Current agriculture is endangered by a decline in genetic distances between plant varieties: Fact or fiction?

Tomato as case study

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Why this topic?

Worry at the Dutch Board for Plant Varieties:

Reduction of genetic diversity between varieties of modern crops?

Narrow genetic basis can lead to serious epidemics.

Examples: Banana (Panama disease), corn (Southern corn leaf blight)

The Board funded a project. Acknowledged!

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Modern breeding

Introgression from wild relatives ↑

Result?

Strong selection during breeding ↓

Genetic erosion?

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Diversity of tomato varieties, as a case

- Phenotypic diversity (traits)
- Genotypic diversity (DNA)

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Phenotypic diversity

- Dutch Variety List for Horticultural Crops
- Does not include all varieties for tomato
- Does not accurately describe acreages of varieties

- In spite of these limitations: the Variety List still represents trends.

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1943

- First issue of the Dutch Variety List for vegetables
- 3 groups:
  - Ailsa Graig type (standard size)
  - Tuckwood group (larger)
  - Intermediate size
- No cherry tomatoes
- All open pollinated; No hybrids

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1951

- Same groups as in 1943, but more varieties per group.
- However, varieties were very similar, although they had different names, issued by different companies.
- Increase in number of varieties did not represent increase in diversity.

1960

- Tuckwood group had disappeared.
- Only Ailsa Craig group left.
- Lowest number of cvs
- Lowest diversity

1968 to 1985

- Increasing number of resistances to diseases mentioned (viruses, *Cladosporium fulvum, Verticillium* and *Fusarium,* and *Meloidogyne*)
- Gradually more variation in fruit size (beef tomatoes)

1985

80-85% of tomatoes for fresh market in Germany

No attention for taste or sweetness...

leading to….

Wasserbombe disaster

Dramatic decrease in tomatoes production

from ~1.700 ha in 1985

to ~275 ha ten years later.

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1996

- Taste, including sweetness, became more important
- Keeping quality improved
- Cherry types were introduced
- Disease resistances increased further in importance: UPOV required evaluation of 7 disease resistances

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After 1996

- No Variety Lists appeared anymore
- An impressive diversity nowadays in shops

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Summary from Dutch Variety Lists

- Phenotypic variation in tomato varieties low in 1940s
- Very low in 1960s. Varieties very similar, homozygous.
- Increase in diversity after 1960s
- Variation in fruit size
- More resistances
- More diversity in taste and sweetness
- Now a wide variation.

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Variety diversity for tomato

- Phenotypic diversity
- **Genotypic diversity**

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- DNA collected from 90 tomato varieties, commercially introduced between 1950 and 2016 in NL.
- 7720 SNP DNA-markers scored for each variety
- Genetic diversity index (H) calculated per decennium

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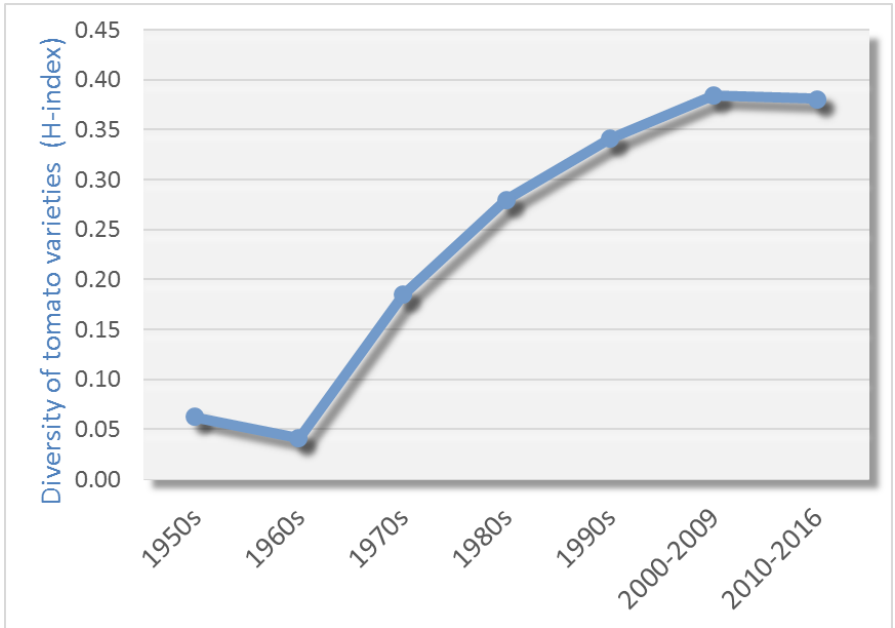

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- We estimated the amount of 'new' DNA,
  - representing introgressions (chromosomal fragments)
  - from (wild) accessions

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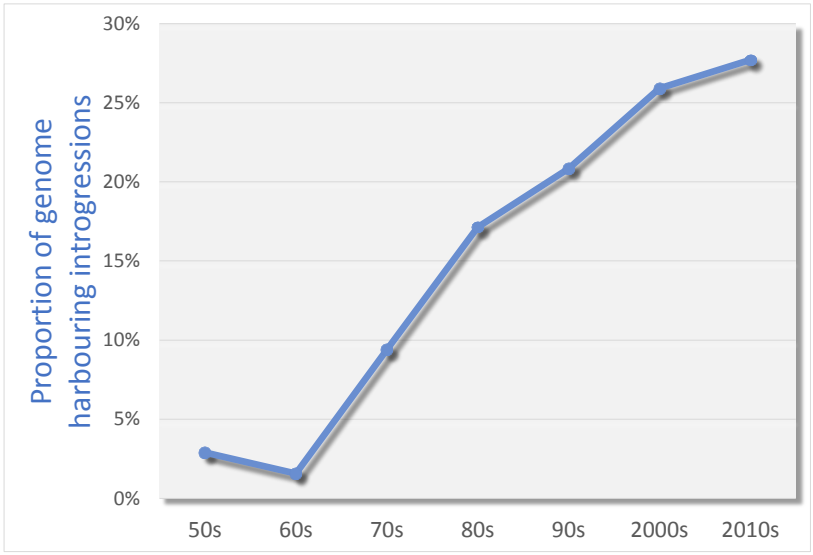

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Conclusions for tomato

Both the

phenotypic data (Descriptive Variety Lists)

and the genotypic data (DNA markers)

show that the plant variety diversity was very low in the 1960s.

After this dip, a very pronounced increase in variety distances.

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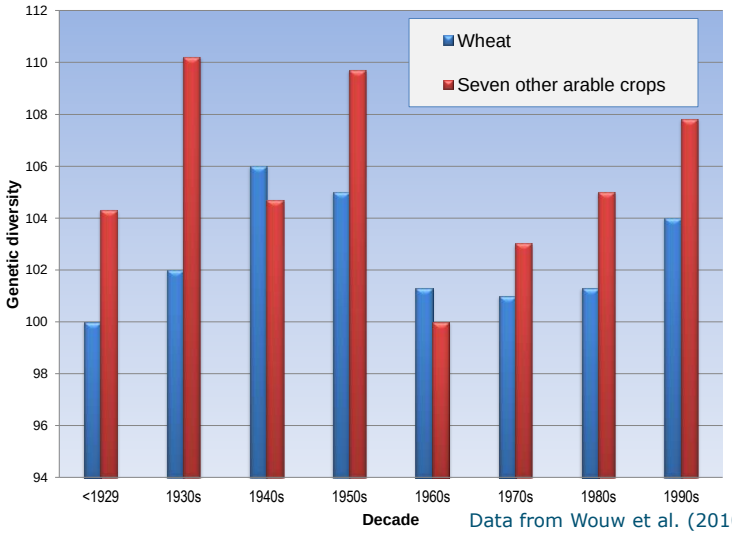
How about other crops?



Data from Wouw et al. (2010)

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Current agriculture is endangered by a decline in genetic diversity between plant varieties: Fact or fiction? **FICTION**

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