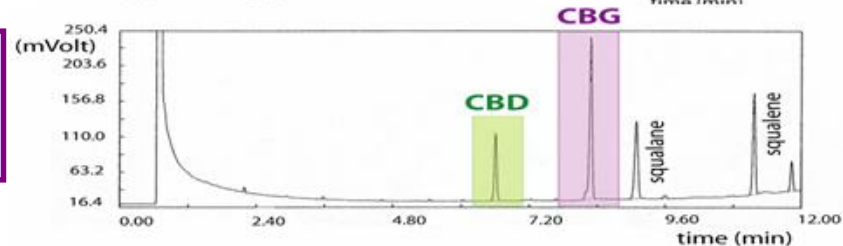
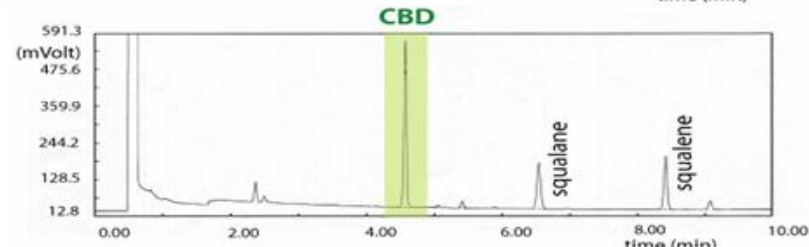
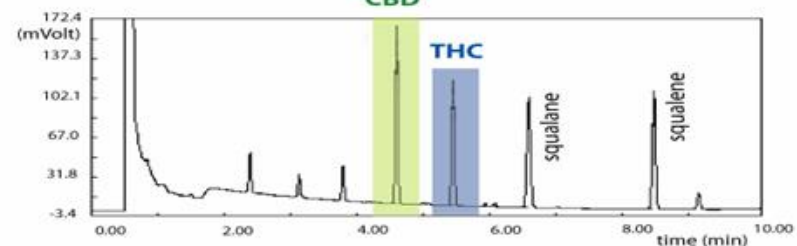
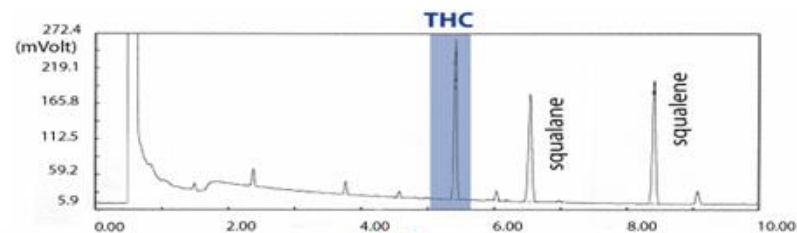
Chemotipo I: THC > 0.3% p.s.
(medico) CBD < 0.5% p.s.

Chemotipo II: THC ≥ 0.3% p.s.
(medico) CBD > 0.5% p.s.

Chemotipo III: THC < 0.3% p.s.
(industriale) CBD > 0.5% p.s.

Chemotipo IV: CBG > 0.3% p.s.
(CBG, pot. medico) altri < 0.5% p.s.

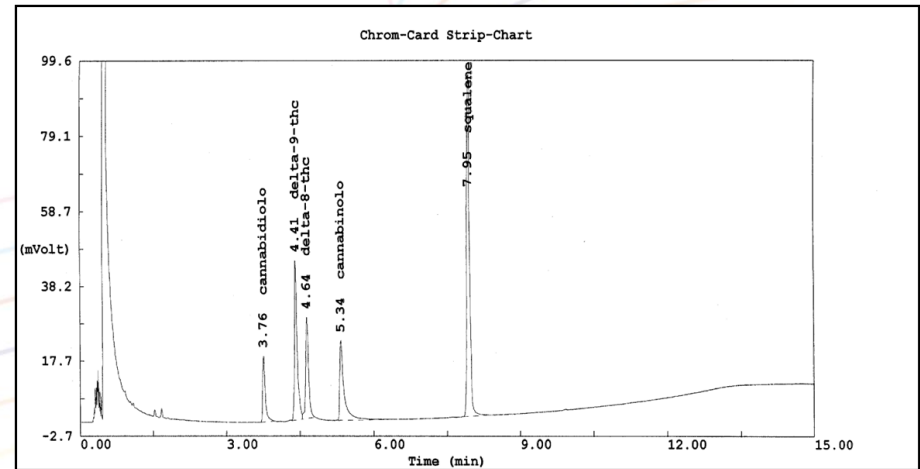
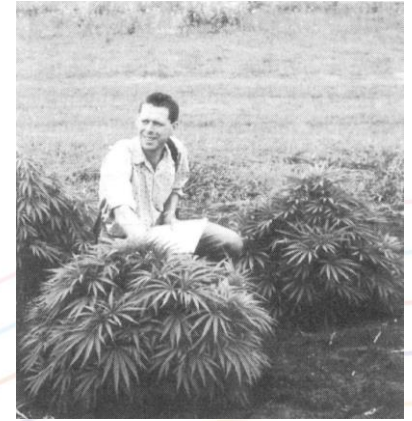
Chemotipo V: cannabinoidi
(placebo) < 0.2 % p.s.



Due personaggi fondamentali per il decollo della canapa medica a Rovigo

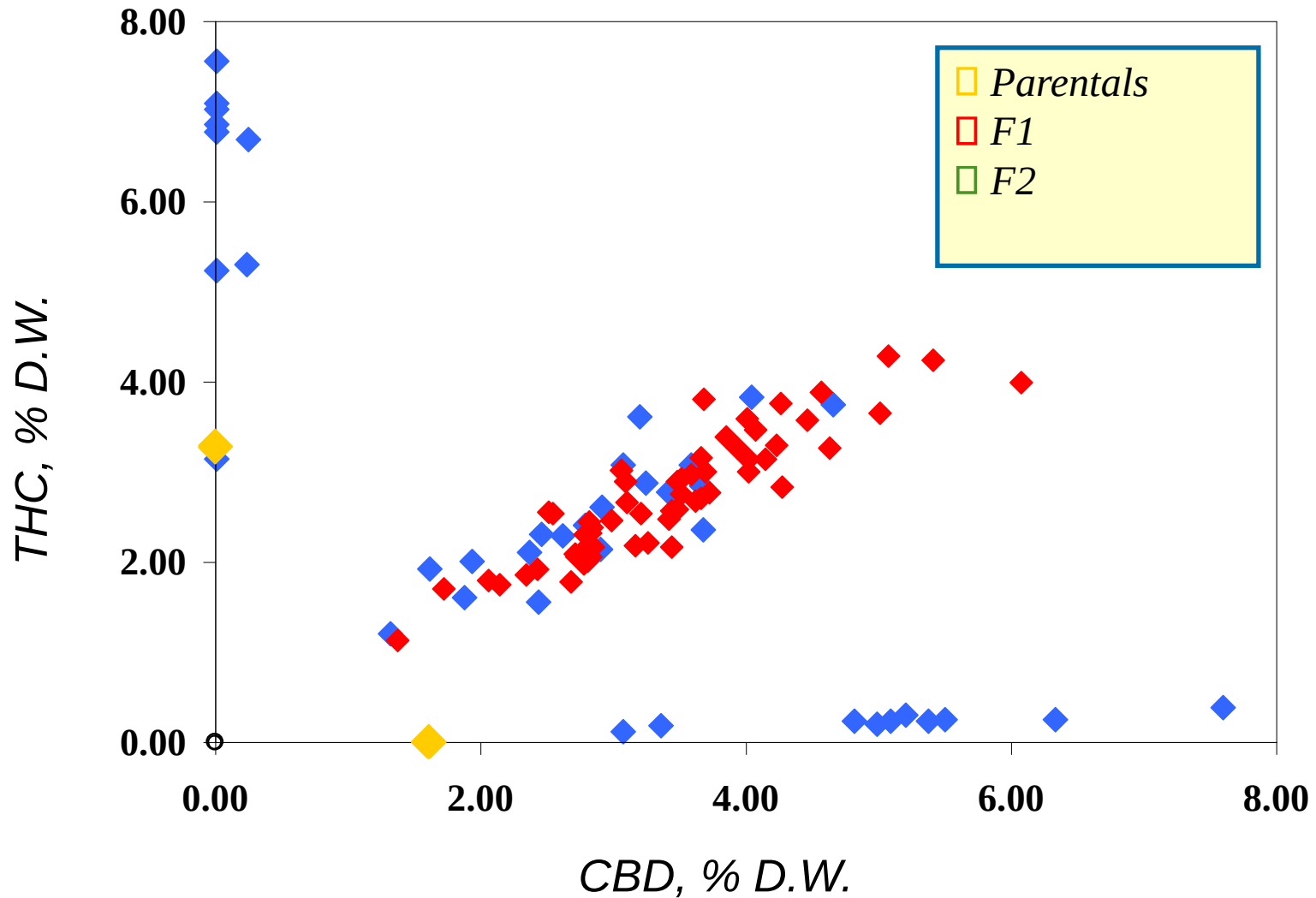
Dr. Etienne P.M. de Meijer

*Esperto di germoplasma e breeder di canapa medica
(HortaPharm B.V., GW Pharmaceuticals plc)*

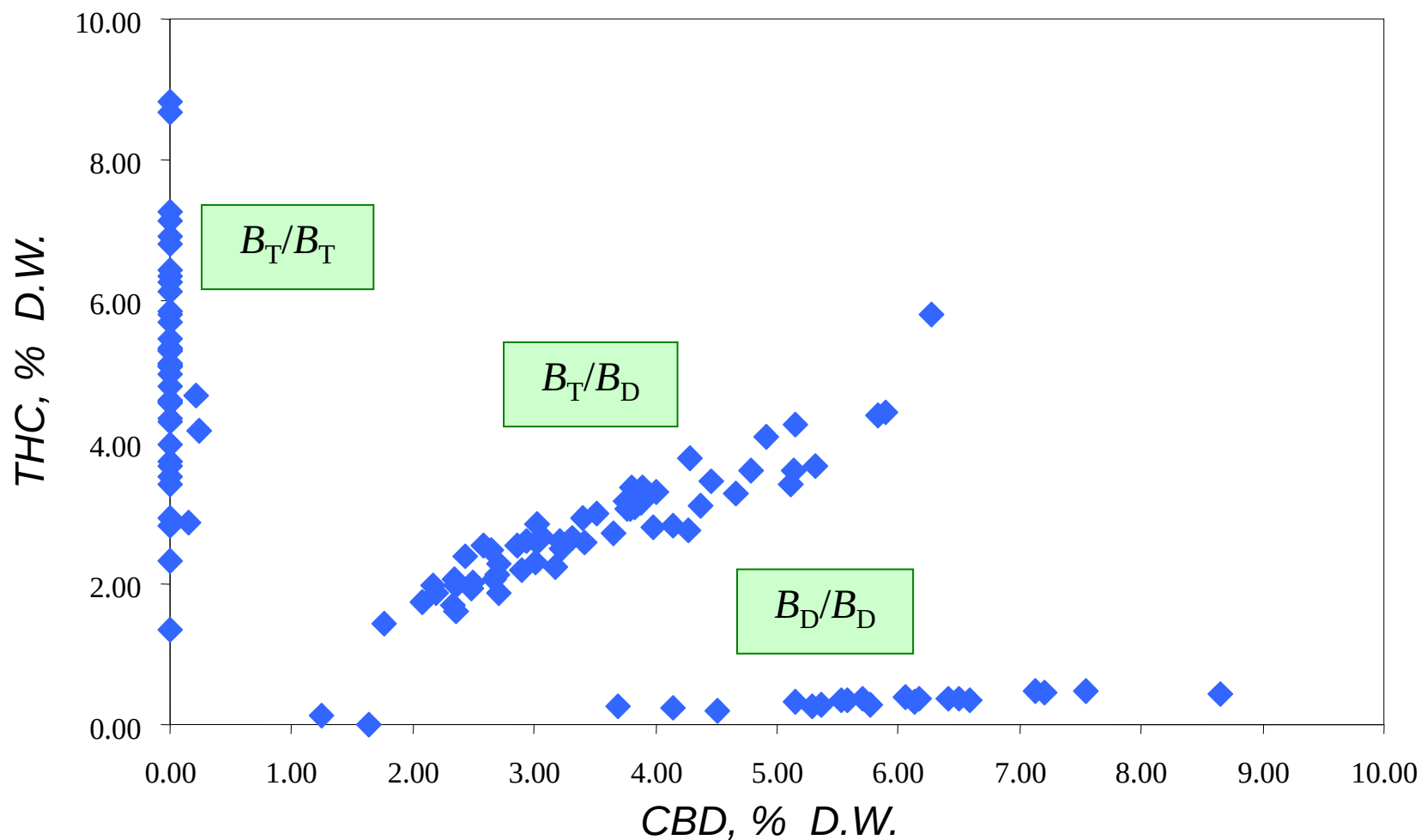


1. Reversione parziale del sesso di piante geneticamente femminili
2. Cicli di autofecondazione e selezione
3. Analisi gas-cromatografica delle progenie inbred ottenute

Segregazione dei chemotipi negli incroci fra linee inbred



Il chemotipo appare completamente determinato da un singolo gene, B , con due alleli codominanti, B_T and B_D



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V. M. Cristiana Moliterni,[†] Paolo Ranalli[†] and Giuseppe Mandolino^{†,2}

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Manuscript received April 23, 2002
Accepted for publication October 16, 2002

ABSTRACT

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Four crosses were made between inbred *Cannabis sativa* plants with pure cannabidiol (CBD) and pure Δ^9 -tetrahydrocannabinol (THC) chemotypes. All the plants belonging to the F_1 's were analyzed by gas chromatography for cannabinoid composition and constantly found to have a mixed CBD-THC chemotype. Ten individual F_1 plants were self-fertilized, and 10 inbred F_2 offspring were collected and analyzed. In all cases, a segregation of the three chemotypes (pure CBD, mixed CBD-THC, and pure THC) fitting a 1:2:1 proportion was observed. The CBD/THC ratio was found to be significantly progeny specific and transmitted from each F_1 to the F_2 's derived from it. A model involving one locus, *B*, with two alleles, B_1 and B_2 , is proposed, with the two alleles being codominant. The mixed chemotypes are interpreted as due to the genotype B_1/B_2 at the *B* locus, while the pure-chemotype plants are due to the codification by the genotype B_1/B_1 or B_2/B_2 . It is suggested that such codominance is due to the codification by the same synthase, having different specificity for the conversion of the same precursor into CBD or THC, respectively. The F_2 segregating groups were screened for the presence of the two alleles by using RAPD primers; three chemotypes were found, corresponding to the three genotypes B_1/B_1 , B_1/B_2 , and B_2/B_2 , respectively. The results suggest that the same genetic mechanism controls the biosynthesis of CBD and THC, and that the same genetic mechanism controls the conversion of the same precursor into CBD or THC, respectively. The results suggest that the same genetic mechanism controls the biosynthesis of CBD and THC, and that the same genetic mechanism controls the conversion of the same precursor into CBD or THC, respectively.



Article

Analysis of Sequence Variability and Transcriptional Profile of *Cannabinoid synthase* Genes in *Cannabis sativa* L. Chemotypes with a Focus on *Cannabichromenic acid synthase*

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Abstract: *Cannabis sativa* L. has been long cultivated for its narcotic potential due to the accumulation of tetrahydrocannabinolic acid (THCA) in female inflorescences, but nowadays its production for fiber, seeds, edible oil and bioactive compounds has spread throughout the world. However, some hemp varieties still accumulate traces of residual THCA close to the 0.20% limit set by the European Union.



Phytochemistry 116 (2015) 57–68

Contents lists available at [ScienceDirect](#)

Phytochemistry

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



Sequence heterogeneity of cannabidiolic- and tetrahydrocannabinolic acid-synthase in *Cannabis sativa* L. and its relationship with chemical phenotype

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ARTICLE INFO

Article history:
Received 2 October 2014
Received in revised form 21 March 2015
Available online 9 April 2015

ABSTRACT

Sequence variants of THCA- and CBDA-synthases were isolated from different *Cannabis sativa* L. strains expressing various wild-type and mutant chemical phenotypes (chemotypes). Expressed and complete sequences were obtained from mature inflorescences. Each strain was shown to have a different specificity and/or ability to convert the precursor CBGA into CBDA and/or THCA-type products. The comparison of the expressed sequences led to the identification of different mutations, all of them due to SNPs. These SNPs were found to relate to the identification of chemical phenotypes at maturity and are therefore proposed to have a functional significance. The amount of inflorescence at maturity is higher within the CBDA sequence family than in the THCA family, suggesting a more recent evolution of THCA-forming enzymes from the CBDA sequence family. We therefore consider CBDA as the ancestral type of these synthases.

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1. Introduction

1.1. Biochemistry of THCA and CBDA

Cannabinoids are terpenophenolic secondary metabolites, produced by all *Cannabis sativa* L. plants in the sessile and stalked tri-

Genetics and marker-assisted selection in *Cannabis sativa* L.

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Received 4 August 2005; accepted in revised form 5 December 2005

Key words: Cannabinoids, Cannabis, Chemotype, Hemp, Markers, MAS

Abstract

Abstract

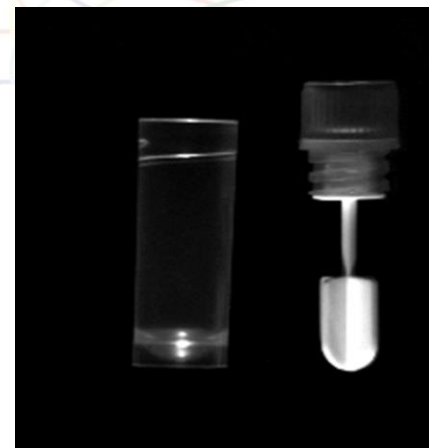
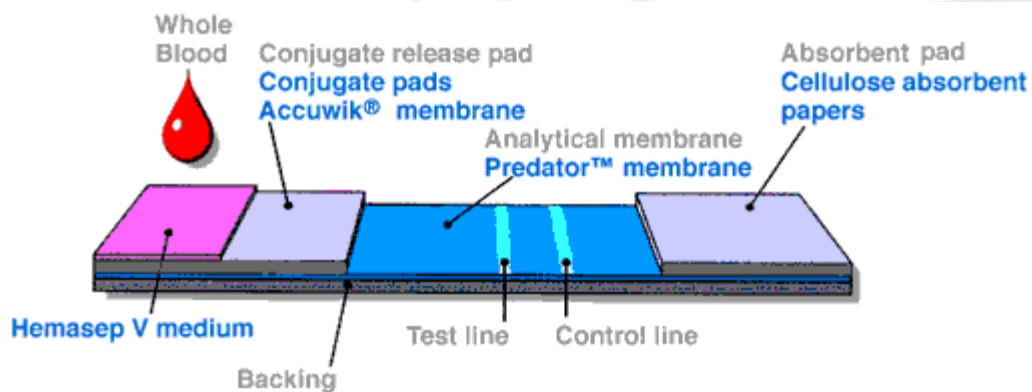
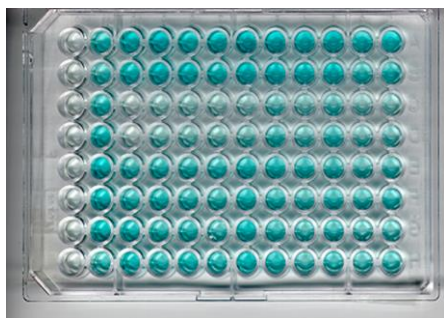
Cannabis sativa is an interesting crop for several industrial uses, but the legislations in Europe and USA require a tight control of cannabinoid type and content for cultivation and subsidies release. Therefore, a cannabinoid survey by gas chromatography of materials under selection is an important step in hemp breeding. In this paper, a number of *Cannabis* accessions were examined for their cannabinoid composition. Their absolute and relative content was examined, and results are discussed in the light of both the effective-breeding. In addition, the legislation's requirements. In addition, the effectiveness of two different types of markers associated to the locus determining the chemotype in *Cannabis* was evaluated and discussed, as possible tools in marker-assisted selection in hemp, but also for possible applications in the forensic and pharmaceutical fields.

limits weeds' presence, and it is also used for bio-

Due personaggi fondamentali per il decollo della canapa medica a Rovigo

Dr. Gianpaolo Grassi

Virologo, esperto di sistemi diagnostici e breeder di canapa medica ed industriale (ex ricercatore CREA)



Alcune varietà di canapa industriale selezionate a Rovigo

CARMA

monoica

NUOVA VARIETÀ DI CANAPA DA FIBRA PER USO INDUSTRIALE DENOMINATA 'CARMA'



CARMALEONTE

monoica

NUOVA VARIETÀ DI CANAPA DA FIBRA PER USO INDUSTRIALE DENOMINATA 'CARMALEONTE'



ERMO

monoica

VARIETÀ MONOICA DI CANAPA DA SEME PRIVA DI THC E CANNABINOIDI PSICOTROPI
'ERMO'

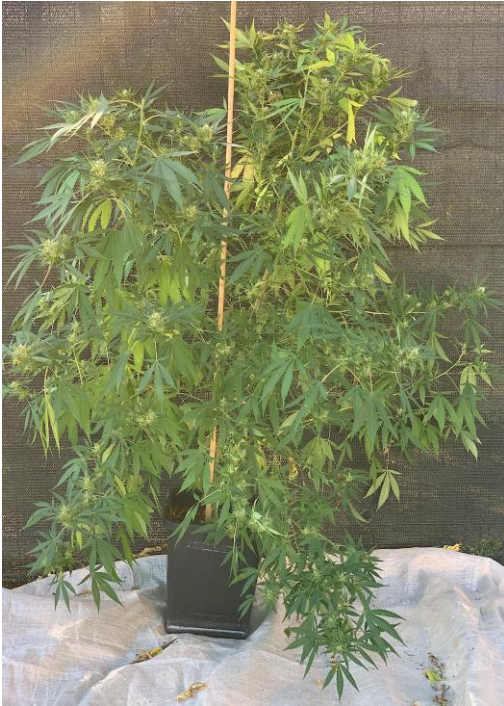


CODIMONO

monoica

Le varietà CREA di cannabis medica

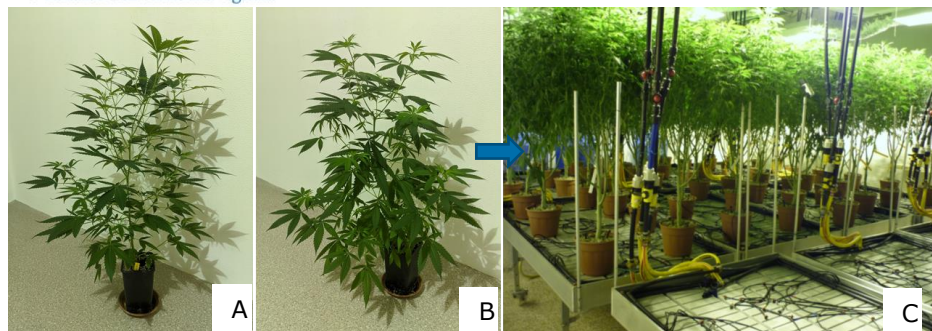
CINBOL (alto THC)



CINRO (alto THC + alto CBD)



Conservazione delle piante madri e produzione di talee

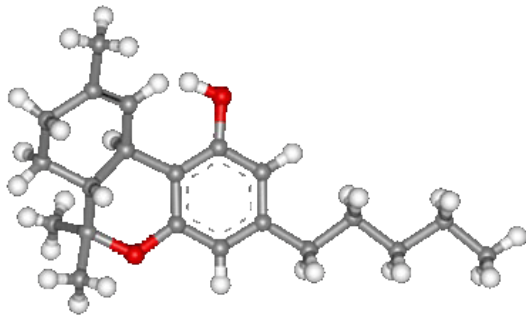


a SCFM



A.CINRO pianta madre "giovane";
B.CINBOL pianta madre "giovane";
C.Mantenimento in purezza delle
piante madri;
D.Talee dalle piante madri;
E.Talee sviluppate;
F. Trasferimento a SCFM;
G.Trapianto;
H.Prodotto farmaceutico FM1.

Il gruppo di ricerca attuale sulla canapa (industriale e medica) al CREA

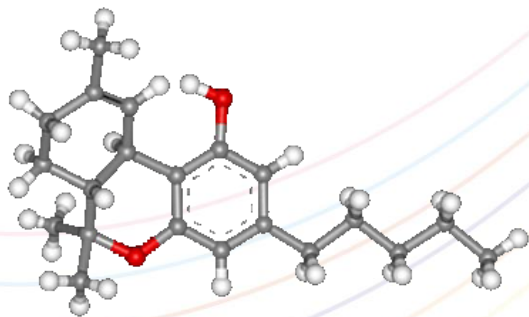


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- Cristina Baldin, CREA-CI Rovigo
- Andrea Villani, CREA CI Rovigo
- Primo Daniele Ghinato, CREA-CI Rovigo
- Massimo Montanari, CREA CI Bologna
- Roberta Paris, CREA CI Bologna
- Flavia Fulvio, CREA CI Bologna
- Samuele Paganelli*, CREA-CI Bologna
- Giuseppe Mandolino, CREA CI Bologna
- Anna Moschella, CREA CI Bologna
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- Laura Righetti, CREA CI Bologna
- Irma Terracciano, CREA CI Bologna
- Simon Troha**, CREA-CI Bologna

• * Studente PhD, UniMORE

• ** Studente Erasmus, Università Lubiana

Personale che ha contribuito allo sviluppo della canapa medica a Rovigo negli anni passati



- Gianpaolo Grassi, ex ricercatore CREA;
- Gianmaria Magagnini, ex tecnico CREA, oggi ad SCFM;
- Lina Faustini, ex tecnico CREA
- Gabriella Paglia, ex tecnico CREA
- Maria Grazia Arduini, ex tecnico CREA

A close-up photograph of a cannabis plant. The image shows several bright green, serrated leaves with prominent veins. In the center, there is a small, developing bud or flower cluster. The background is dark and out of focus, making the plant stand out.

Grazie per
l'attenzione