Genetic Progress in a Subtropical Oat Germplasm

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Brazil’s climate diversity

A – Tropical Climate
- Af – Wet (rains all year long)
- Am – Monsoon
- Aw – Wet summer and dry winter (savanna)
- As – Dry summer and wet winter

B – Semiarid Climate
- BSh – Hot steppe

C – Subtropical humid Climate
- Cf – Without dry season
  - Cfa – With hot summer
  - Cfb – With warm summer
- Cw – With dry winter
  - Cwa – and hot summer
  - Cwb – and warm summer
  - Cwc – and short cold summer
- Cs – With dry summer
  - Csa – and hot summer
  - Csb – and warm summer

Köppen–Geiger climate classification system

Main oat cultivation area

Equator

Capricorn Tropic

Area 8,547,403 km²

Brazil’s climate diversity

Main oat cultivation area

Area 8,547,403 km²

4,394 km

4,319 km
Adaptation area of UFRGS oat germplasm

Amazonia humidity circulation
Southern Brazil Precipitation

UFRGS Experimental Station
Southern Brazil Typical Landscape
No-tillage System

Farm

Breeding Program
Southern Brazil Crop System

- Soybean
- Avena strigosa / ryegrass
- Grain Oats
- Maize
- Forage/Cover Oats

Seasons:
- Summer
- Fall
- Winter
- Spring
Methodology

Germplasm belongs to UFRGS Oat Breeding Program
- Program started in 1974
- First cultivars released in 1982, from lines developed in 1978

Germplasm sampled from 1978 to 2008
- Year of line development = time when the genotype was considered a pure line (bulked)
- 92 genotypes
  - 28 cultivars
  - 64 inbred lines

Experiments conducted at UFRGS Experimental Station
- With fungicide (2010-2011)
- Without fungicide (2010)

Genetic progress analysis
- Segmented linear regression (SegReg software)
- Year of line development were grouped in ten 3-year periods
Genetic Progress with fungicide (2-year average)

**Grain Yield**

- \( y = 4140 + 34.1x \)  
  - \( R^2 = 0.11 \)
- \( y = 5890 \)  
  - \( R^2 = 0.39 \)
- \( y = 4340 \)  
  - \( R^2 = 0.12 \)

**Legend:**
- \( \text{red} \) all genotypes
- \( \text{dotted blue} \) higher value genotypes within each triennium
- \( \text{green dashed} \) lower value genotypes within each triennium

Grain yield
- Genetic progress (Total): 24.71%
- Annual: 0.82%

**Apparent Biomass**

- \( y = 1240 \)  
  - \( R^2 = 0.11 \)
- \( y = 1110 \)  
  - \( y = 1083.5 \)  
  - \( R^2 = 0.08 \)

- \( y = 1030 - 4.9x \)  
  - \( R^2 = 0.08 \)

**Legend:**
- \( \text{red} \) all genotypes
- \( \text{dotted blue} \) higher value genotypes within each triennium
- \( \text{green dashed} \) lower value genotypes within each triennium
Genetic Progress with fungicide (2-year average)

**Harvest Index**

- **Total:** 18.24%
- **Annual:** 0.61%

Mathematical models:
- \( y = 28.9 + 0.7x \) with \( R^2 = 0.3 \)
- \( y = 27.3 + 0.17x \) with \( R^2 = 0.07 \)
- \( y = 22.1 + 0.15x \) with \( R^2 = 0.12 \)

**Legend:**
- red: all genotypes
- blue: higher value genotypes within each triennium
- green: lower value genotypes within each triennium

**Nº of panicles per m²**

- **Total:** 15.74%
- **Annual:** 0.52%

Mathematical models:
- \( y = 413 \) with \( R^2 = 0.16 \)
- \( y = 337 \) with \( R^2 = 0.04 \)
- \( y = 287 \) with \( R^2 = 0.17 \)

Mathematical models:
- \( y = 245 \) with \( R^2 = 0.17 \)
**Genetic Progress with fungicide (2-year average)**

### 1000-grain weight

#### Linear Models for 1000-grain weight:

- **y = 34.3 + 0.73x** with $R^2 = 0.58$
- **y = 32.9 + 0.18x** with $R^2 = 0.04$
- **y = 29.8**
- **y = 27.8 + 0.26x** with $R^2 = 0.14$

**Legend:**
- **Red** all genotypes
- **Dotted blue** higher value genotypes within each triennium
- **Green dashed** lower value genotypes within each triennium

**Genetic Progress Summary:**
- **Total:** 11.23%
- **Annual:** 0.53%

### Test weight

#### Linear Models for Test weight:

- **y = 53.7 + 0.2x** with $R^2 = 0.45$
- **y = 50.3 + 0.3x**
- **y = 48.6**
- **y = 55.7 + 0.4x** with $R^2 = 0.2$
- **y = 52.9**

**Genetic Progress Summary:**
- **Total:** 10.69%
- **Annual:** 0.59%

Legend:
- **Red** all genotypes
- **Dotted blue** higher value genotypes within each triennium
- **Green dashed** lower value genotypes within each triennium
Genetic Progress with fungicide (2-year average)

**Grain weight per panicle**

- $y = 3.22 - 0.027x$
- $R^2 = 0.14$
- $y = 2.23 + 0.076x$
- $y = 2.11$
- $y = 1.63$

**No of grains per panicle**

- $y = 81.1 + 0.36x$
- $R^2 = 0.08$
- $y = 66.9$
- $y = 56 -0.37x$
- $R^2 = 0.07$

**Legend:**
- red: all genotypes
- dotted blue: higher value genotypes within each triennium
- dashed green: lower value genotypes within each triennium

**Year of genotype development**

- 1975
- 1980
- 1985
- 1990
- 1995
- 2000
- 2005
- 2010

**Grain weight / panicle**

**Genetic Progress**

- No change

**No of grains / panicle**

**Genetic Progress**

- No change
Genetic Progress with fungicide (2-year average)

Days from emergence to heading

Days Emerg. Heading
Genetic Progress
Total: - 8.49%
Annual: - 0.28%

Plant height

Plant height
Genetic Progress
Total: - 5.88% (1978-1993)
Annual: - 0.39% (1978-1993)

Legend:
- all genotypes
- higher value genotypes within each triennium
- lower value genotypes within each triennium
Genetic Progress with fungicide (2-year average)

Legend:
- all genotypes
- higher value genotypes within each triennium
- lower value genotypes within each triennium

Lodging

Year of genotype development

Genetic Progress
Total: - 44.28%
Annual: - 1.48%
CROWN RUST
Epidemics last from 70 to 100 days
**Genetic Progress without fungicide**

### Grain Yield

- **No fungicide**

  **Grain yield – no fungicide**

  **Genetic Progress**

  - **1978-1990**
    - Total: -43.03%
    - Annual: -3.49%

  - **1990-2008**
    - Total: 282.75%
    - Annual: 16.02%

### Crown rust

- **AUDPC**

  **Genetic Progress**

  - **1978-1990**
    - Total: 403.49%
    - Annual: 32.28%

  - **1990-2008**
    - Total: -381.25%
    - Annual: -5.95%

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**Legend:**
- `all genotypes`
- `higher value genotypes within each triennium`
- `lower value genotypes within each triennium`

**Equations:**

- Grain yield without fungicide:
  - 1978-1990: $y = 408 + 148x$, $R^2 = 0.93$
  - 1990-2008: $y = -1020 + 167x$, $R^2 = 0.69$

- Crown rust AUDPC:
  - 1978-1990: $y = 1580 - 83.9x$, $R^2 = 0.78$
  - 1990-2008: $y = 1830 - 63.8x$, $R^2 = 0.93$
Genetic Progress without fungicide

**1000-grain weight**

- **No fungicide**

  - **1978-1991**
    - Total: -12.04%
    - Annual: -0.94%

  - **1991-2008**
    - Total: 46.31%
    - Annual: 2.70%

**Test weight**

- **No fungicide**

  - **1978-1991**
    - Total: -17.18%
    - Annual: -1.27%

  - **1991-2008**
    - Total: 42.08%
    - Annual: 2.55%

**Legend:**

- **all genotypes**
- **higher value genotypes within each triennium**
- **lower value genotypes within each triennium**
Genetic Progress without fungicide

Black leaf spot

Pyrenophora chaetomoioides
(Dreschelera avenae)

Black leaf spot severity
Increase of 98.5% from 1999 on

Legend:
- all genotypes
- higher value genotypes within each triennium
- lower value genotypes within each triennium

Black leaf spot severity (%)

Year of genotype development
THANK YOU

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