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SUSTAINABLE OPTIONS for QUALITY MAIZE

Carlotta Balconi

MAIZE RESEARCH UNIT
Unità di Ricerca per la Maiscoltura
BERGAMO
ITALY

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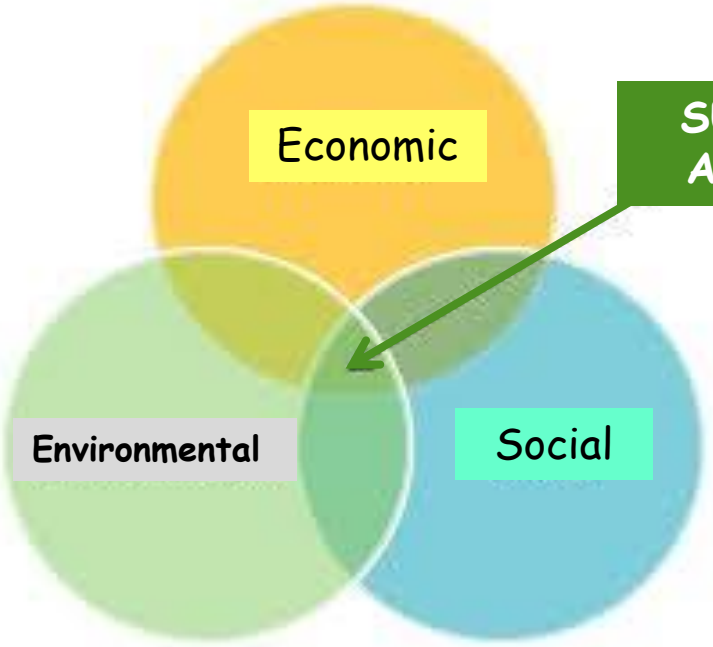
KEYWORS

SUSTAINABLE OPTIONS for QUALITY MAIZE

SUSTAINABLE

QUALITY MAIZE

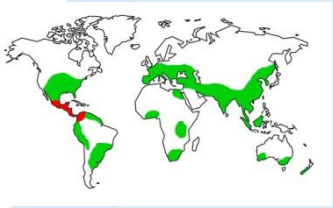


SUSTAINABLE AGRICULTURE

- ✓ QUALITY PROTEIN MAIZE (nutritional)
- ✓ HIGH NITROGEN USE EFFICIENCY
- ✓ LOW SUSCEPTIBILITY to ABIOTIC and BIOTIC FACTORS

SUSTAINABLE OPTIONS for QUALITY MAIZE

- OUTLINE



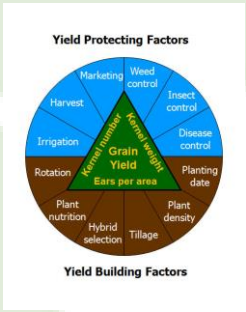
- MAIZE: a WORLDWIDE CEREAL CROP

- MAIZE: ANNUAL CROP

- MAIZE: CHALLENGES for SUSTAINABLE PRODUCTION

- MAIZE ABIOTIC STRESSES
  - LOSS of SOIL FERTILITY

- MAIZE BIOTIC STRESSES
  - MYCOTOXIGENIC FUNGAL CONTAMINATION

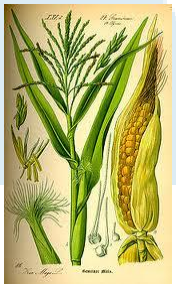


- CONCLUSIONS and PERSPECTIVES

➢ MAIZE: a WORLDWIDE CEREAL CROP

Origin area

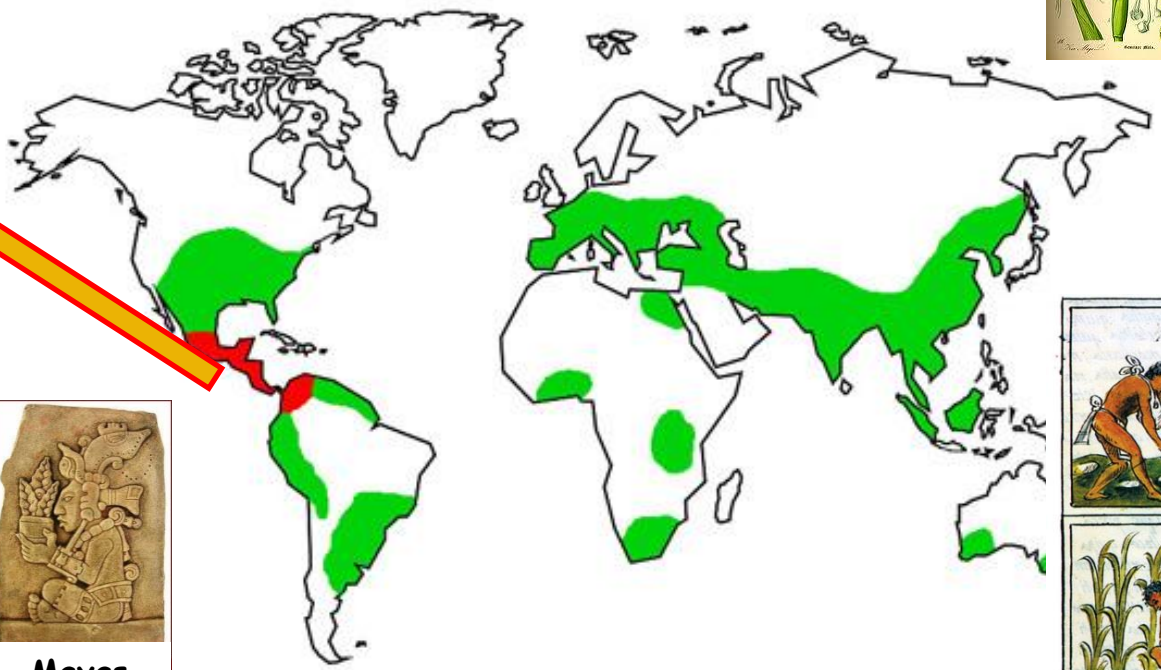
Cultivation areas (180 million hectares/year)
Production (980 million tonnes/year)



MEXICO

ARCHAEOLOGICAL MAIZE SURVEYS:
- POLLEN: 80.000 years ago
- COBS: 7.000 years ago

MAIZE DOMESTICATION:
- around 7.000 years ago



MESOAMERICAN AGRICULTURE

Mayas

MITHOS of MAIZE

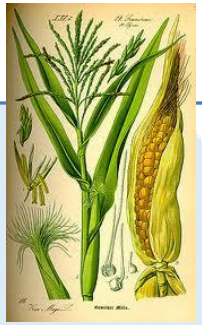
GOD of MAIZE

Aztecs

MAIZE FERTILITY GODDESS

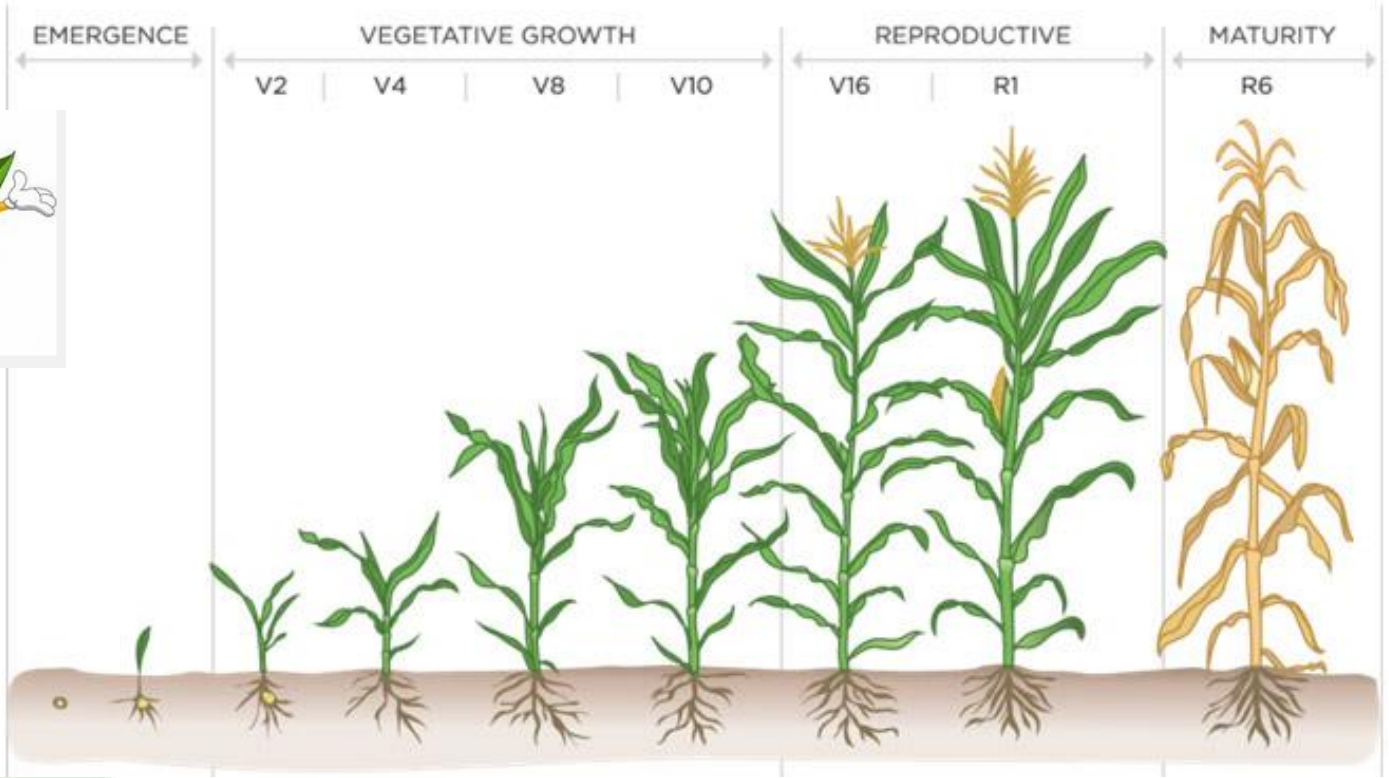
MAIZE CULTIVATION by AZTEC FARMERS

➢ MAIZE: ANNUAL CROP



EUROPE

MARCH → **SEPTEMBER**



Emergence

Establishment (0) 15-25 days

Vegetative (1) 25-40 days

Tassel

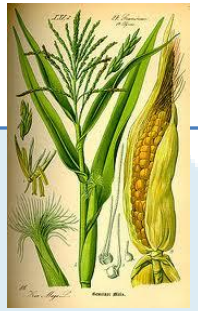
Silk

Flowering (2) 15-20 days

Yield Formation (3) 35-45 days

Ripening (4) 10-15 days

➢ MAIZE: CHALLENGES for SUSTAINABLE PRODUCTION



➢ ENVIRONMENTAL CONSTRAINTS

➢ ABIOTIC STRESSES

➢ GLOBAL CLIMATE CHANGE

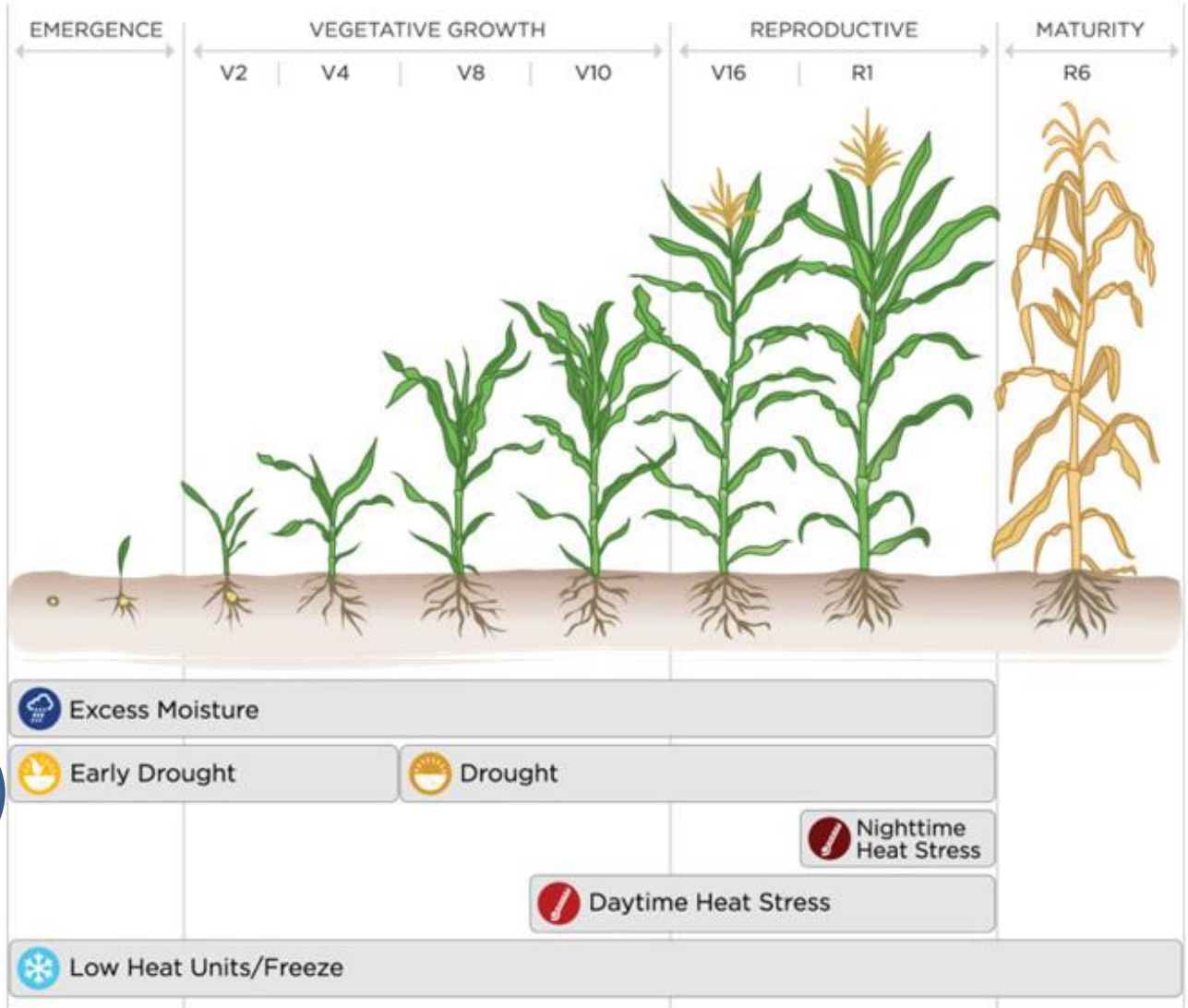
➢ PESTS and PATHOGENS

➢ LOSS of GENETIC DIVERSITY

➢ ENVIRONMENTAL CONSTRAINTS

➢ MAIZE ABIOTIC STRESSES

- ➢ MOISTURE
- ➢ DROUGHT
- ➢ HEAT STRESS
- ➢ GLOBAL CLIMATE CHANGE



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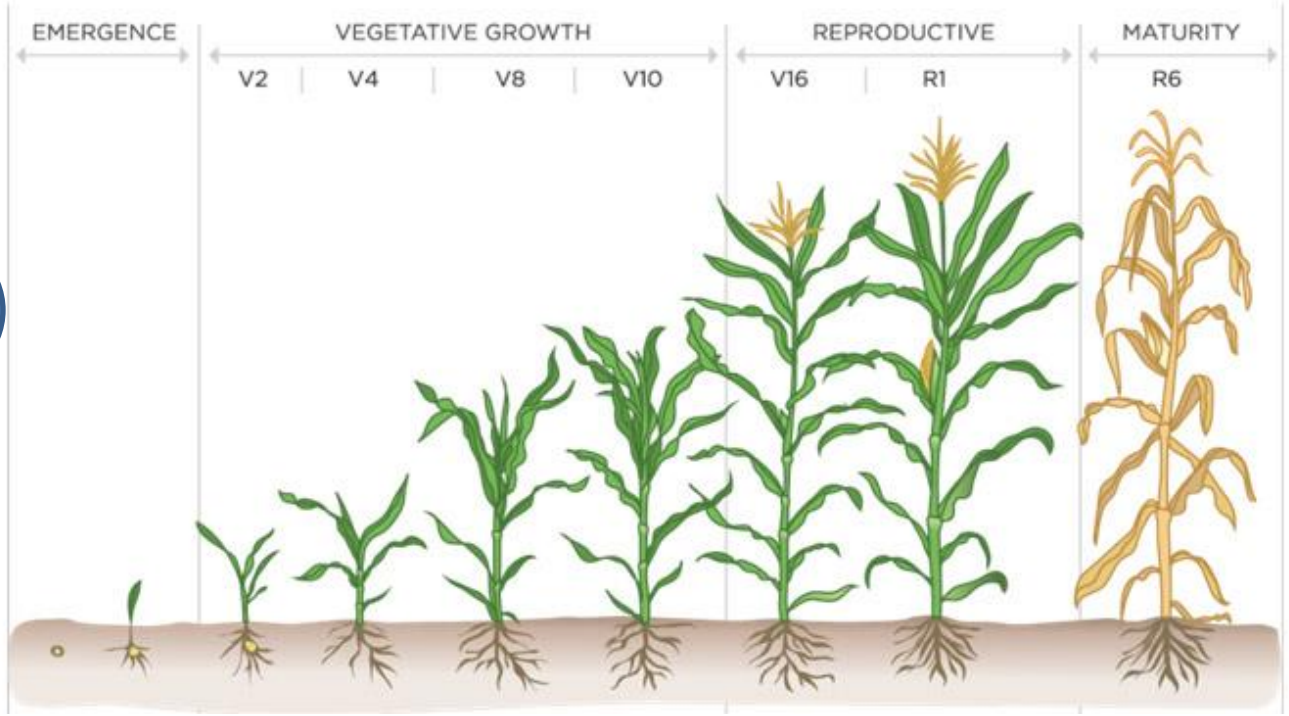
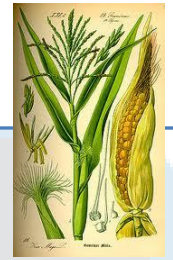
- ENVIRONMENTAL CONSTRAINTS
- MAIZE ABIOTIC STRESSES

- GLOBAL CLIMATE CHANGE
- SALT STRESS

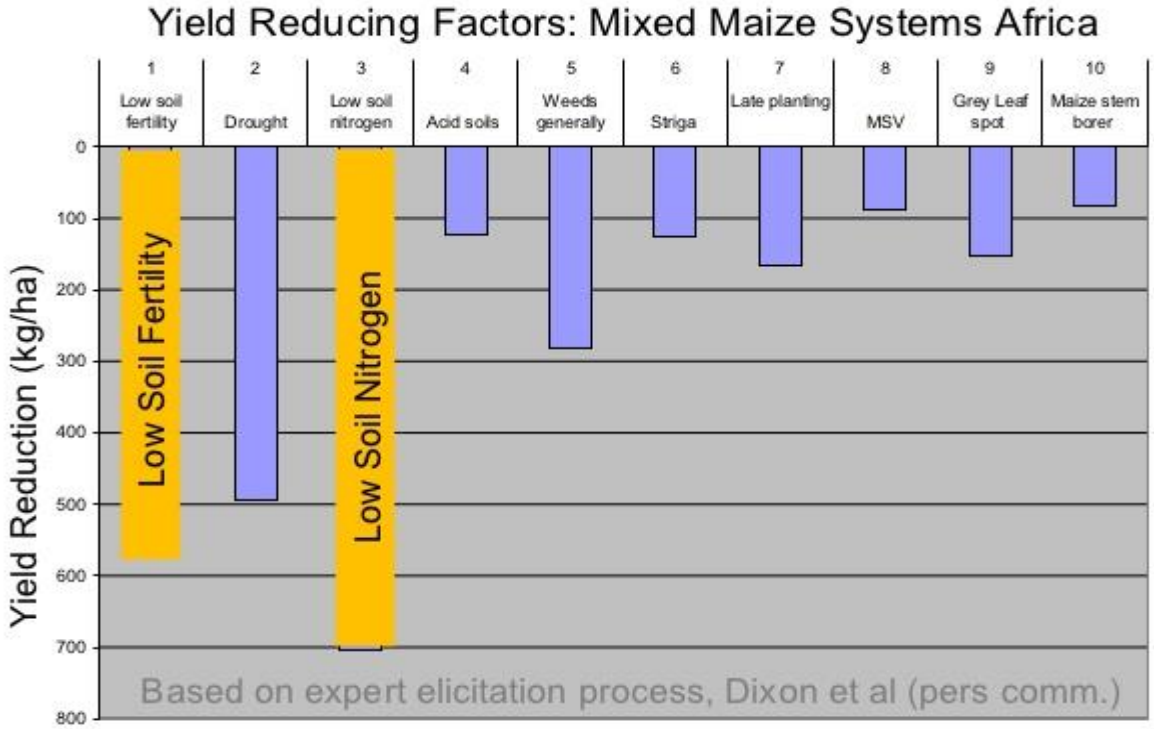


- ENVIRONMENTAL POLLUTANTS (heavy metals, pesticides, fertilizers, petroleum products, chemicals)
- LOSS of SOIL FERTILITY

➢ MAIZE: CHALLENGES for SUSTAINABLE PRODUCTION



Yield Reducing Factors



➢ LOSS of SOIL FERTILITY

➢ SOIL FERTILITY REPLENISHMENT

MAIZE CHALLENGES for SUSTAINABLE PRODUCTION

➢ LOSS of SOIL FERTILITY

➢ SOIL FERTILITY REPLENISHMENT

➢ FERTILIZER TREE SYSTEMS
- N-FIXING PLANTS:
- ✓ *Faidherbia albida*
- ✓ *Sesbania sesban*
- ✓ *Cajanus cajan*
- ✓ *Glicirida sepium*

➢ BENEFITS:

Fertiliser trees for sustainable food security in the maize-based production systems of East and Southern Africa. A review

Festus K. AKINNIFESI[1]*, O.C. AJAYI[1], G. SILESHI[1], P.W. CHIRWA[2], Jonas CHIANU[3]

Africa Regional Programme, PO Box 30798, Lilongwe, Malawi
University, South Africa
RAF), UN Avenue, Gigiri, PO Box 30677, Nairobi Kenya

(Accepted 3 December 2009)

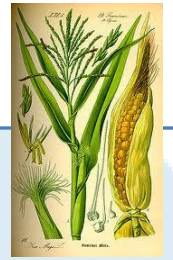
➢ IMPROVEMENT in CROP YIELD

➢IMPROVEMENT in SOIL PHYSICAL and CHEMICAL PROPERTIES

➢ REDUCTION in WEED PROBLEMS

➢ REDUCTION in SOIL INSECTS

➢ MAIZE: CHALLENGES for SUSTAINABLE PRODUCTION



➢ LOSS of SOIL FERTILITY

➢ SOIL FERTILITY REPLENISHMENT

➢ FERTILIZER TREE SYSTEMS

Agron. Sustain. Dev. 30 (2010) 615–629
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www.agronomy-journal.org

Review article

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[2] Pretoria University, South Africa
[3] CIAT, c/o World Agroforestry Centre (ICRAF), UN Avenue, Gigiri, PO Box 30677, Nairobi Kenya

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➢ MAXIMIZING USE of MAIZE STOVER (MAIZE CROP RESIDUE)

Field Crops Research 153 (2013) 12–21

Contents lists available at ScienceDirect

Field Crops Research

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

Maize stover use and sustainable crop production in mixed crop–livestock systems in Mexico

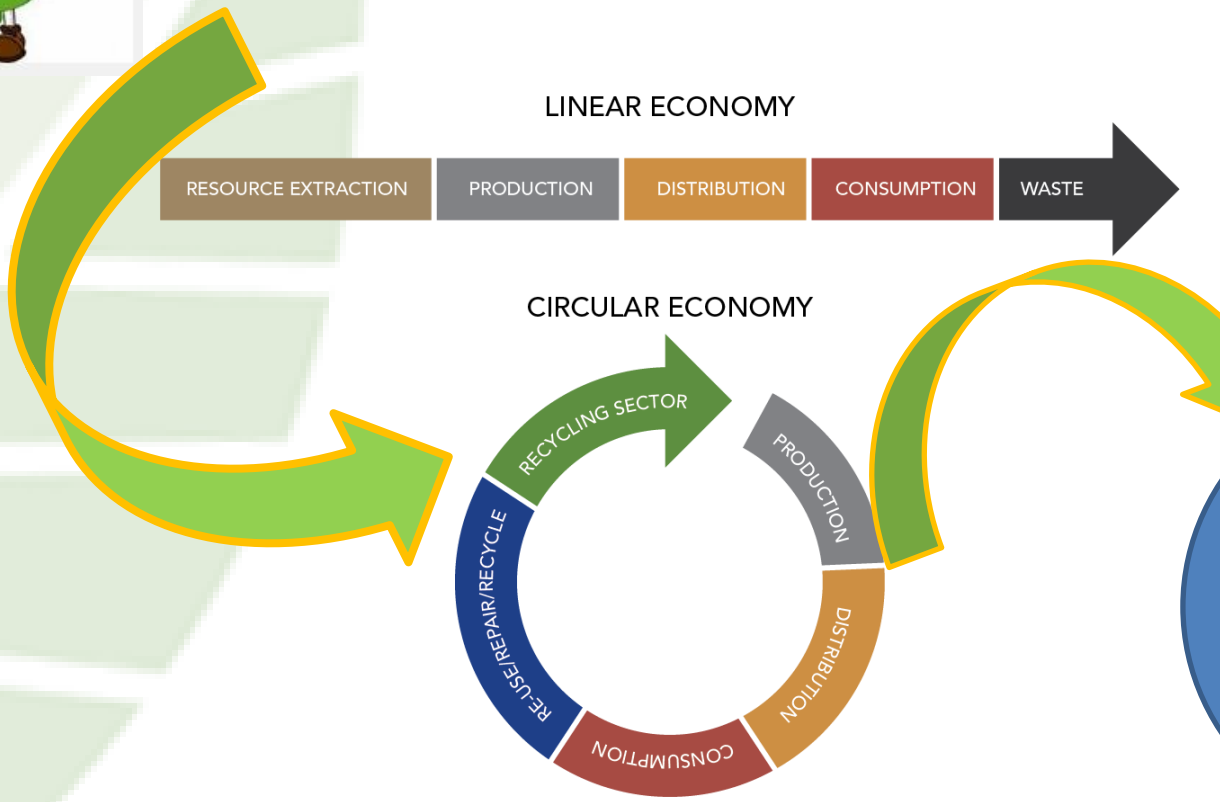
Jon Hellin[a,*], Olaf Erenstein[b], Tina Beuchelt[a], Carolina Camacho[a], Dagoberto Flores[a]

[a] International Maize and Wheat Improvement Center (CIMMYT), Apartado Postal 6-641, 066000 Mexico, D.F., Mexico
[b] International Maize and Wheat Improvement Center (CIMMYT), c/o ILRI, P.O. Box 5689, Addis Ababa, Ethiopia

➢ MAIZE: CHALLENGES for SUSTAINABLE PRODUCTION

➢ SOIL FERTILITY REPLENISHMENT

➢ MAXIMIZING USE of MAIZE STOVER (MAIZE CROP RESIDUE)



CLOSED LOOP SYSTEM to DECREASE MAIZE FERTILIZER USAGE

➢ MAXIMIZING USE of MAIZE CROP RESIDUE

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MAIZE CULTIVATION

CHEMICAL FERTILIZERS

LINEAR ECONOMY

RESOURCE EXTRACTION → PRODUCTION → DISTRIBUTION → CONSUMPTION → WASTE

GRAIN (food/feed)

STOVER (trash)

CIRCULAR ECONOMY

MAIZE CULTIVATION

HARVESTING

GRAIN (food/feed)

DIGESTATE as FERTILIZER

STOVER

Anaerobic digestion

BioCH4

➢ MAIZE: CHALLENGES for SUSTAINABLE PRODUCTION

➢ MAXIMIZING USE of MAIZE STOVER (MAIZE CROP RESIDUE)

CIRCULAR ECONOMY

CLOSED LOOP SYSTEM to DECREASE MAIZE FERTILIZER USAGE

➢ PRECISION FARMING: Producing more with less

1. Precision Soil preparation
2. Precision Seeding
3. Precision Crop Management
4. Precision Harvesting
5. Precision Livestock Farming

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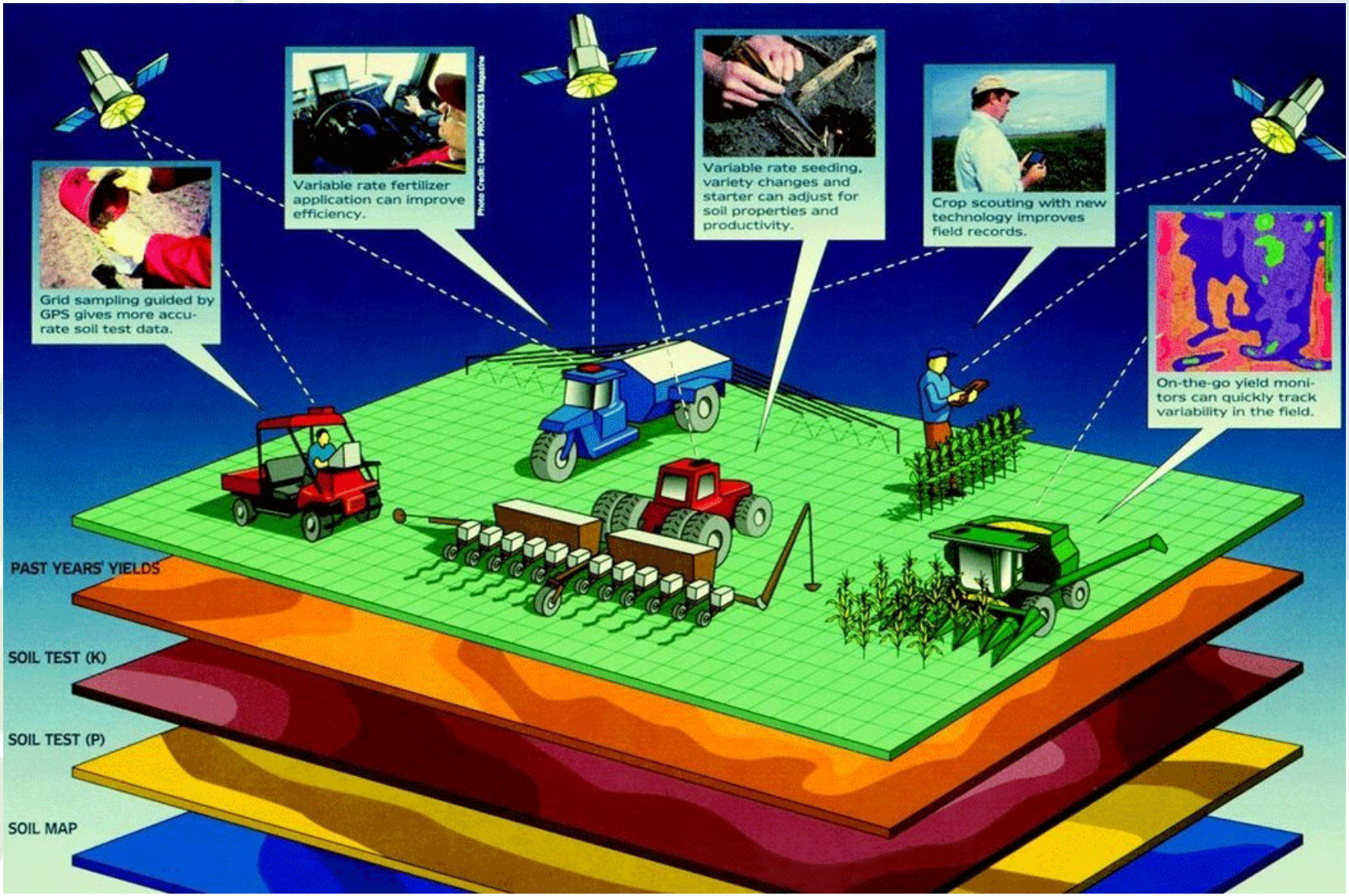
➢MAIZE PRECISION FARMING: Producing more with less



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➢ MAIZE: CHALLENGES for SUSTAINABLE PRODUCTION

➢ PRECISION FARMING: Producing more with less

Published June 23, 2014

Journal of Environmental Quality
TECHNICAL REPORTS
WASTE MANAGEMENT

Life Cycle Assessment of Fertilization of Corn and Corn–Soybean Rotations with Swine Manure and Synthetic Fertilizer in Iowa

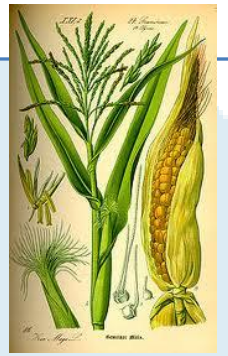
Evan Michael Griffing, Richard Lynn Schauer, and Charles W. Rice*

Published November, 2011
Agronomy Journal • Volume 103, Issue 6 • 2011

Sensor-Based Nitrogen Applications Out-Performed Producer-Chosen Rates for Corn in On-Farm Demonstrations

Peter C. Scharf,* D. Kent Shannon, Harlan L. Palm, Kenneth A. Sudduth, Scott T. Drummond, Newell R. Kitchen, Larry J. Mueller, Victoria C. Hubbard, and Luciane F. Oliveira

➢ MAIZE: CHALLENGES for SUSTAINABLE PRODUCTION



➢ ENVIRONMENTAL CONSTRAINTS

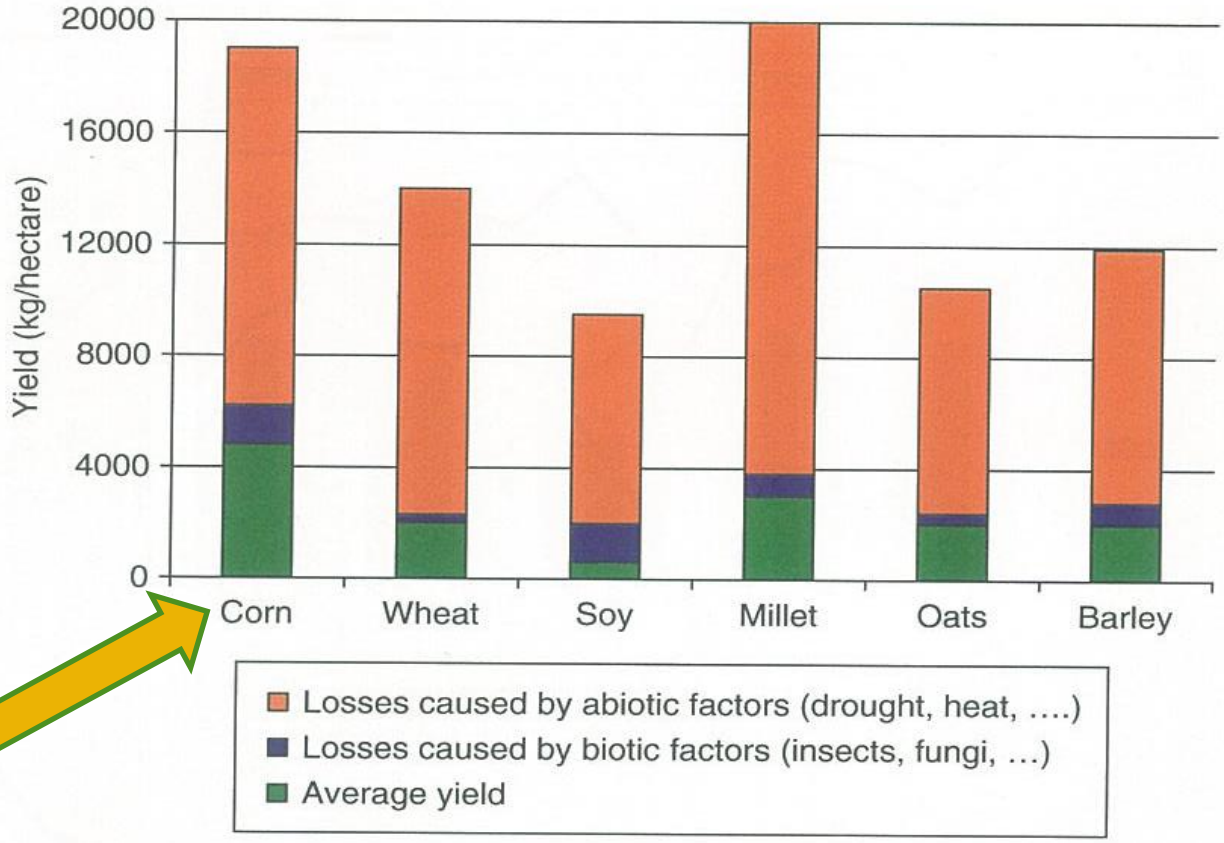
➢ GLOBAL CLIMATE CHANGE

➢ ABIOTIC STRESSES

➢ BIOTIC STRESSES

➢ PESTS and PATHOGENS

➢CROP LOSSES DUE to ABIOTIC and BIOTIC FACTORS



Modified from Ashraf et al.,2012

➢ MAIZE BIOTIC STRESSES

➢ PESTS

Diabrotica virgifera

Thrips

ADULT STAGE

Ostrinia nubilalis- European corn borer

Agriotes

Diabrotica virgifera

LARVAL STAGE

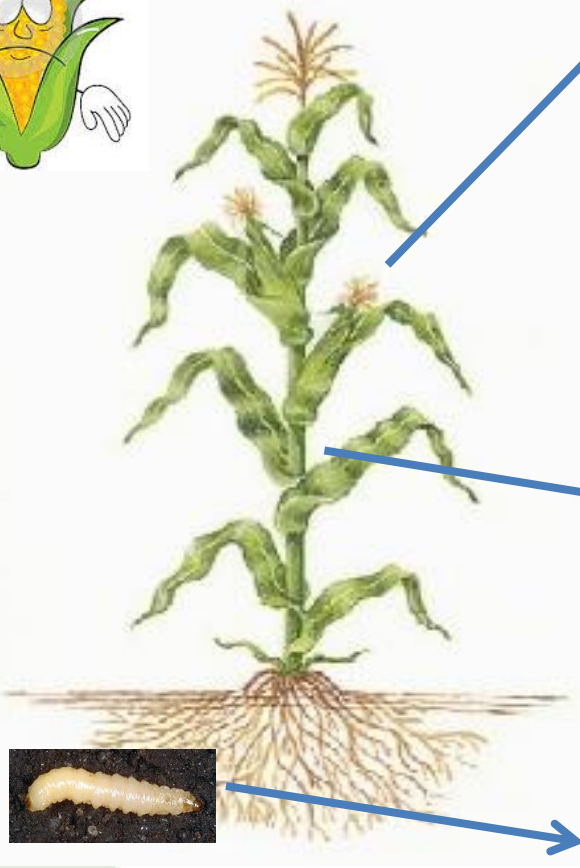
➢ MAIZE BIOTIC STRESSES

Diabrotica virgifera

SILK CLIPPING

➢ YIELD LOSS

LEAF DAMAGE



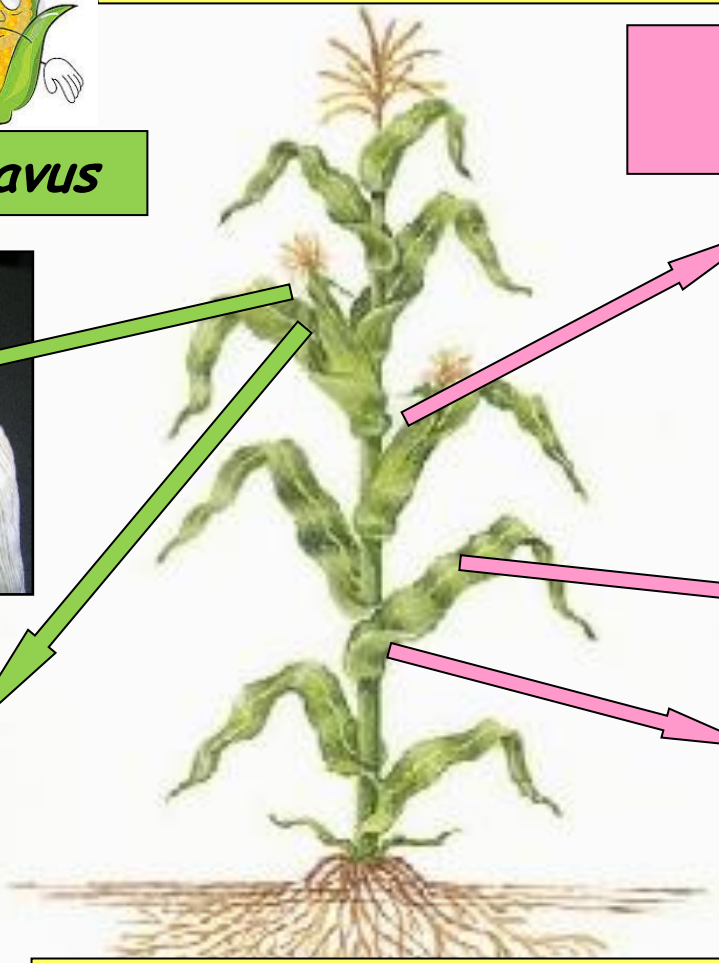
ROOT DAMAGE

➢ MAIZE: BIOTIC STRESSES

➢ MYCOTOXIGENIC FUNGAL PATHOGENS

Aspergillus flavus

Fusarium verticillioides
Fusarium graminearum



➢ YIELD LOSS and QUALITY REDUCTION

➢ MAIZE: CHALLENGES for SUSTAINABLE PRODUCTION

➢ENVIRONMENTAL CONSTRAINTS

➢GLOBAL CLIMATE CHANGE

➢ PESTS and PATHOGENS

➢LOSS of GENETIC DIVERSITY

➢ GENETIC DIVERSITY and PATHOGEN RESISTANCE

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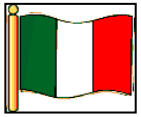
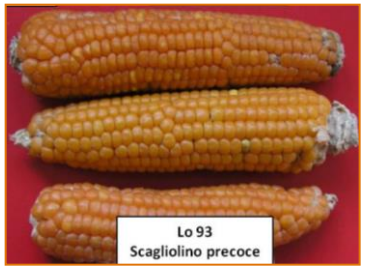
– MAIZE RESEARCH UNIT –



MAIZE GERMPLASM COLLECTION
contains over 5000 accessions

- INBRED LINES
- LOCAL POPULATIONS
- SYNTHETIC POPULATIONS
- PUBLIC LINES
- GENETIC STOCKS



➢ GENETIC DIVERSITY and PATHOGEN RESISTANCE

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

Ostrinia nubilalis
(ECB-European Corn Borer)

MATERIALS and METHODS

During **2009** **2010**

40 maize INBRED LINES

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

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

ARTIFICIAL INOCULATION

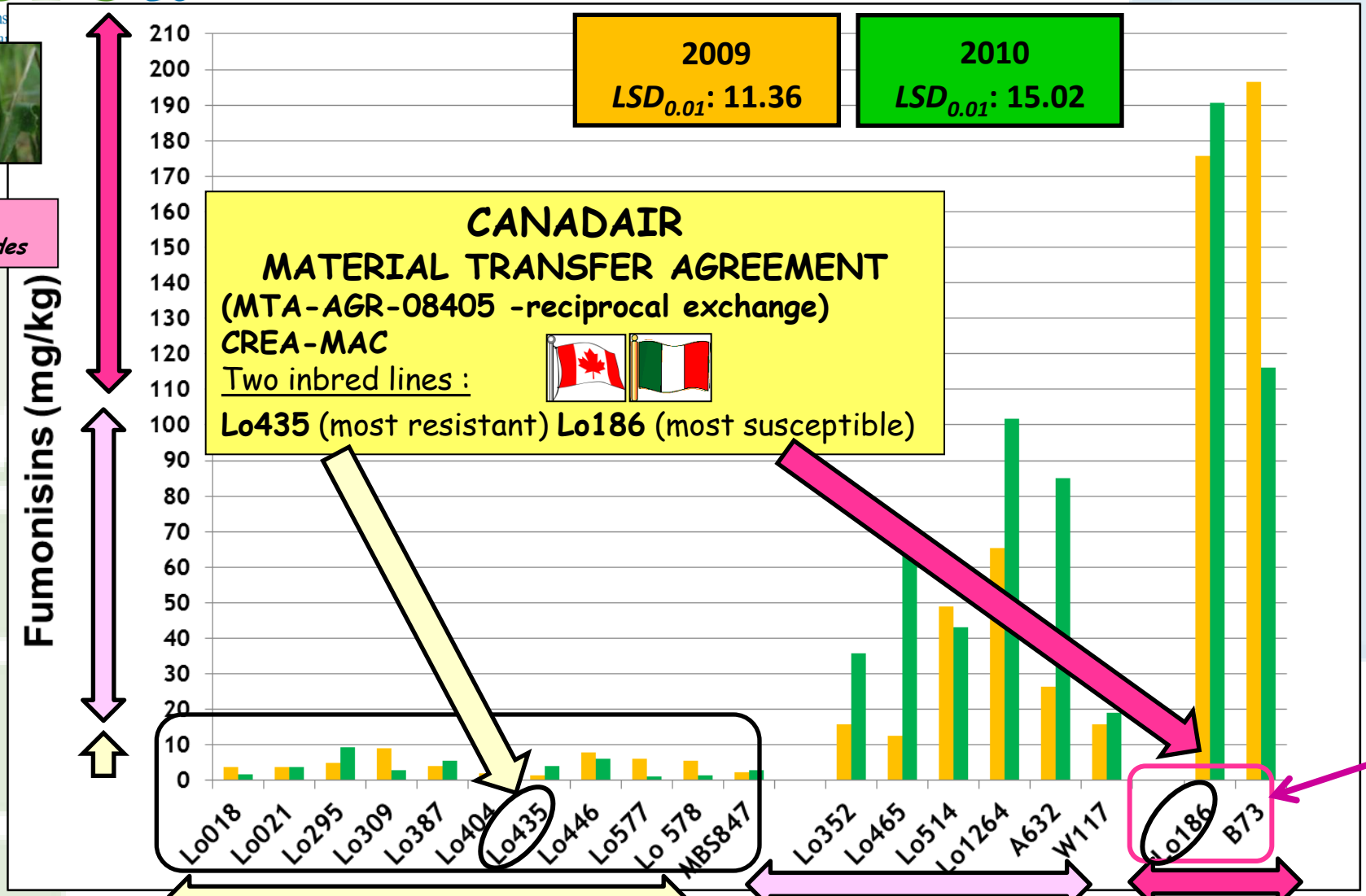
Kernel Inoculation Assay
15-20 Days after mid-silking

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

➢ GENETIC DIVERSITY

CREA-MAC

Fusarium verticillioides



Balconi *et al.*,2014

➢ MAIZE GENETIC DIVERSITY and PATHOGEN RESISTANCE

AAFC-ECORC
AGRICULTURE and AGRI-FOOD CANADA
Eastern Cereal and Oilseed Research Centre, -Ottawa-

CANADA
MAIZE

ITALY
MAIZE

CREA-MAC
- Unità di Ricerca per la Maiscoltura – MAIZE RESEARCH UNIT
-Bergamo-

Fusarium graminearum

Fusarium verticillioides

➢ RESEARCH FOCUS
IDENTIFICATION of GENETIC MATERIALS with RESISTANCE to BOTH PATHOGENS

MATERIAL TRANSFER AGREEMENT

Twinning CANADAIR Project-

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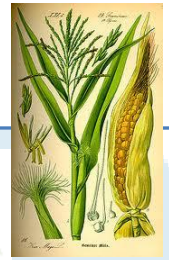
➢ MAIZE: CHALLENGES for SUSTAINABLE PRODUCTION

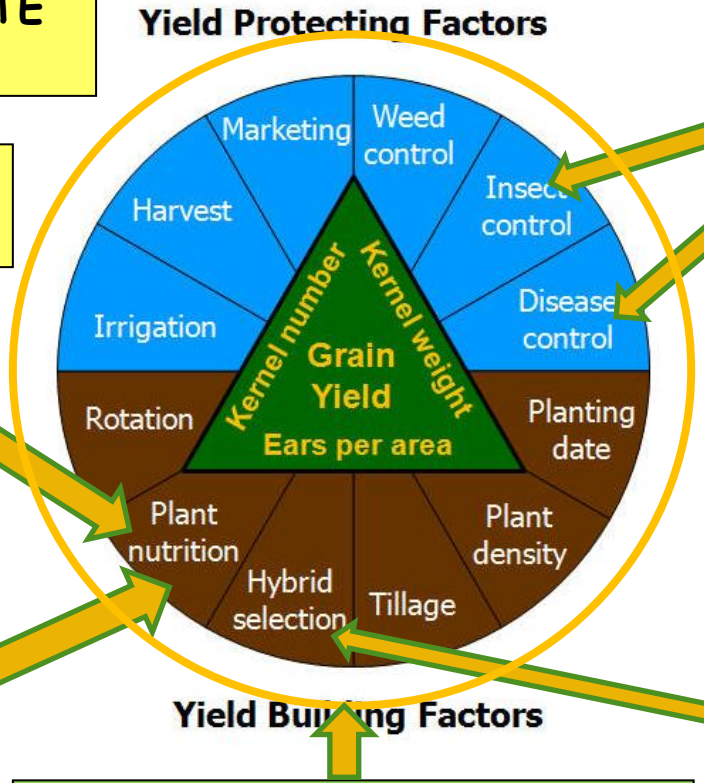


➢ CONCLUSIONS and PERSPECTIVES

➢GLOBAL CLIMATE CHANGE

➢ PESTS and PATHOGENS

➢ENVIRONMENTAL CONSTRAINTS



➢ EVALUATION of MAIZE GENETIC RESOURCES for RESISTANCE to MYCOTOXIGENIC FUNGAL PATHOGENS

➢ FERTILIZER TREE SYSTEMS

➢ MAXIMIZING USE of MAIZE STOVER (MAIZE CROP RESIDUE)

➢LOSS of GENETIC DIVERSITY

➢ PRECISION FARMING: Producing more with less

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SUSTAINABLE OPTIONS for QUALITY MAIZE

THANK YOU FOR YOUR ATTENTION!!!

carlotta.balconi@entecra.it

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