Nitrogen use efficiency in old and modern barley genotypes

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Content of presentation

- Materials and methods
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- Acknowledgements
Materials and methods

- 195 barley genotypes
  - 72 NordGen genotypes + 123 cultivars (from 1930’s till 2010)
- 2 nitrogen rates: 35 and 70 kg N/ha
  - 3 replicates
  - 9 unfertilized genotypes

- Observations
  - heading, maturity, canopy height, lodging
- Plant samples (50 plants per plot)
  - at heading → biomass and N content
  - at maturity → biomass, grain yield, N content, HI, NHI

- Harvesting
  - grain yield (kg/ha)
  - NUE, NUTE, NUPE

- SNP genotyping
  - 1536 SNP-markers (UCLA)
  - Associate mapping: N use indices, disease resistance
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Unfertilized plots

70 kg N

35 kg N
Definitions

NUE: nitrogen use efficiency
   kg grain/kg available N (fertilizer N + soil N)
   kg grain/kg fertilizer N

Subcomponents of NUE:
NUPE: nitrogen uptake efficiency
   kg plant N/kg available N (fertilizer N + soil N)
NUTE: nitrogen utilization efficiency
   kg grain/kg plant N (straw + grain N)
Grain yield (kg/ha) 2011+12

Mean grain yield (kg/ha)

- SGW +
- Grain number +
- Harvest index (HI) +
- Stem length –
- Lodging –

Decade of cultivar release

Breeding effect

Yield kg/ha

NGB-material

N 35

N 70

1880 1900 1920 1940 1960 1980 2000 2020
Min-max grain yield (kg/ha) 2011+12

Min-max grain yield (kg/ha)

Yield kg/ha

Decade of cultivar release

NGB-material

35 N
70 N
Mean grain yield (kg/ha) 2011 vs 2012

Grain yield 2011 vs 2012

- Cultivars
- NGB-material
Fertilizer N use efficiency: 2011+12

Mean fertilizer NUE (kg yield/kg applied fertilizer N)

Decade of cultivar release

NUE kg yield/kg applied fertilizer N

Fertilizer NUE + 30%

NGB-material

35 N

70 N
N use efficiency 2011
soil N = mean plant N uptake in unfertilized plots

NUE : kg grain/kg soil N (estimated) + fert N

Decade of release

NUE + 30%
N utilization efficiency NUTE: 2011

NUTE: kg grain/kg plant N

Decade of cultivar release

NUTE + 10-15%
Min-max NUTE: 2011

Min-max NUTE: kg grain/kg plant N

Some of the NGB genotypes in top NUTE-ranking

High NUTE has a price!
NUTE and grain N: 2011

NUTE: kg grain/kg plant N (grain + straw) and grain N (%)

![Graph showing the relationship between NUTE and grain N percentage.](image-url)
Grain N (%): 2011

Not a major concern in barley, but in bread wheat, yes.
NUPE: 2011

soil N = mean plant N uptake in unfertilized plots

NUPE : kg plant N/kg soil N (estimated) + fert N
Min-max NUPE: 2011

NUPE : kg plant N/kg soil N + fert N

Some of the NGB genotypes in top NUPE-ranking

NUPE 35N
NUPE 70N

Min-max NUPE: 2011

Decade of release

NGB-material
NUPE and NUTE 2011
NUTE (kg yield/kg plant N) ja NUPE (kg plant N/kg soil + fert N)

Slight negative correlation between NUTE and NUPE
Conclusions

- Breeding has greatly improved agronomic traits and yielding capacity
- Modern cultivars outperformed the land races in N use efficiency
- However, some of the landraces had high N utilization or uptake efficiency → potential crossing material for breeding programmes
- Some DNA-markers (SNP) associated with N use efficiency indices. These markers may fasten the backcrossing process in plant breeding
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