



## Maize diversity

(Photos by V. Babic, Maize Research Institute, Serbia)



ECP/GR



MAIZE GERMLASM  
BERGAMO - ITALY



CREA-RESEARCH  
CENTRE for CEREAL and  
INDUSTRIAL CROPS

**Carlotta Balconi**  
Email: [carlotta.balconi@crea.gov.it](mailto:carlotta.balconi@crea.gov.it)



# BERGAMO & THE PO VALLEY



**CREA-RESEARCH CENTRE for  
CEREAL and INDUSTRIAL  
CROPS  
Section of BERGAMO**







### MISSION

### MAIZE BREEDING



**STRATEGIES**

**GENETIC**

**BIOCHEMICAL**

**PHYSIOLOGICAL**

**MOLECULAR**

**PHYTOPATHOLOGICAL**

**LOCAL MAIZE  
GENETIC  
RESOURCES  
VALORIZATION**



**Breeding  
Agronomy**



**Pathology  
Entomology**



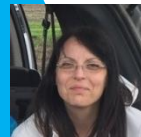
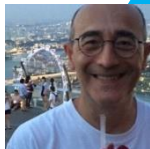
**Chemistry  
Spectroscopy**



**Biochemistry**



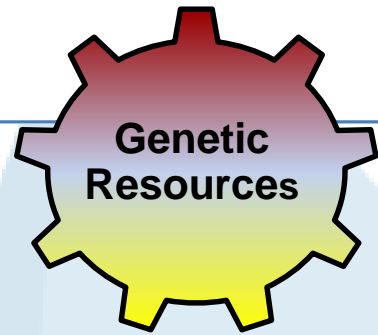
**Molecular  
Biology**



**Genetic  
Resources**







Over 5700 accessions are preserved in cold storage rooms at 7°C



**Maize *ex situ* collection**  
the largest in ITALY



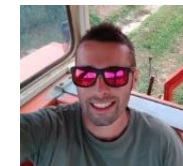
- > 1.200 landraces (500 Italian)
  - > 3.000 inbred lines (600 Italian)
- derivated from breeding programs

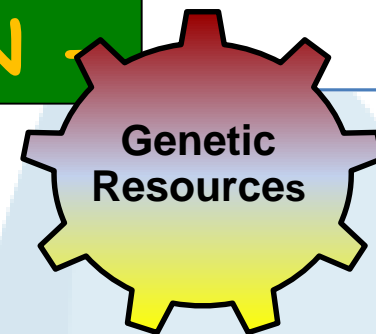


Periodically regenerated in the **FIELD** by nursery (controlled pollination)



## Germplasm Bank Staff





**GERMPLASM COLLECTION**

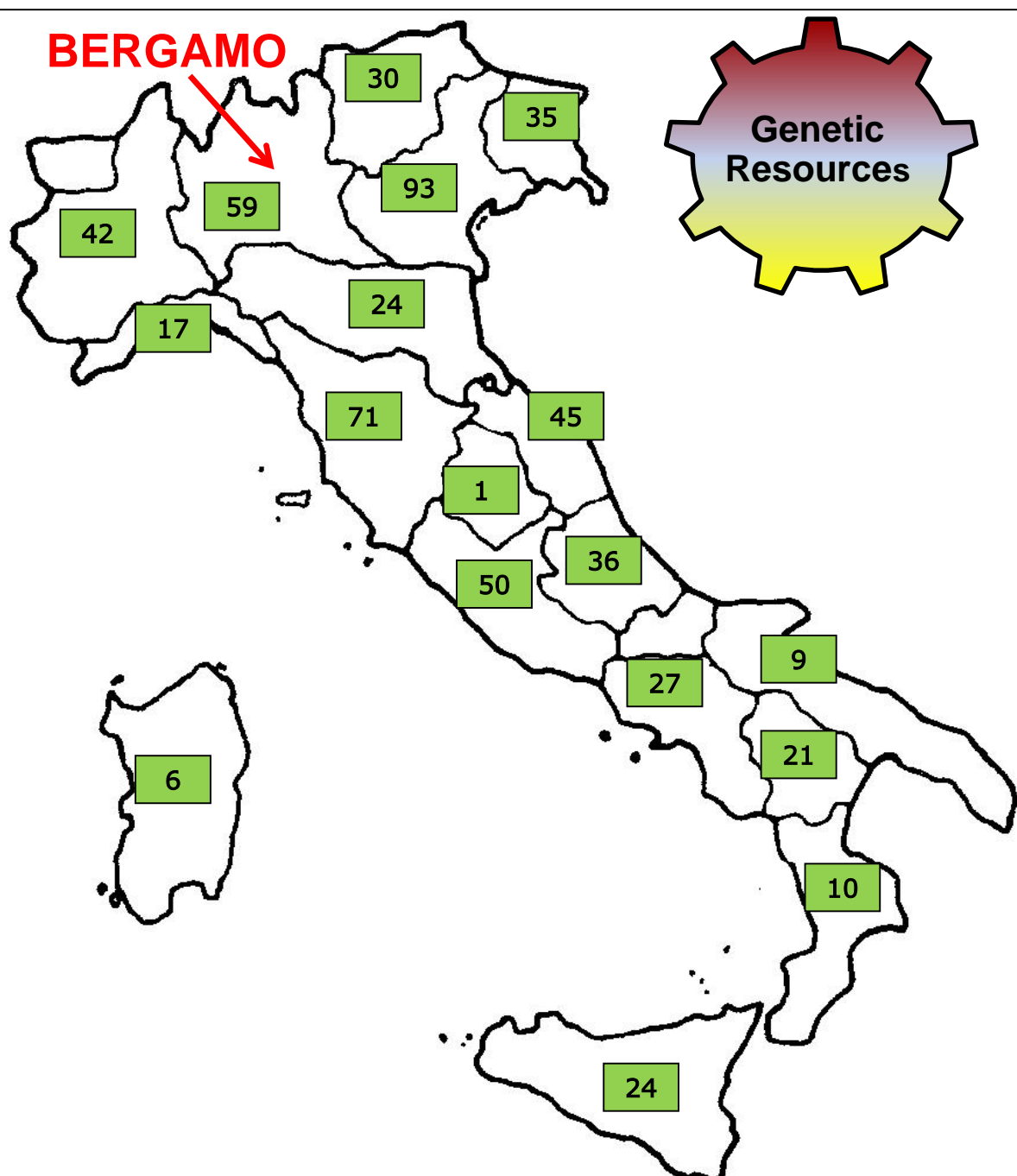
## MAIZE GERMPLASM BANK

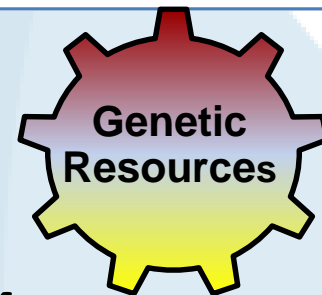
Landraces	1,262
Italian landraces	500
Inbred lines	3,590
Italian inbred lines	600
Synthetics	476
Mutants	426



## CREA - BERGAMO SECTION -

Italian  
Landraces  
collected  
starting by  
1950 at  
Bergamo in the  
Germplasm  
Bank





## MAIZE GERmplasm BANK

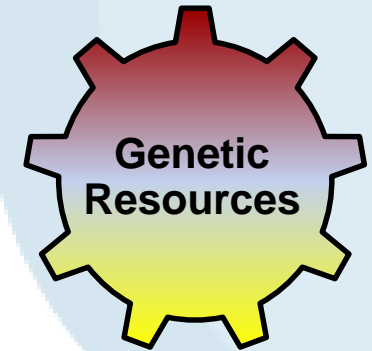
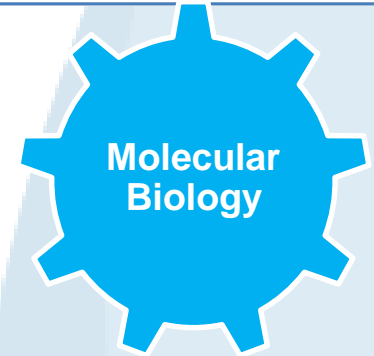


Landraces	1,262
Italian landraces	500
Inbred lines	3,590
Italian inbred lines	600
Synthetics	476
Mutants	426

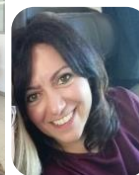


# GENOTYPING ITALIAN MAIZE GERmplASM

- GbS (genotyping by sequencing) of
  - ❖ 400 Italian Inbred lines
  - ❖ 100 derived from American background

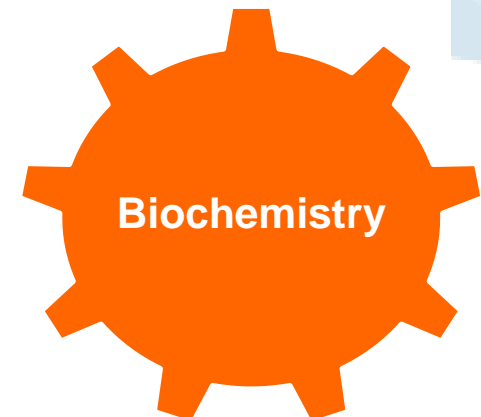
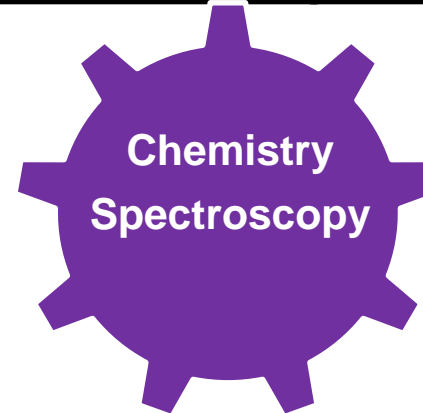
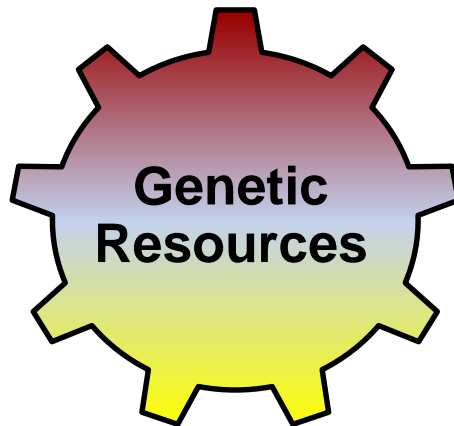


GENOTYPING  
- STAFF



The large number of populations and ecotypes and their genetic variability of grain composition provides interesting material for the identification of genotypes with:

➤ good nutritional value



➤ safety characteristics



*Antioxidants* play an important role in human diet, as they reduce the cellular damages due to oxidative stresses, also helping to prevent the occurrence of degenerative diseases.

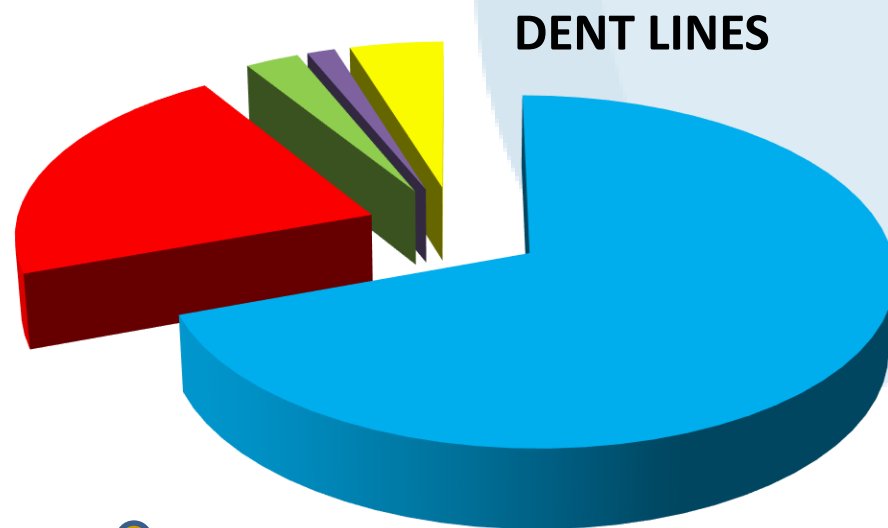
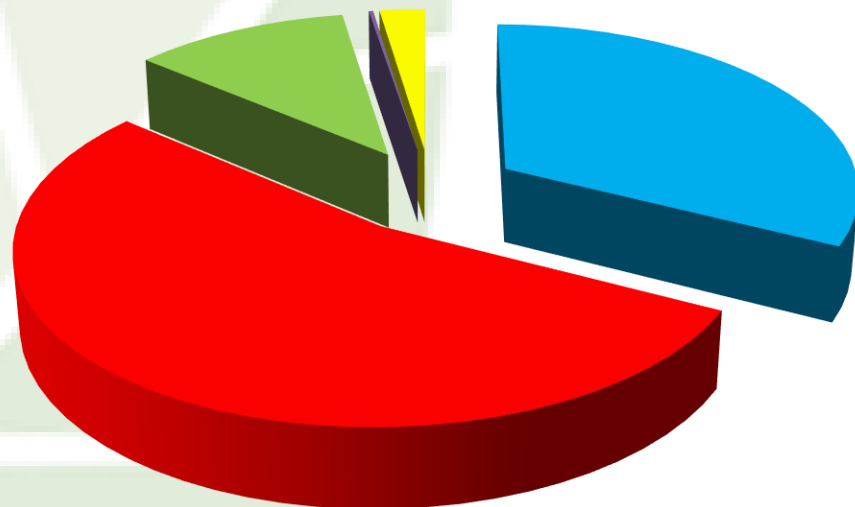
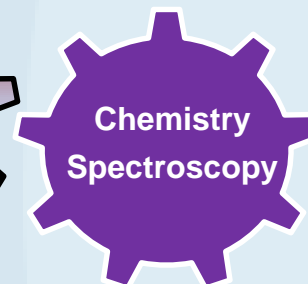
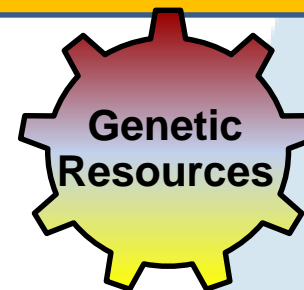
Maize contains many compounds with antioxidant properties, such as:

- ✓ Carotenoids
- ✓ Tocochromanols
- ✓ Phenolics
- ✓ Anthocyanins



## CAROTENOID COMPOSITION IN VITREOUS AND DENT LINES

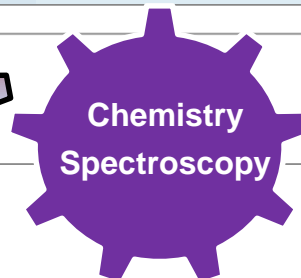
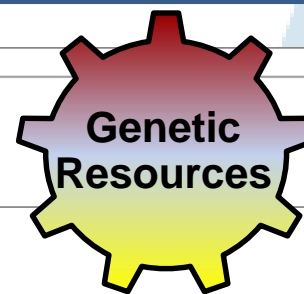
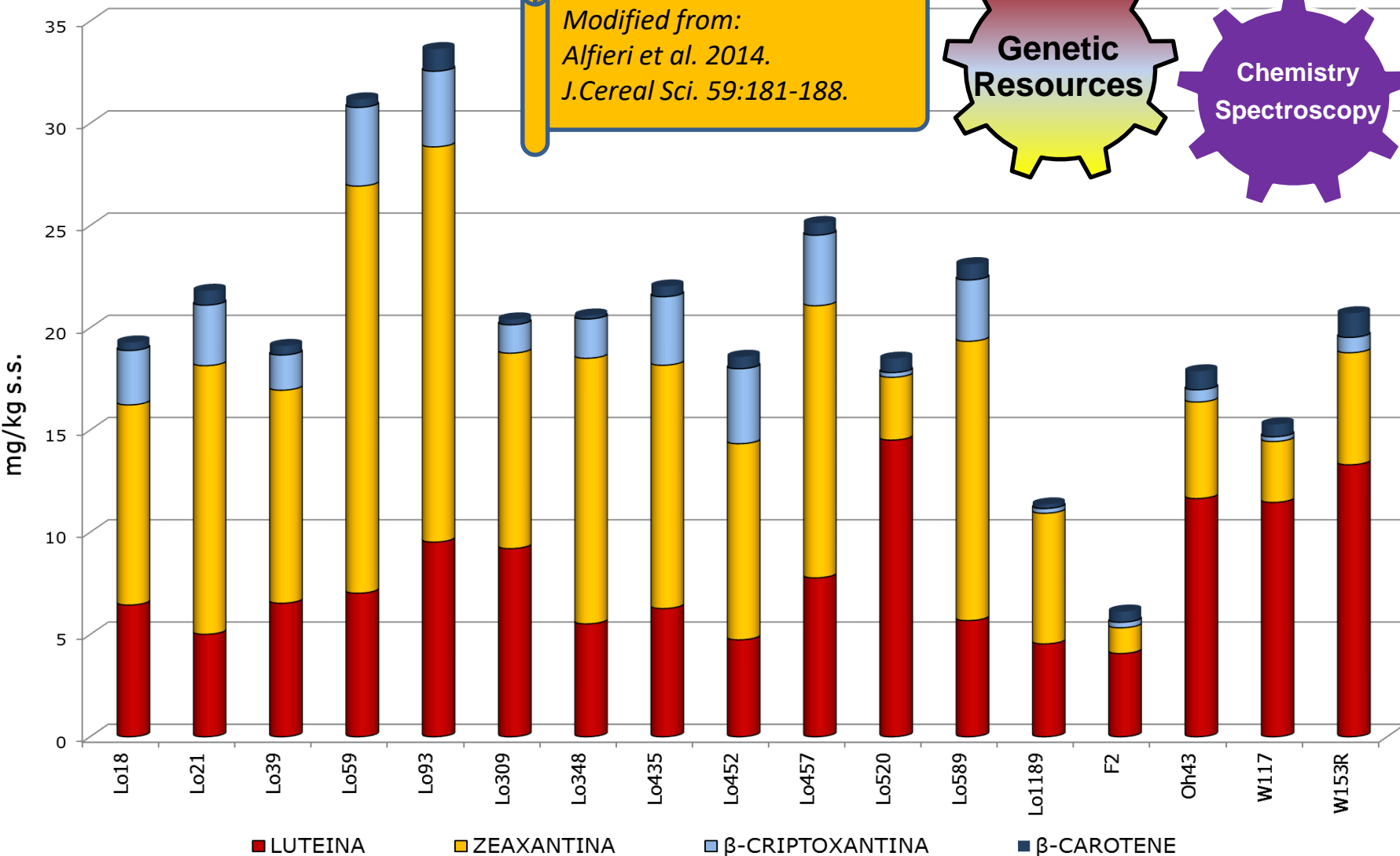
■ LUT ■ ZEA ■  $\beta$ CRY ■  $\alpha$ CAR ■  $\beta$ CAR



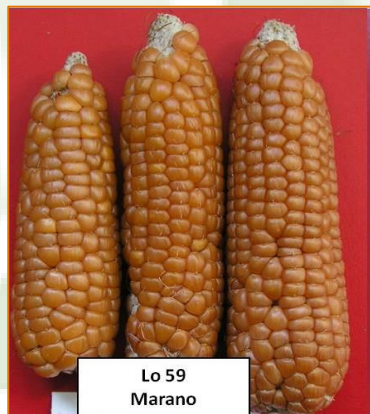
Modified from:  
Alfieri et al. 2014.  
*J.Cereal Sci.* 59:181-188.



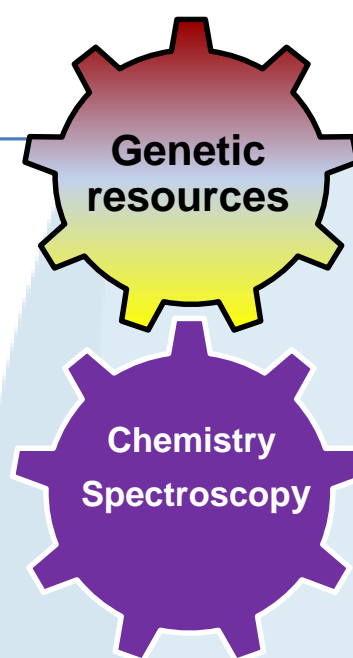
# CONTENT of CAROTENOIDS



# Italian Inbred lines

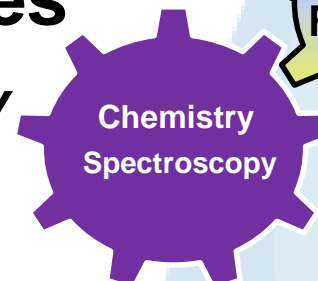
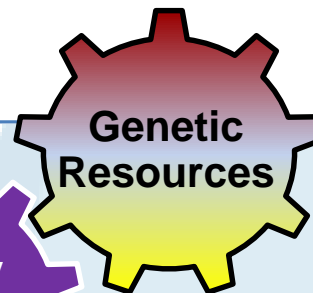


Inbred Lines	Origin	Carotenoids total µg/g s.s.
Lo18	Nostrano dell'Isola	30,99
Lo21	Nostrano dell'Isola	36,66
Lo39	Scagliolo	28,48
Lo59	Marano	50,10
Lo93	Scagliolino	46,91
Lo309	King Ko	31,46
Lo348	Lo5 <sup>2</sup> x Lo23	33,16
Lo 435	Cinquantino bianchi	23,18
Lo452	Lo5 <sup>2</sup> x Lo19	28,49
Lo457	Lo43 x Lo 58	37,69
Lo520	ICAR54	27,08
Lo589	Nostrano dell'Isola	35,60
Lo1189	LA47678xP3245	23,16
	<b>Mean</b>	<b>33,21</b>
	<b>DS</b>	<b>8,9</b>





# Italian Inbred Lines: protein and lipid analyses



## NEAR INFRARED REFLECTANCE SPECTROSCOPY (NIRS)



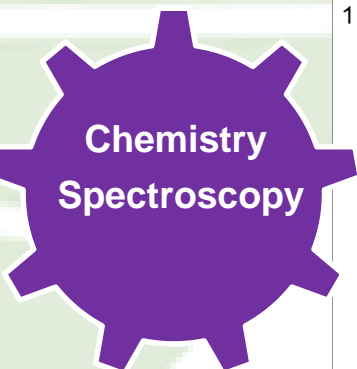
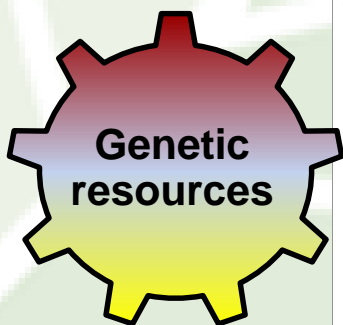
Calibrations developed  
by CREA Bergamo  
(Berardo et al.  
Journal of Agricultural  
and Food  
Chemistry, 2009) .

## Chemical analyses

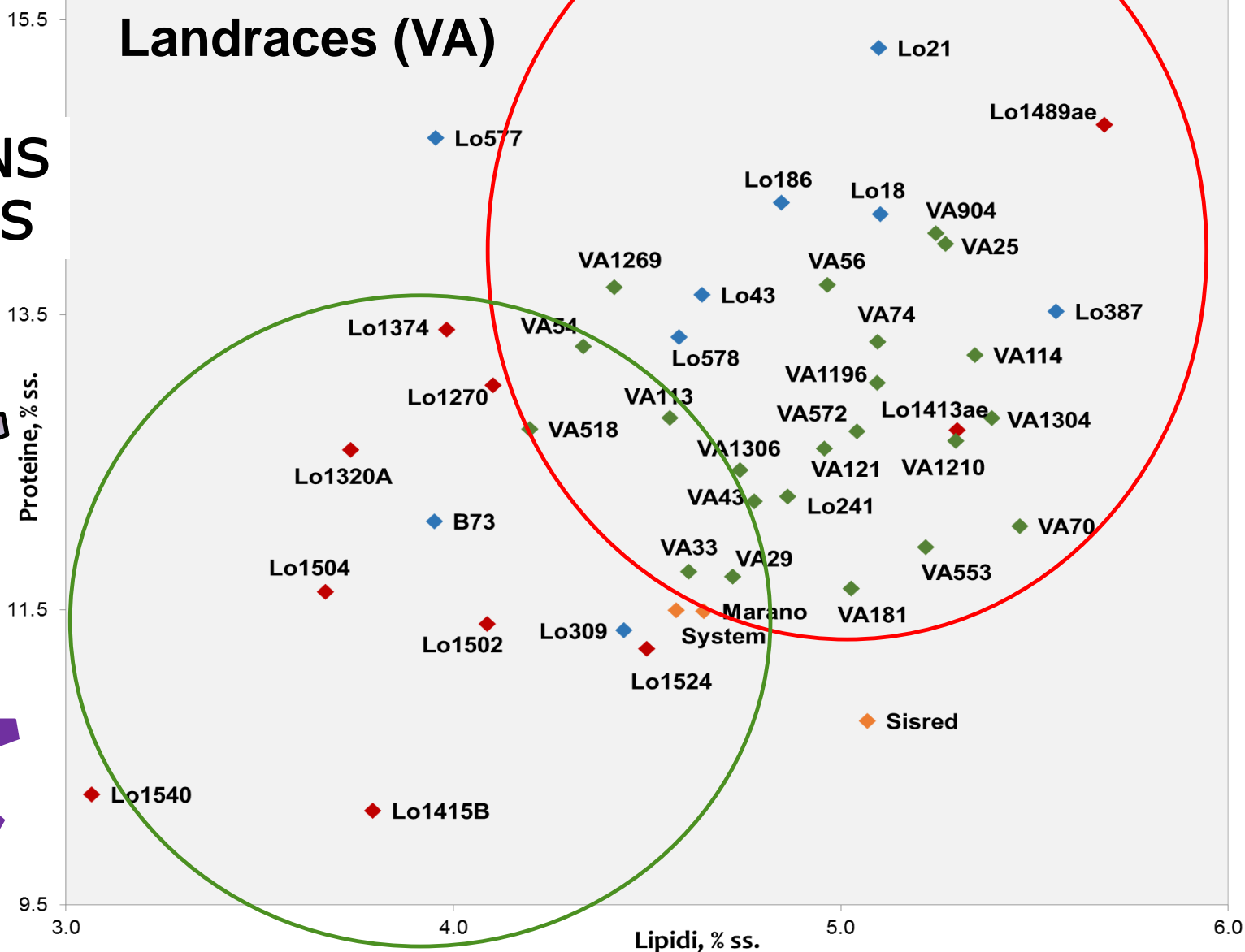
Public Lines	Proteins (% s.s.)	Lipids (% s.s.)
F2	11,52	5,37
Oh43	10,69	4,32
W117	9,99	4,57
W153R	11,20	4,23
Mean ± DS	<b>10,85 ± 0,67</b>	4,62 ± 0,52

Italian Inbred Lines	Proteins (% s.s.)	Lipids (% s.s.)
Lo18	15,57	5,59
Lo21	14,95	5,27
Lo39	13,01	4,89
Lo59	12,98	5,46
Lo93	14,42	4,85
Lo309	11,94	4,53
Lo348	14,39	5,41
Lo435	16,78	6,06
Lo446	16,46	6,19
Lo452	13,10	4,93
Lo457	13,33	5,46
Lo520	10,80	4,97
Lo589	13,38	4,83
Lo1189	10,09	4,00
Mean ± DS	<b>13,66 ± 1,95</b>	5,17 ± 0,58

# PROTEINS & LIPIDS



## Inbred lines (Lo) and Landraces (VA)





Maranello  
Ottofile Maceratese  
Scagliolo di Marne  
Ottofile di Tortona  
Cinquantino Bianco  
Ostenga del Canadese  
Culaccione  
Pignoletto Rosso del Canadese  
Locale Elbano

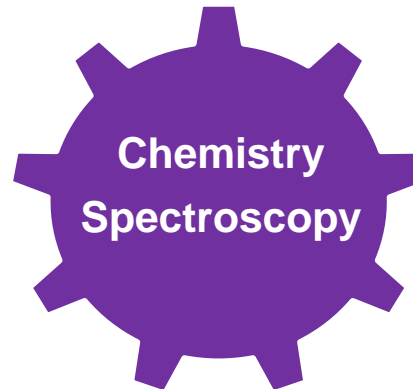
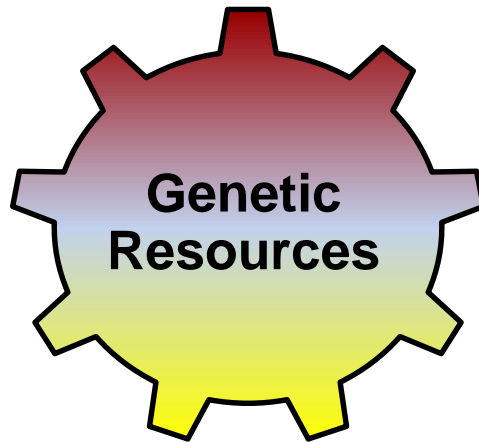
**ITALIAN WHITE  
LANDRACES**





The large number of populations and ecotypes and their genetic variability of grain composition provides interesting material for the identification of genotypes with:

➤ good nutritional value



➤ safety characteristics

# ➤ GENETIC DIVERSITY and PATHOGEN RESISTANCE



- EVALUATION of MAIZE ITALIAN INBRED LINES for RESISTANCE to *Fusarium verticillioides* EAR ROT and to FUMONISIN ACCUMULATION



## MATERIALS and METHODS During TWO FIELD SEASONS

40 maize INBRED LINES



- 34 Italian (CREA BG collection)
- six commercial public

TESTED at CREA-BERGAMO  
in FIELD EXPERIMENTS  
through *F. verticillioides*

ARTIFICIAL INOCULATION



*Ostrinia nubilalis*  
(ECB-European Corn Borer)

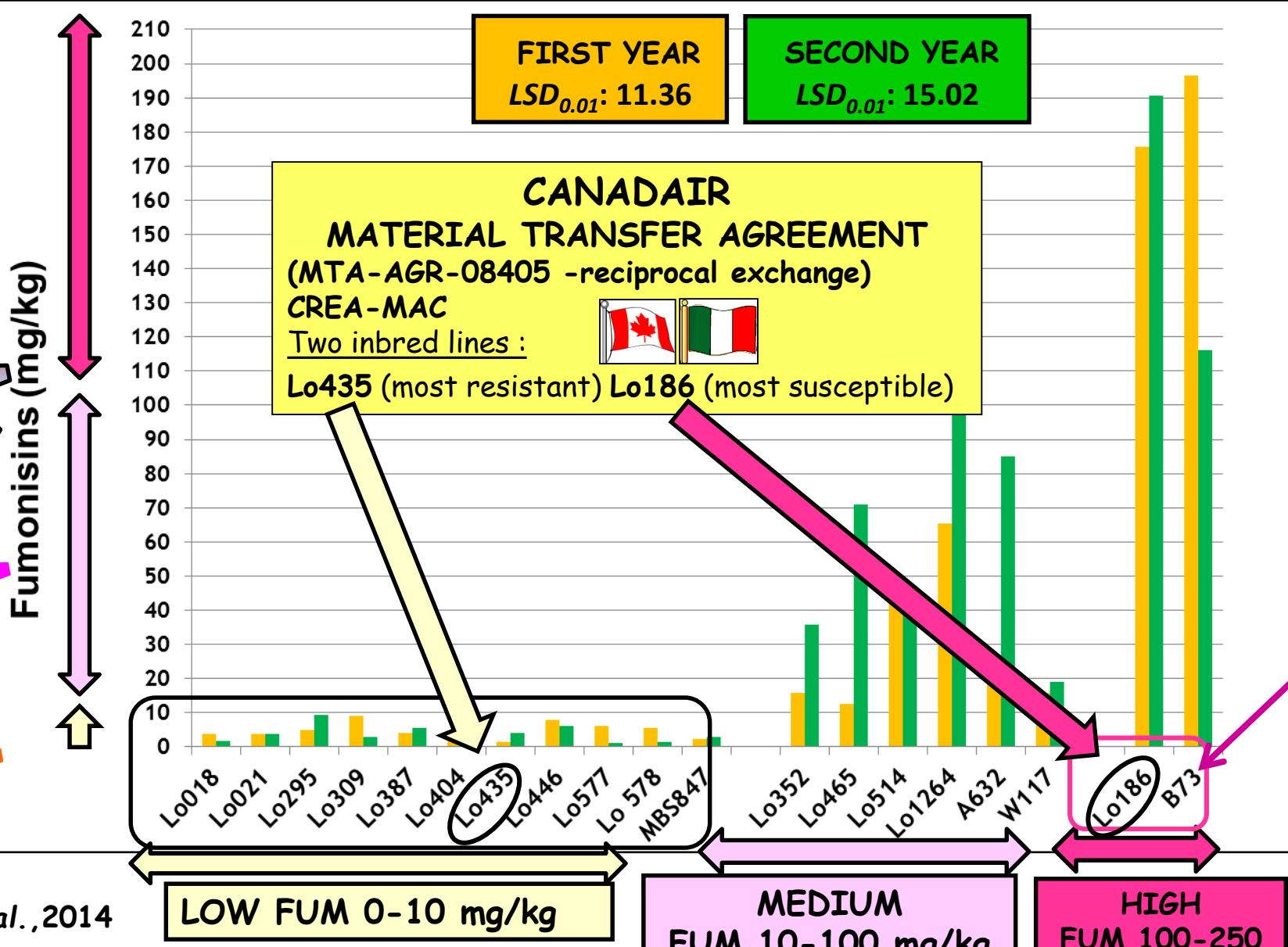
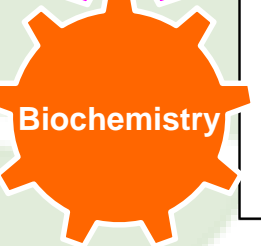
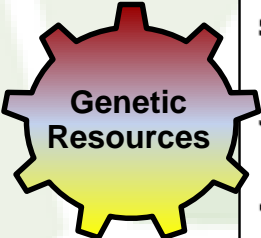


Kernel Inoculation Assay  
15-20 Days after mid-silking

MIX *F. verticillioides* strains  
supplied by Prof. Battilani,  
UNIV. PC -ITALY

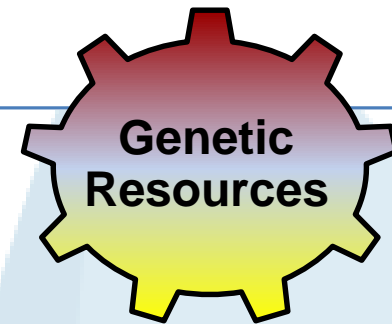


*Fusarium verticillioides*



Balconi et al., 2014





mipaaf  
Ministero delle  
politiche agricole  
alimentari e forestali



**Rete Semi Rurali**  
participatory breeding  
(2016-2021)

- Since 2004 up to 2022 CREA-CI is involved in the Project “Plant Genetic Resources” (RGV-FAO), funded by the Italian Ministry of Agriculture, Food, Forestry with specific focus to preservation, characterisation and valorisation of traditional maize germplasm.

- We started a **Germplasm Maize Collection valorization program with Boliva and Mexico of the, taking advantage from Expo 2015 in Milan**

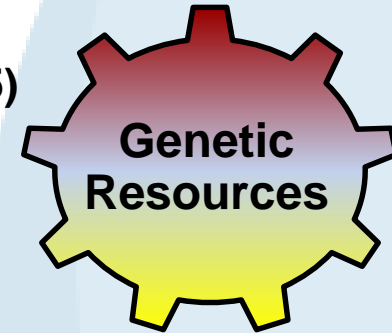


- Meetings and open days at Bergamo in the frame of "Maize Expo Bergamo" network.

- **P.G.S.O. Km 0 Bolivia. Progetto (2018-2021).** Germplasm valorization, P.G.S.O. Km 0 Bolivia **AICS International Agency Cooperation and Development**



- **N. 1 LOAN FORM – PRESTITO MUSEALE BIODIVERSITY PARK (2015)**
- **N. 1 PROTOCOL COLLABORATION with Consorzio Agrario del NORDEST (2018-2021)**
- **N. 18 Standard Material Transfer Agreements (international)**
- **N. 50 Material Transfer Agreements (national)**



## Recent Projects and Proposals(2015-2021)

**BERGAMO EXPERIENCE- 2015** – “Regione Lombardia (BURL 5 dicembre 2014 Decreto n. 11527 del 3/12/2014 – BURL n.28 del 10 luglio 2015 con D.G.r. n.X/3766/

**Big Pinic - HORIZON 2020 (2016-2018)** Task 1.3 (Orto Botanico Bergamo) Food Security Advisory Groups (FSAG)

**AttivAREE Progetto Fondazione Cariplo (2017-2019)**. Titolo Progetto: “Oltrepò Biodiverso” Titolo della ricerca: “Creazione in Oltrepò della filiera del mais ottofile pavese, varietà tradizionale locale recuperata”,

**P.G.S.O. Km 0 Bolivia. Progetto: AICS-Agenzia Italiana per la Cooperazione allo sviluppo (2018-2021)**. Germplasm valorization, P.G.S.O. Km 0 Bolivia. (2018-2021) (AICS International Agency Cooperation and Development). Prot. CREA N. 9429 del 28.02.2018)

**MIRALO (APPROVED, to be FUNDED) (2010-2022)** : Progetti di Ricerca Agricola e Forestale, Regione Lombardia «Analisi di linee di Mais per lo sviluppo di Ibridi con efficiente apparato radicale da utilizzare nell'areale lombardo»

**GEMMA (APPROVED, to be FUNDED) (2010-2022)** : Progetti di Ricerca Agricola e Forestale, Regione Lombardia

**VALOMAYS** – Varietà locali di mais: caratterizzazione per la reintroduzione nel territorio lombardo (in preparation, Bando PSR Lombardia, Mis. 10, sottomisura 10.2, operazione 10.2.01- Conservazione della biodiversità)



## MAIZE GERMPLASM BERGAMO - ITALY



We are really interested

- to highlight Italian maize genetic resources valorization in Europe
- to support initiatives of ECGPR Maize Working Group
- to share experiences and materials between researchers working with maize genetic resources



**THANK YOU  
FOR YOUR  
ATTENTION!!!**

