Genetic diversity and CGN

with some extra PGR documentation issues

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Centre for Genetic Resources, the Netherlands

Genetic diversity and CGN

- content of the presentation
  - genetic diversity
    - definition
    - history
    - value of genetic resources
    - conservation strategies
  - CGN
    - reason to exist
    - collections
    - activities
   - extra focus on documentation

Genetic diversity and CGN

- **definition of genetic resources in Convention on Biological Diversity**
  - material of plant, animal, microbial or other origin containing functional units of heredity that is of actual or potential value
    - for food, fiber, shelter, timber, herbal medicines and draught animals

Genetic diversity and CGN

- timeline
  - big bang   13,700,000,000 year ago
  - earth   4,570,000,000 year ago
  - life   3,700,000,000 year ago
  - plants   425,000,000 year ago
  - flowering plants   220,000,000 year ago
  - agriculture   10,000 year ago
  - scientific plantbreeding   150 year ago
  - genebanks   50 year ago

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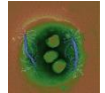
Genetic diversity and CGN

- crop plant genetic diversity in historical context
  - farmers have been domesticating crops since c. 10,000 years
    - selection adapted phenotypes from wild populations
    - in 'centers of origin'
    - result: landraces

Genetic diversity and CGN

- *Vaviliov's centres of origin*

oats, wheat, lettuce, peas, spinach

maize, common beans

millet, soybean, rice

rice, wheat

sugarcane, yam, banana

potato, ground nut, cassava, lima beans

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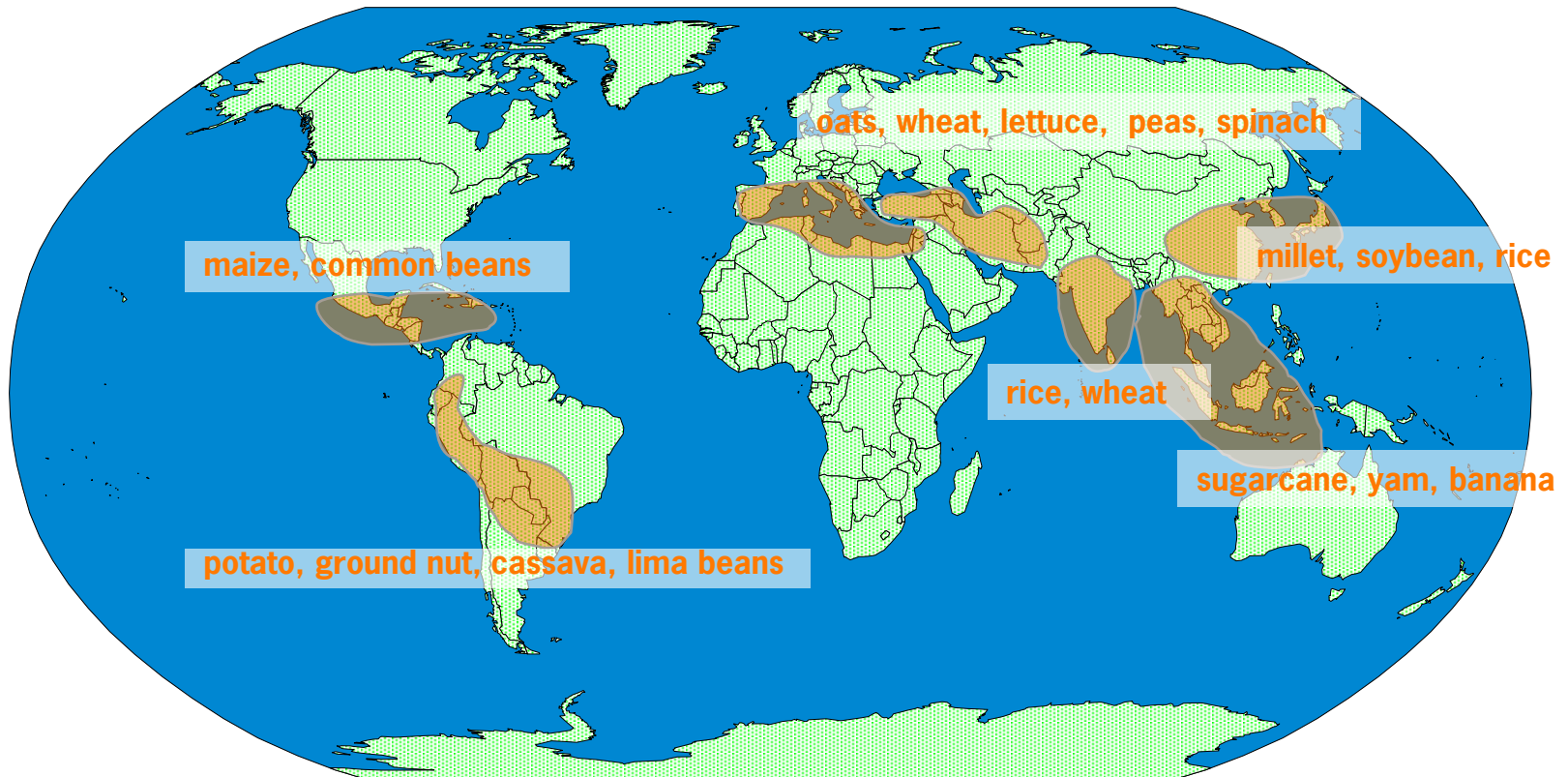
Genetic diversity and CGN

- crop plant genetic diversity in historical context
  - since c. 1850 crop genetic diversity disappears due to monocultures and habitat destruction
    - scientific plant breeding based on Mendel and de Vries
    - urbanization, desertification, climate change
    - result: genetic erosion

Genetic diversity and CGN

- **food crop diversity narrowing**
  - species diversity
    - 7000 species ever used as food - 1200 species important on a national scale - 150 entered into world commerce
    - nowadays three cereal species responsible for 55% of food energy supply
      - rice, wheat, maize
  - loss of genetic diversity
    - between species, within species, at ecosystem level
    - genes, gene complexes, traits, varieties
    - indigenous knowledge and bio-cultural heritage

Genetic diversity and CGN

- the importance of genetic diversity is increasing dramatically

  - increased farmers and consumers demands
  - global population growth
  - climate change

HUMAN POPULATION GROWTH CHART (including projections)

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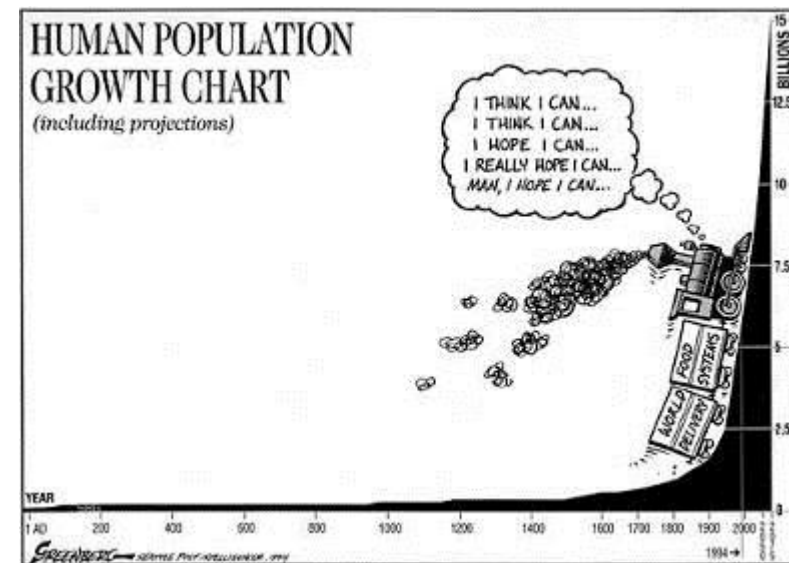
Genetic diversity and CGN

- genetic diversity needs to be conserved and made available

  - *ex situ* – in genebanks

  - *in situ* – in nature reserves

  - *on-farm* – in 'traditional' farming systems

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Genetic diversity and CGN

- Centre for Genetic Resources, The Netherlands (CGN)
  - crop GR programme established in 1985
  - reasons
    - strategic: guaranteed access to resources
      - contribution to international networks
    - legal: NL signatory to international agreements
      - CBD and IT-PGRFA
    - ethical: NL industry net user of diversity
    - biological: germplasm adapted to NL
    - technical: control over quality
  - since 1999/2002 also mandate for animal/forestry GR

Genetic diversity and CGN

- collections
  - 28 crops
    - depends on definition
  - 22519 accessions
    - varieties, landraces and wild populations
    - focus on vegetable crops and potato
      - new collections of neglected species added
        - lamb's lettuce, chives, carrot, asparagus, *Scorzonera*, parsnip
    - focus on small numbers of high quality

Genetic diversity and CGN

- **collection sizes** (15 November 2012)

  - lettuce   2363
  - potato   1438
  - tomato   1309
  - onion   417
  - spinach   387
  - pepper   1010
  - cucumber   937
  - brassicas   1970

  - wheat   4911
  - barley   2665
  - flax   952
  - peas   1002

  - *other crops*   3158

  - TOTAL   22519

Genetic diversity and CGN

- **quality management**
  - entire genebank is ISO9001:2000 certified
    - now: ISO9001:2008

- **all material is always available**
  - only with Standard Material Transfer Agreement of International Treaty (SMTA)
  - yearly 5000-8000 distributed samples

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Genetic diversity and CGN

- **seed storage**
  - storage conditions:
    - -20 °C
    - 3-7% moisture content
  - minimum germination requirements for seed storage:
    - cvs and landraces: 80%
    - wild species: 60%
  - monitoring germination

Genetic diversity and CGN

- ▪ regeneration
  - ● in collaboration with breeding companies

self-fertilizing crop: barley

cross–fertilizing crops: potato, clover

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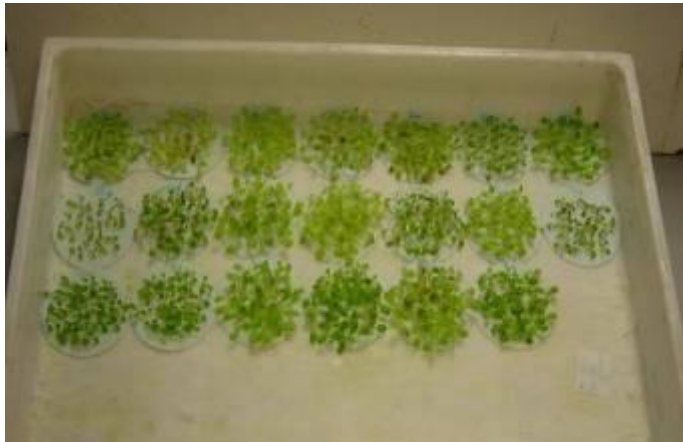
- ■ **characterisation and evaluation**
  - characterization
    - taxonomical
    - easy to describe
    - independent of environment
  - evaluation
    - resistance for diseases & pests
    - biochemical, molecular, physiological measurements
  - C&E in cooperation with breeding companies and in the context of national or international (EU) programmes

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Genetic diversity and CGN

- **documentation**
  - Oracle DBMS
  - all information is on-line accessible
    - material can be requested on-line
    - SMTA via click-wrap
    - www.cgn.wur.nl

Core Selector

- if one selects material from the CGN collection and finds too many accessions that meet the query
  - say 49

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- we allow the user to enter a 'maximum number of accessions to be retrieved'
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- resulting in a core selection
  - in this case 10 very diverse accessions of yellow butterhead lettuce with good data

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- European PGR documentation landscape
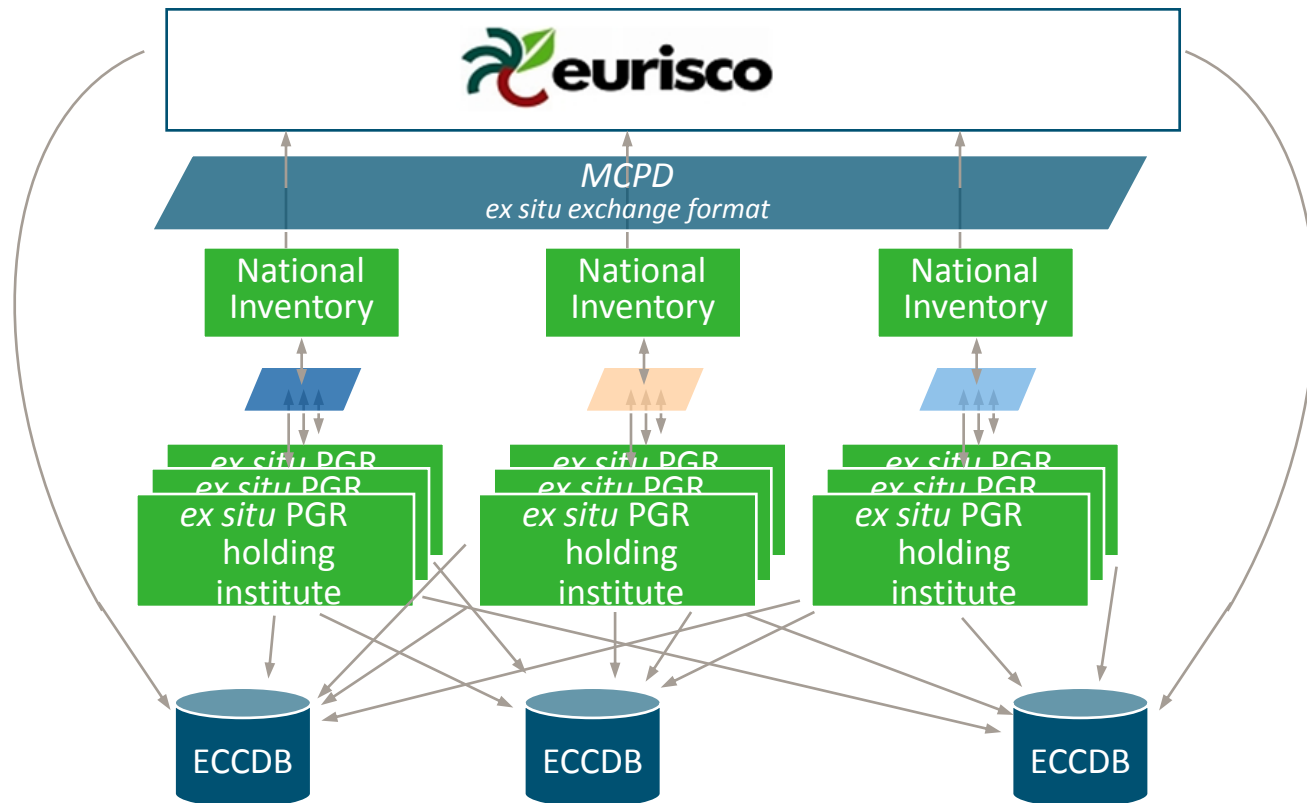
Genetic diversity and CGN

- **CGN's role in PGR documentation**
  - state of the art CGN documentation system
    - Oracle DBMS
    - bar-coding
  - innovative CGN web site
    - searchable & downloadable passport and C&E data
    - core selector
    - click-wrap paper-free SMTA handling
  - prominent role in international initiatives
    - ECPGR documentation & information network
    - EURISCO
    - GeneSys

Thank you for your attention !

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