Adaptation of Kernza to temperate regions in south America

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Sections

• Vernalization requirements

• Agronomic adaptation

• Breeding
Vernalization requirements

Objetives

• Explore *T. intermedium* possibilities to produce grain in temperate geographic regions

• determinate primary induction cold requirements on germplasm moderately adapted to winter cold areas
Vernalization requirements

Materials and Methods

Emergence → 3 leaves → Growth chamber (4°C – 16 hs)

Greenhouse (25°C – 16 hs)

TLI Cycle 5
TLI Cycle 4 (MN)
TLI Cycle 4 (AK1)
MN1501-Syn2
MN1502-Syn2
MN1503-Syn2
MN1504-Syn2
MN1505-Syn2

Weeks

1 2 3 4 5 6 7

Greenhouse (25°C – 16 hs)

- Flowering
- Dry weight
- Spikes per plant
- Spikelets per spike
- Spikelets per plant
- Plant height
- Harvest index
Results

Cold requirements for flowering

Percent of plants flowering

Weeks of incubation

0 1 2 3 4 5 6 7 8

0 20 40 60 80 100
Results

Grain yield components

Weeks of incubation

Spikes per plant or spikelets per spike

Spikelets per plant

Spikelets per spike

Spikes per plant

0 1 2 3 4 5 6 7 8

0 50 100 150 200 250 300

0 50 100 150 200 250 300
Results

Germplasm response to vernalization

![Bar chart showing percent of plants flowering in different Kernza populations over different time periods (1-2 wk, 3-4 wk, 5-6 wk). The chart compares different populations (TLIC5, TLIC4MN, TLIC4A, MN01, MN02, MN03, MN04, MN05) with different levels of flowering, indicated by letters (A, B, AB, ab).](image)
Agronomic adaptation

Objetives

• Evaluate the agronomic performance of *T. intermedium* in South America conditions (Uruguay)

• measure grain yield and dry matter yield during 2-3 years
Materials and Methods

- Sowing date: 04/18
- Trasplant date: 05/18
- Distance among plants: 20 cm
- 25 plants per plot
- 36 plot
Agronomic adaptation

Treatments

2 germplasm types of TLCI4

- **Spring** (seed harvested without a winter in Wisconsin)
- **Vernalized** (seed harvested after a winter in Wisconsin)

3 N applications per year

- 0 Kg ha \(^{-1}\)
- 80 Kg ha \(^{-1}\)
- 160 Kg ha \(^{-1}\)

Traits to evaluate

- Dry matter yield
- Weeds (dry weight)
- Grain yield*
- Crude protein
- NDF and ADF

<table>
<thead>
<tr>
<th>Year</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
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<tbody>
<tr>
<td>Season</td>
<td>Sum</td>
<td>Fall</td>
<td>Wint</td>
<td>Spri</td>
</tr>
<tr>
<td></td>
<td>*</td>
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</tbody>
</table>

N applications
Flowering and Heading time - Preliminary results

Flowering: 45.8%  
Flowering: 49.7%

Spring: 2309  
Vernalized: 2274

Density vs. Heading time (°C.day-1)
Forage production - Preliminary results

ANOVA p<0.05

Dry matter yield (Kg.ha⁻¹)

- Summer
  - Vernalized: a
  - Spring: b

- Fall
  - Vernalized: a
  - Spring: a

- Total
  - Vernalized: a
  - Spring: b

ANNOVA p<0.05
Agronomic adaptation

Weeds- Preliminary results

Dry matter yield (Kg.ha⁻¹)

<table>
<thead>
<tr>
<th></th>
<th>Summer</th>
<th>Fall</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vernalized</td>
<td>b</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>Spring</td>
<td>a</td>
<td>a</td>
<td>b</td>
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</table>

ANOVA p<0.05
Nutritive value parameters – Preliminary results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Germplasm</th>
<th>Summer 18/19</th>
<th>Fall 19</th>
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<tbody>
<tr>
<td></td>
<td>Spring</td>
<td>68.4</td>
<td>63.4</td>
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<tr>
<td>NDF (%DM)</td>
<td>Vernalized</td>
<td>67.6</td>
<td>64.2</td>
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<tr>
<td>ADF (%DM)</td>
<td>Spring</td>
<td>40.5</td>
<td>33.1</td>
</tr>
<tr>
<td></td>
<td>Vernalized</td>
<td>40.3</td>
<td>34.1</td>
</tr>
<tr>
<td>CP (%DM)</td>
<td>Spring</td>
<td>8.4</td>
<td>14.4</td>
</tr>
<tr>
<td></td>
<td>Vernalized</td>
<td>8.0</td>
<td>14.0</td>
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</table>

Tukey p<0.05
Breeding

Objetives

• Measure genetic components and response to selection on agronomic traits

• estimate additive variance, heredability and response to classical/phenotypic recurrent selection on different agronomic traits

• estimate response to selection mediated by genomic selection
Breeding—Material and Methods

Two half sib experiments

Arlington, Wisconsin (EEUU)

Paysandú (Uruguay)
Breeding

Experiment 1 (Wisconsin, EEUU)

TLIC4MN - 54 Half Sib families

Arlington (WI)

Traits evaluated per plant

- Flowering time
- Plant height
- Spikes per plant
- Spikelets per spike
- Spike weight
- Spike length
- Spikelets per plant
- Dry matter yield
Breeding

Experiment 2 (Paysandú, Uruguay)

TLIC4 / TLIC4MN / TLIC4A

Traits to evaluate

- Flowering time
- Plant height
- Spikes per plant
- Spikelets per spike
- Spike weight
- Spike length
- Spikelets per plant
- Dry matter yield

6/15/19
Breeding

Experiment 2 (Paysandú, Uruguay)

Characteristics of the experiment

- 30 Half Sib families
- 1080 plants (30 families x 12 plants per plot x 3 replications)
- Individual plant evaluation for two years (2019 – 2020)
  - flowering time
  - Dry matter yield (Summer and Winter)
  - Grain yield
- Genomic selection
  - selection of 200 genets at the end of 2020 (training population)
  - Selection of 400 genets under next generation (tested population) (April 2021)
  - Early genomic selection under next generation

$\{V_a, h^2\}$
Breeding – Experiment 2

Seedling vigor

- Emergence date (°C.day\(^{-1}\))
- Measure of plant height and Haun 30 days after planting

Tukey p<0.05