What type of research is needed and why? – a debate

Theo van Hintum and Hilde Nybom

What type of research is needed and why?

- introduction of the session
- brief introductions of the speakers
- provocative propositions
  - speakers introduce and comment
  - audience can contribute
- wrap up

What type of research is needed and why?

- Theo van Hintum
  - responsible for documentation and methodology at the Centre for Genetic resources, the Netherlands (CGN)
  - member management team Generation Challenge Programme (GCP)

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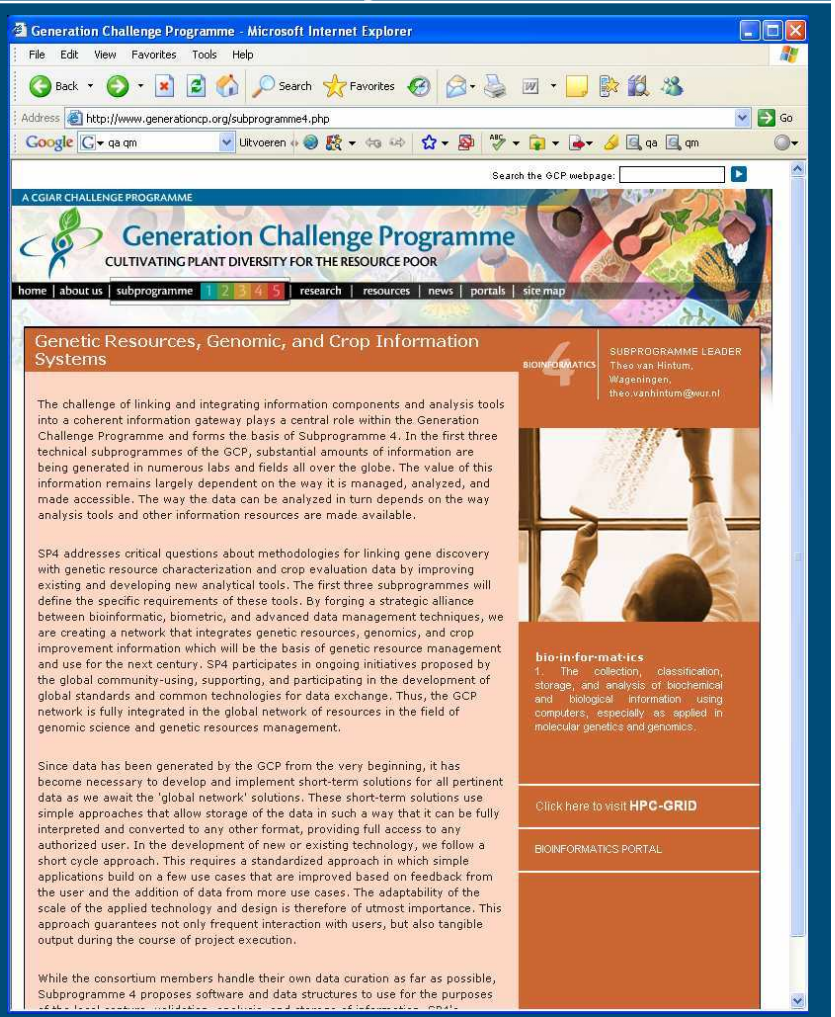
What type of research is needed and why?

- Generation Challenge Programme (GCP)
  - science for better crops
    - farmers in the developing world have big problems: drought, pest and disease infestations, and low soil fertility combined with lack of resources and thus no irrigation, fertilizers and pesticides
    - the Generation Challenge Programme uses advances in molecular biology and the rich global stocks of crop genetic resources to create and provide a new generation of plants that meet farmers' needs
    - consortium of 20 partner institutes (incl 8 CGIAR centres)



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What type of research is needed and why?

- Generation Challenge Programme (GCP)
  - leader sub-programme on bioinformatics and information systems
    - creation platform for information exchange (webservices, ontologies)
    - ensure proper information management (DBMS, LIMS, QA/QM)
    - creation proper bioinformatics / biometrical tools: software development
    - support analysis of experiments (LD mapping, transcriptomics, QTLxE)
  - recent related papers
    - Bruskiewich, R., G. Davenport, T. Hazekamp, Th. Metz, M. Ruiz, R. Simon, M. Takeya, J. Lee, M. Senger, G. McLaren and Th. van Hintum, 2006. The Generation Challenge Programme (GCP) – Standards for Crop Data. OMICS 10:215-219
    - Lee, J.M., G.F. Davenport, D. Marshall, T.H. Ellis, M.J. Ambrose, J. Dicks, Th.J.L. van Hintum and A.J. Flavell, 2005. GERMINATE, A generic database for integrating genotypic and phenotypic information for plant genetic resource collections. Plant Physiology 139: 619-631.
    - Bindraban, P., N. Louwaars, H. Löffler, Th. van Hintum and R. Rabbingen, in press. Breeding strategy for mixed production systems in Africa. Tailoring Biotechnologies

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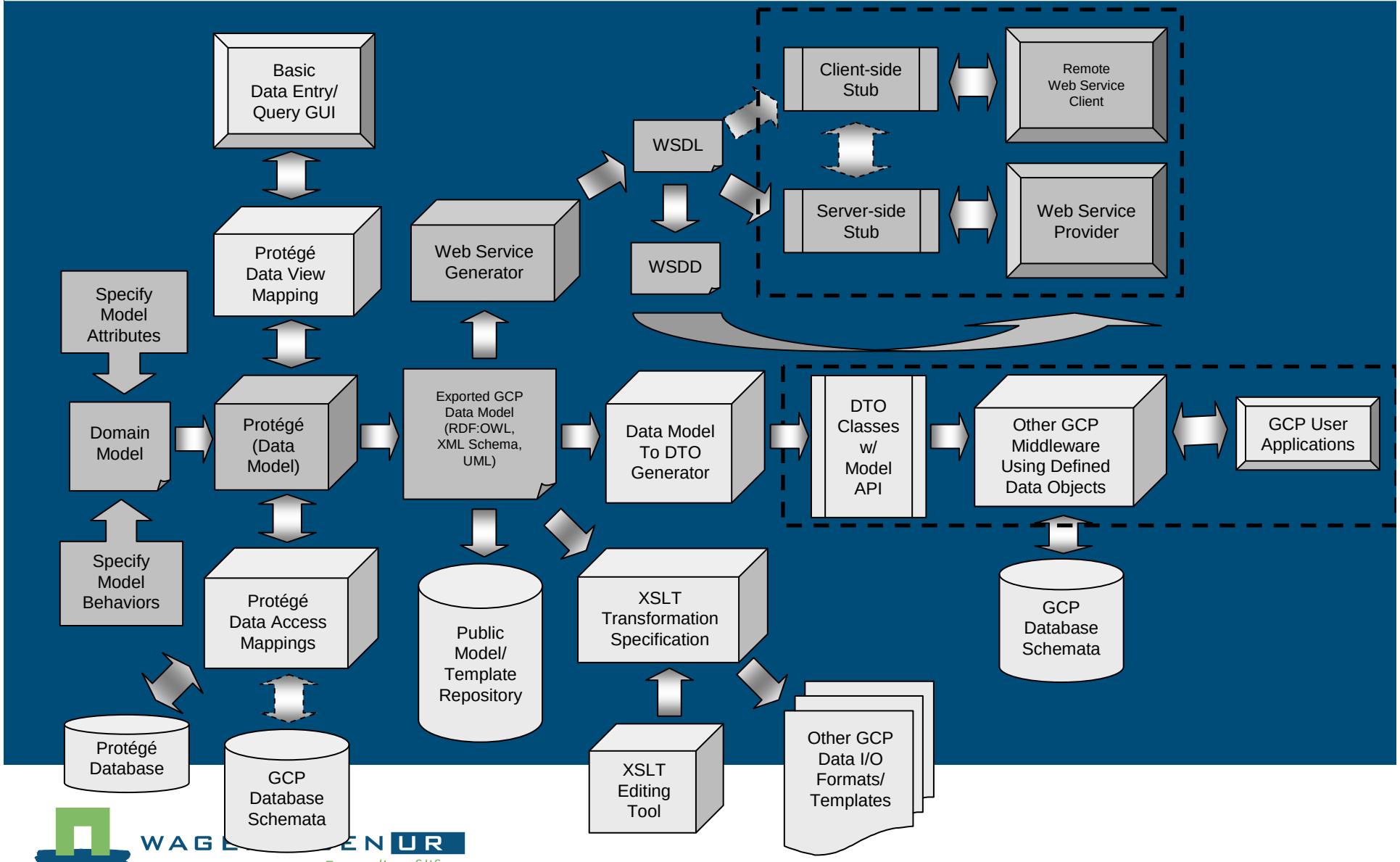

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What type of research is needed and why?

- Generation Challenge Programme (GCP)
  - trying to use modern crop technology to improve the livelihood of poor farming families in the developing countries
  - opportunity to invest my abilities on issues of global importance

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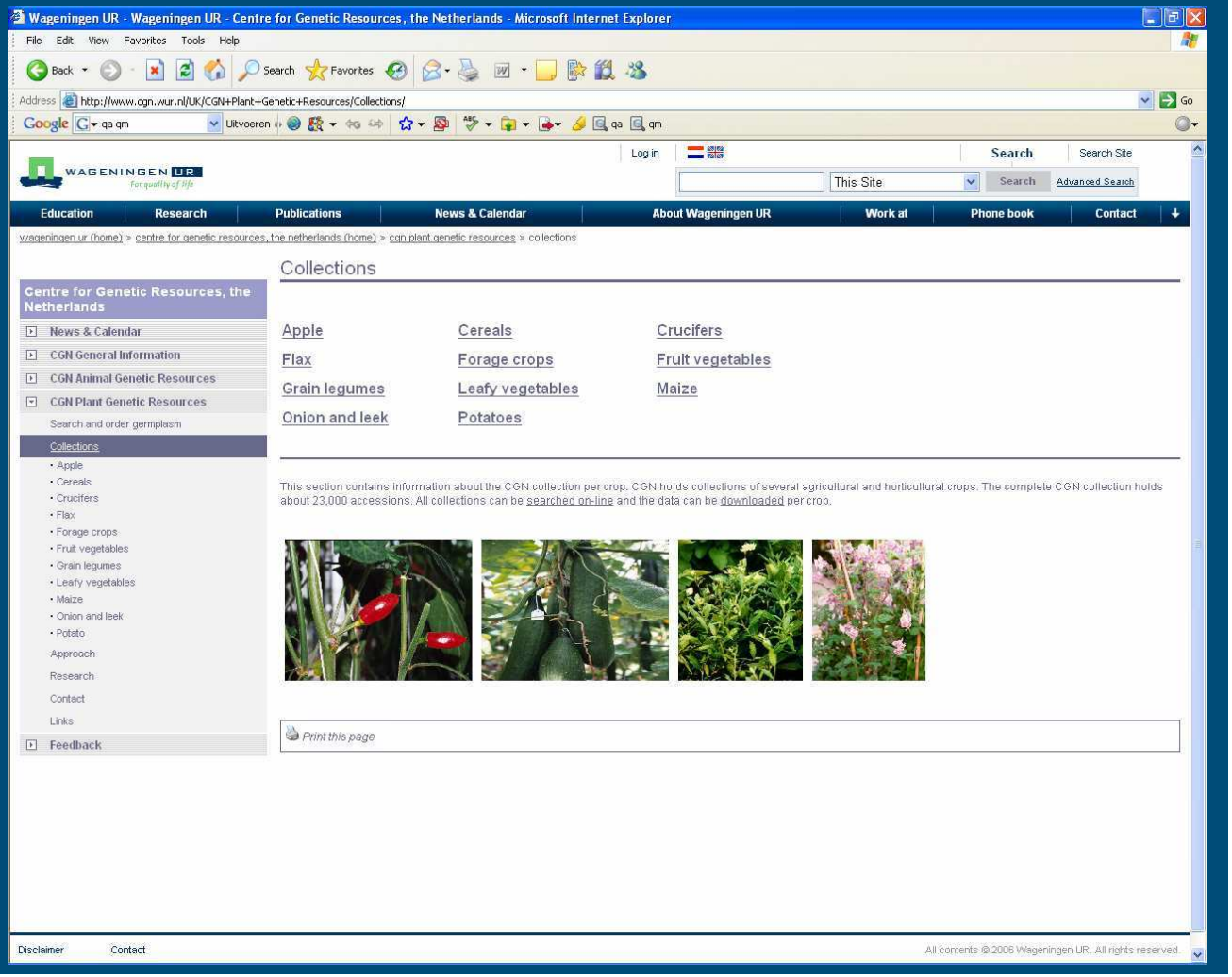
What type of research is needed and why?

- Centre for Genetic Resources, the Netherlands (CGN)
  - Wageningen



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What type of research is needed and why?

- Centre for Genetic resources, the Netherlands (CGN)
  - involved in genebank methodological research
    - composition of collections / core collection formation
    - collection management protocols
    - quality management
    - on-farm conservation
  - recent related papers
    - Hintum, Th.J.L. van, R. van Treuren, C. van de Wiel, D. Visser, B. Vosman, in press. The distribution of AFLP variation in a *Brassica oleracea* genebank collection in comparison with the effects of regeneration on diversity. Theoretical and Applied Genetics
    - Treuren, R. van, I. Tchoudinova, L.J.M. van Soest, and Th.J.L. van Hintum, 2006. Marker-assisted acquisition and core collection formation of plant genetic resources: a case study in barley using AFLPs and pedigree data. Genetic Resources and Crop Evolution 53: 43-52.
    - Jansen, J., H. Verbakel, J. Peleman and Th. J. L. van Hintum, 2005. A note on the measurement of genetic diversity within genebank accessions of lettuce (*Lactuca sativa* L.) using AFLP markers. Theoretical and Applied Genetics 112: 554-561.
    - Jansen, J., Th.J.L.van Hintum, in press. Genetic distance sampling - a novel sampling method for obtaining core collections using genetic distances with an application to cultivated lettuce. Theoretical and Applied Genetics
    - Seboka, B. and Th.J.L. van Hintum, in press. The dynamics of on-farm management of sorghum in Ethiopia: Implication for the conservation and improvement of plant genetic resources. Genetic Resources and Crop Evolution

What type of research is needed and why?

- example of research
  - the distribution of AFLP variation in a *Brassica oleracea* genebank collection in comparison with the effects of regeneration on diversity
  - 50 accessions, 30 plants each plus 6 regenerations
    - accessions from 7 duplication groups and 2 ‘global groups’
  - characterised with AFLPs for 103 polymorphic bands
  - accepted for publication in TAG

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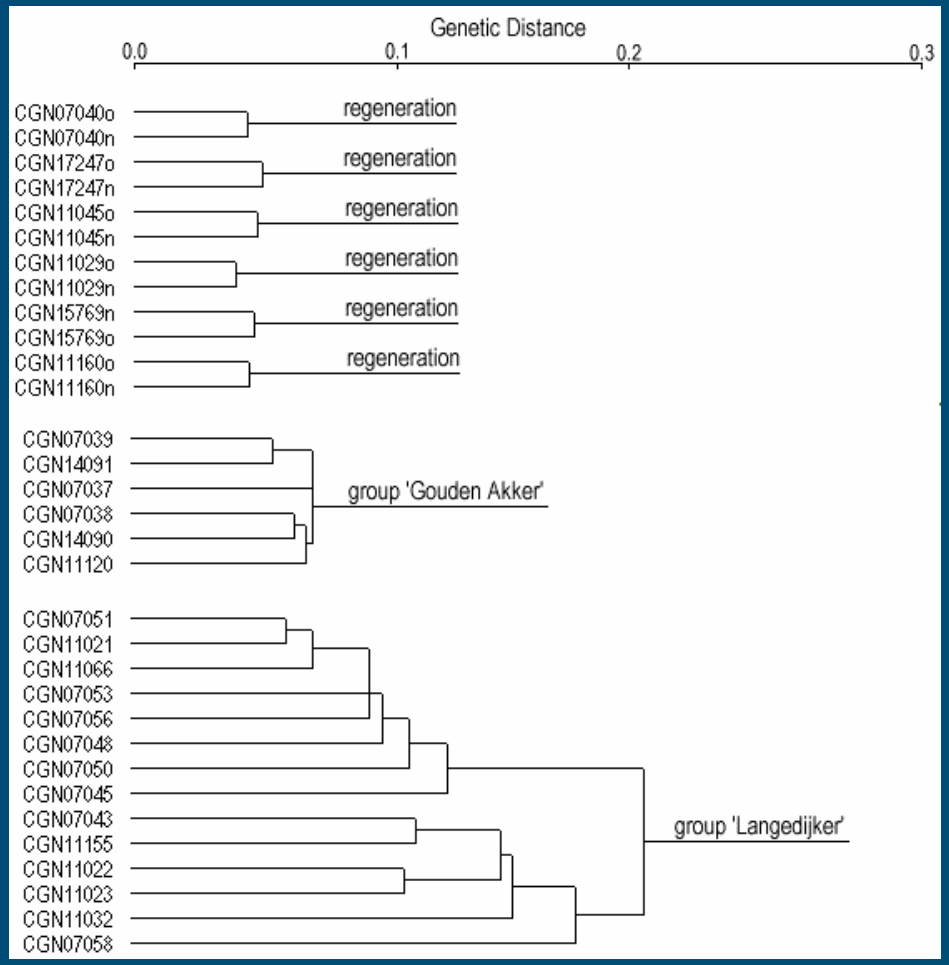
What type of research is needed and why?

- example of research
  - results
    - changes over regenerations are compareble to differences between accessions
    - changes are caused by a few bands only



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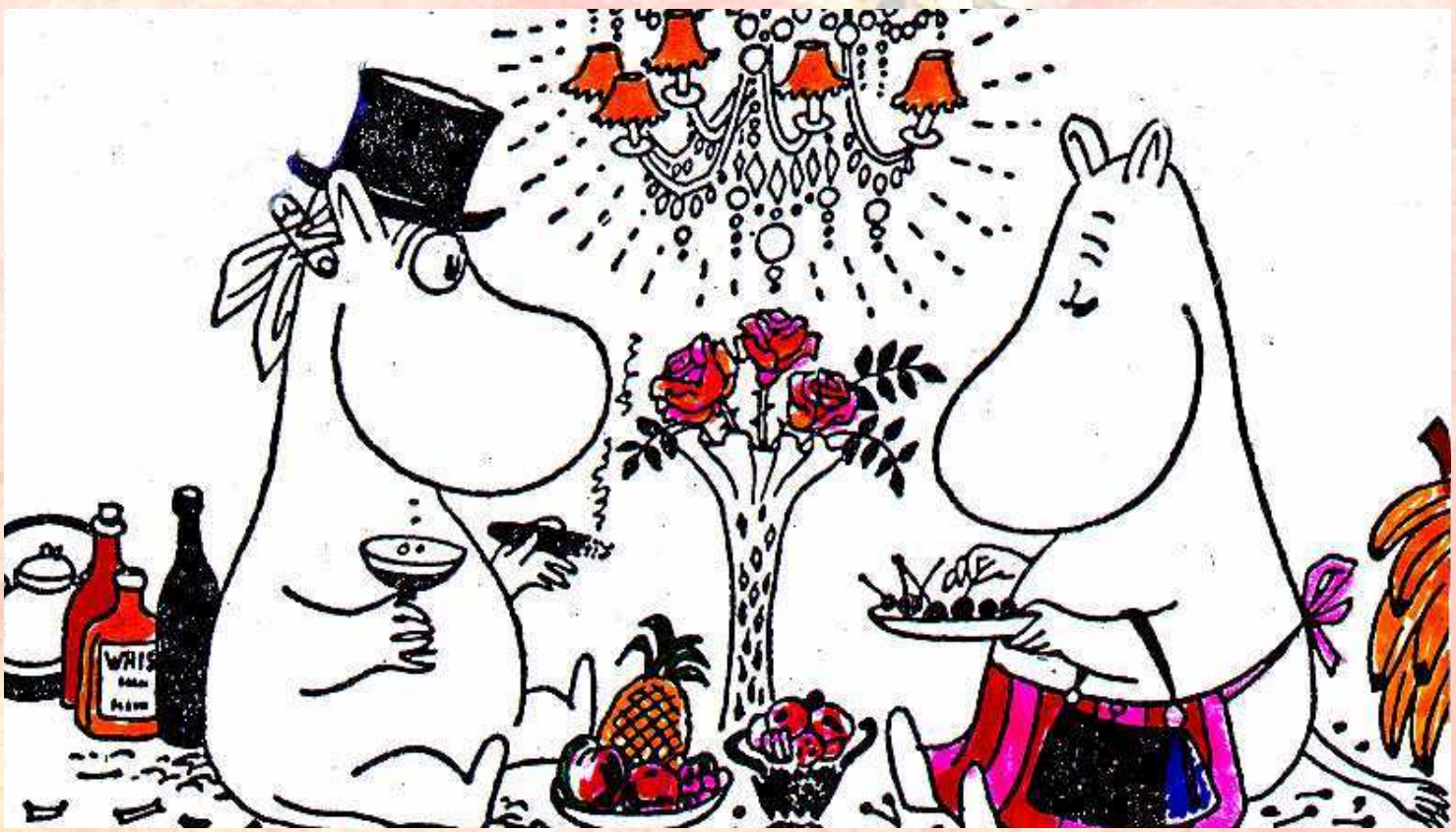
Let’s forget about grasses and cabbage and instead enjoy some of the good things in life...



Hilde Nybom, Balsgård-SLU

Balsgård-SLU in the South of Sweden

originated as a fruit breeding station in the 1940's

Plant breeding for development of new cultivars

Yield, quality, resistence

Research

Genetic diversity in wild populations and cultivated material using morphology and DNA-markers

Incompatibility, crossing barriers

Inner quality (health food): Contents of e.g. allergens, oxalate, antioxidants, pectins, flavour

Propagation, cultivation, weeds, fertilization, harvest and post-harvest

Management of our genetic resources

Apple breeding has been very important, some crosses and evaluations are still performed

The most popular Swedish-bred cultivar is Aroma

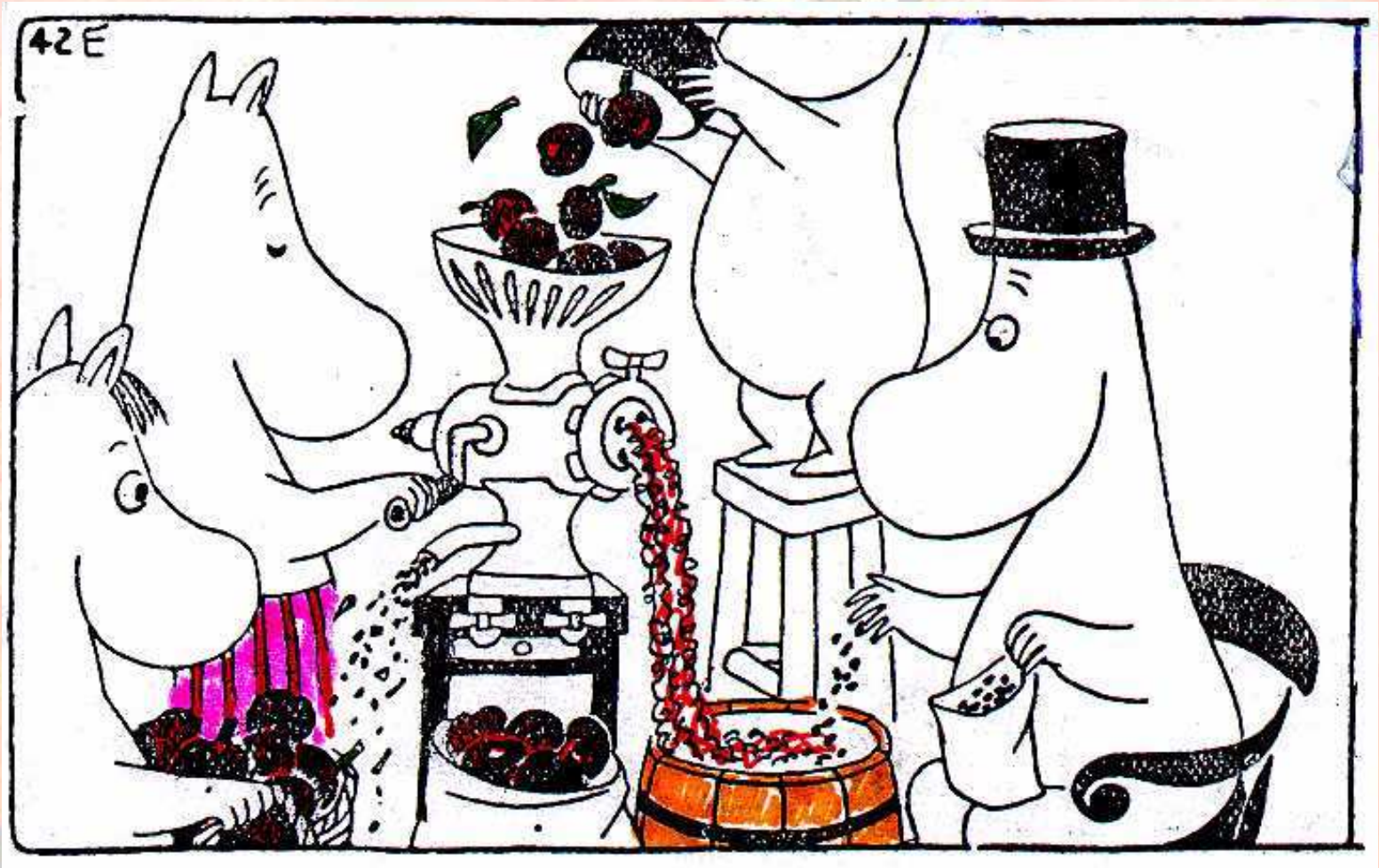
Frida is our most recent cultivar - it is now being planted in large numbers by professional growers

A promising selection K:1160 'Lovisa'

But funding is almost non-existant!

Easier to obtain funding for research

In one project, we have screened some of our apple cvs and selections for health-promoting chemical compounds

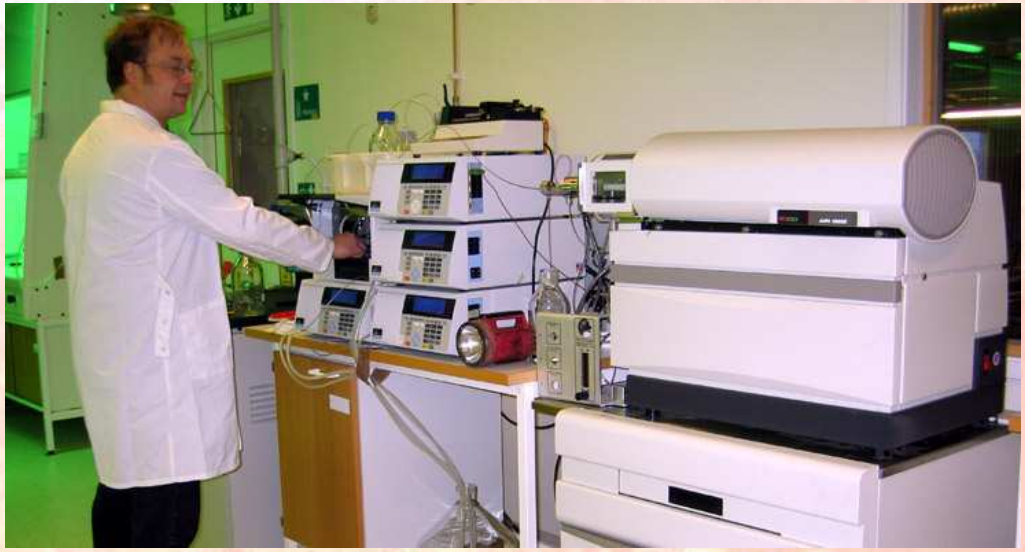


Anthocyanins and other phenolic compunds are powerful antioxidants

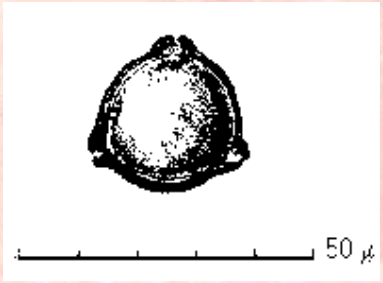
Screening of phenolic compounds in the Balsgård apple gene bank

- We have estimated total phenol content and content of single phenolic compounds in flesh and skin of fruits of 99 cvs during three years.

- The apple cvs differed 4-fold in content of total phenols and more than 20-fold in content of single phenolic compounds



Apple allergies are especially common in people who are already allergic to birch pollen



10-20% of the Swedish population are allergic to birch, 50-90% of the birch-pollen allergic people become sensitized also to apple: itching and swelling of lips, tongue and throat, OAS (oral allergy syndrome)

We have screened 150 cvs in our gene bank for content of the Mal d 1 protein, at harvest and after storage

B:0654 appears to have unusually low levels of Mal d 1

Data for some of the cvs in our apple gene bank

Phenolic compounds and pectins

Mal d 1 protein

Scab resistance genes (DNA markers)

Self-sterility genes (DNA markers)

Ploidy levels

Growth and yield

Inner and outer fruit quality

Consumer preferences

DNA marker screening of the apple gene bank

Proper identification of apple genotypes is necessary in order to link (expensive) research data to a defined genotype for future research and utilization (growing, breeding etc)

Using RAPD and microsatellite loci, we found numerous mislabellings, duplications and other problems

Genetic diversity estimated by DNA analysis

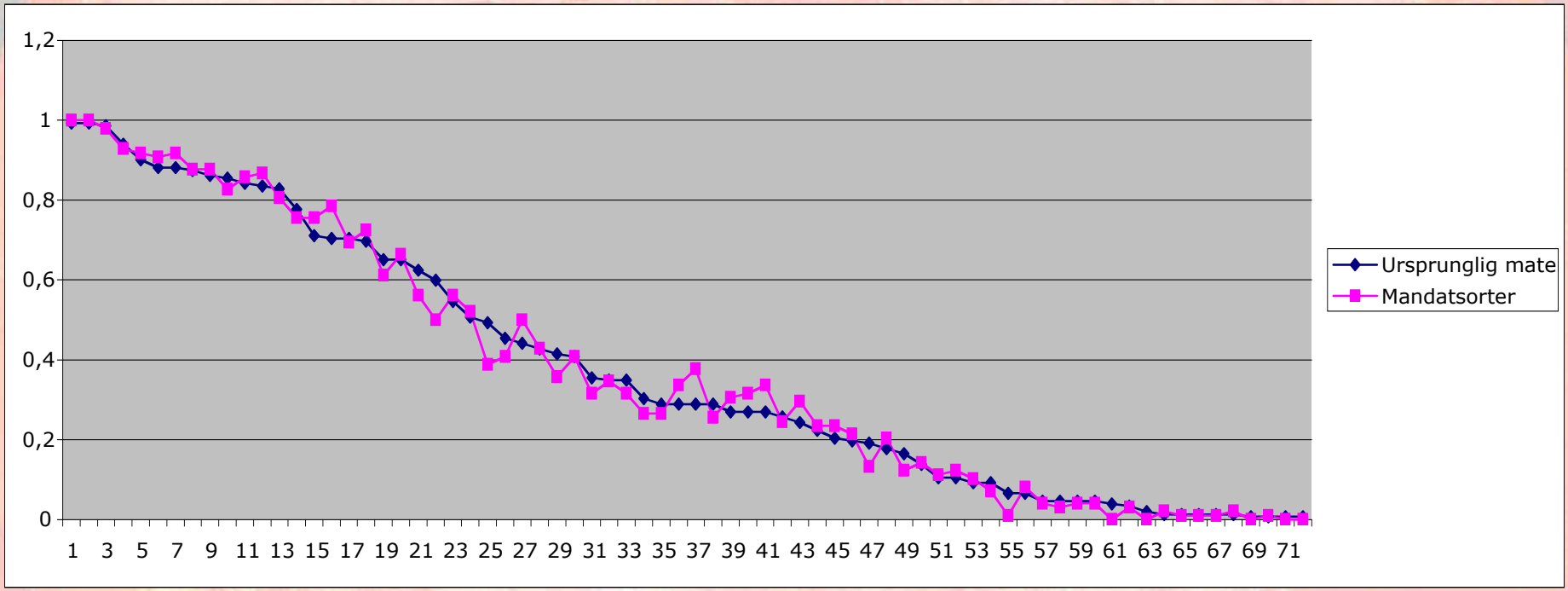
Shannon index-based estimates of genetic variation were similar for historically different groups;

old 0.580
medium 0.585
recent 0.566

and for geographically different groups;

Swedish 0.576
other European 0.583
non-European 0.543

Comparison between the whole material (150 cvs) and the mandate cvs (100, mostly Swedish) demonstrates large similarity in RAPD band frequencies



Fruit and berry gene banks at Balsgård

apple: 1000 cvs (+ 200 selections + 2000 seedlings)
pear: 150 cvs
plum: 200 cvs/selections
cherry: 70 cvs/selections
currants and gooseberry: 120 cvs + 1000 seedlings
raspberry and blackberry: 20 cvs
strawberry: 70 cvs/selections + 200 seedlings

We have about 1000 apple cultivars in our large plant genetic resource collections

a few of these trees constitute mandate cvs and presently have some funding from the national PGR programme

A new gene bank for apples at Balsgård, planted in 2003-2005, contains approx. 280 cultivars

Included are mainly international cultivars, 'tried and true' in Sweden or having genes of special interest

No funding - these are nobody's responsibility!

National responsibility:
(Swedish) mandate apple cvs, maintained in several NGB/POM clone archives. Suited to preserve the cultural history of apple but not suited for plant breeding and research:
not properly identified,
not characterised and not containing suitable germplasm

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apricot: 10 cvs/selections + 300 seedlings
dogrose: 30 cvs/selections + 800 seedlings
ornamental roses: 200 cvs/selections + 600 seedlings
sea buckthorn: 100 cvs + 3000 seedlings
lingonberry: 20 cvs/selections + 60 wild
blueberry: 30 cvs/selections
aronia: 10 cvs/selections + 200 seedlings
blue honeysuckle: 14 selections + 500 seedlings
Japanese quince: 20 cvs/selections + 1000 seedlings
Clematis: 200 cvs + selections

But who takes the financial responsibility???

so that we can develop healthy

(for environment and consumers),

beautiful and tasty fruits and berries!

What type of research is needed and why?

- debate
  - a broader form of argument than logical argument, since it includes persuasion which appeals to the emotional responses of an audience
    - forgive us our bluntness – we were commissioned to be this way
  - not a proper form in science
    - an additional step is needed to formulate research agendas

What type of research is needed and why?

- format
  - provocative propositions are shown
    - these were chosen to make you angry or relief our frustration
  - we comment and debate
    - you get involved if you like

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What type of research is needed and why?

- Proposition 1 - COMPOSITION PGR COLLECTIONS
  - PGR programmes should decide who their customers are. If the goal is to work with breeders to create improved cultivars, valuable germplasm (regardless of country of origin), research populations and other directly useable material should be made available. Some PGR programs instead appear to cater mainly to cultural history interests and home gardens and have no interest in cooperating with scientists and breeders.

What type of research is needed and why?

- Proposition 2 - GENEBANK STAFFING
  - The quality of genebank staff generally is too low. As a result, the quality of genebank research is very poor (as reflected by the quality of PGR science journals). Gene bank curators should have a background in research and plant breeding. Only then will it be possible to set proper priorities, network with the scientific community, and establish cooperative research projects.

What type of research is needed and why?

- Proposition 3 - GENOTYPE BASED STRUCTURE
  - Germplasm collections should be genotyped so that the curators can determine the proper composition and users can select the most interesting selections of material for use. DNA based assessments of diversity can help structure the collection by partitioning the diversity present (between accessions, populations, geographic areas, taxa or whatever).

What type of research is needed and why?

- Proposition 4 - GENEBANK QUALITY
  - Genebanks should meet basic quality requirements in terms of their operations. For example, genebanks should have proper inventories, and these should be made publicly accessible. But also basic operations such as the handling of the material and requests, should meet basic quality requirements. If these are not met, the genebank can be closed !

What type of research is needed and why?

- Proposition 5 - EVALUATION AND CHARACTERISATION
  - Genebanks should invest, or collaborate with plantbreeders, in evaluating for economically important characters - and the data should be made publicly available! Quantitative morphological (UPOV) traits are useless.

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What type of research is needed and why?

- Proposition 6 - INTERNATIONAL COORDINATION
  - PGR research is not coordinated or supported internationally: the EU excludes it from the framework programmes and from GENRES, IPGRI is not interested in ex-situ work, ECPGR doesn't have any funds except for talking. Coordination is essential, especially for the smaller countries.

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What type of research is needed and why?

- Proposition 7 - RESEARCH FUNDING
  - Breeding companies should fund genebank research (they don't have to pay for the germplasm). Governmental entities should fund genebank activities for minor crops.

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What type of research is needed and why?

- Proposition 8 - SEED STORAGE PROTOCOLS
  - Genebanks do not have a clue what is happening to the seeds in their collections. They test the germination of the wrong seeds and know very little about the storage behaviour. This implies unacceptable risks or money wasted.

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