Genetic shift in white clover after natural selection in a marginal area

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White clover in Iceland

- Unreliable crop
  - Yield differs between years
  - Generally low winter survival

- Need for improved cultivars
  - Stability - in yield and nitrogen fixation rate
  - High level of winter survival

- Traits associated with winter survival
  - Stolon morphology
  - Fatty acid composition of stolons
Objectives

- Monitor genetic shift after four years of natural selection in a marginal area

- Evaluate morphological traits associated with winter survival

- Assess composition of fatty acids in stolon tissue after exposure to frost
Experimental setup

Field trial

White clover populations:
- ‘Norstar’
- ‘Norstar S’ – four years of natural selection

Reference populations:
- ‘Korpa’ - local
- ‘Skorradalur’ - wild
- ‘Ramona’ - cultivar
Methods

- AFLP study

- Phenotypic characterisation
  - Stolon characters - persistence
  - Leaf characters - yield

- Chemical analysis of stolon fatty acids
Winter survival

% Winter Survival

'Norstar'  'Norstar S'  'Korpa'  'Skorradalur'  'Ramona'

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PCA – molecular diversity (AFLP)

PC I (54.8%)
PC II (22.9%)
Ramona Norstar Norstar S Skorradalur

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Structure

- Assigns $k$ populations to a dataset

$k = 4$
Phenotypic characters

- Persistence
  - Specific stolon length (dry weight unit length$^{-1}$)
  - Significantly higher in ‘Norstar S’ than in ‘Norstar’ (P=0.05)

- Yield
  - Specific leaf area (dry weight per unit area$^{-1}$)
  - No significant difference between ‘Norstar S’ and ‘Norstar’
PCA - Morphological traits

PC I (80%) - PC II (15%)

'Eli Nielsen' - 'Norstar' - 'Skorradalur' - 'Korpa'

Legend:
- 'Norstar'
- 'Norstar S'
- 'Skorradalur'
- 'Korpa'

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Pattern of variation within populations - phenotypic and molecular data

![Graph showing variation within populations](image-url)

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Fatty acid composition

![Bar chart showing fatty acid composition for 'Norstar', 'Norstar S', 'Korpa', and 'Skorradalur'. The chart compares the levels of UFA and SFA in milligrams per gram dry matter (mg/gDM).]
Fatty acid composition

18:1 oleic acid; 18:2 linoleic acid; 18:3 linolenic acid

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Stabilising selection for degree of UFA

CV Fatty Acid Content

% Coefficient of variation

'Norstar' 'Norstar S' 'Korpa' 'Skorradalur'

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Main conclusions

- No conflict in simultaneous selection for high winter tolerance and maintained yield
- Homology between results obtained from molecular, phenotypic and fatty acid data
- Potential for further improvement of cultivars selected for marginal areas
Thank you for your attention!