Does endophyte-association improve productivity in tall fescue?

The case of the novel AR584 strain in a non-limiting environment

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Lake Buena Vista, FL
March 26th 2019
Endophytes in tall fescue: some background

- Enhanced plant robustness     (Bacon & Siegel, 1988)
- Water deficit stress tolerance     (Elmi & West, 1995)
- Disease resistance     (Latch, 2009)

**AR584 strain**     (Latch et al., 2000) (Grasslanz Technology Ltd.):

- lacks ergot-alkaloids   - resistance to invertebrate pests

**AR584 in Uruguay:**

- Safe for cattle grazing     (Pereyra et al., 2018)
- Increased tolerance to aphids and white grubs     (Cibils-Stewart et al., 2017)
- Summer behavior   ->  no significant effect     (Pereyra et al., 2017; Larratea et al., 2018)
Environmental characterization

- **Temperature**: Annual average: 17ºC (Summer 24ºC/Winter 11ºC)
- **Rainfall**: Annual 1200mm / monthly 100mm (60-120mm)
- **Day length**: 10 hour winter / 14 hours summer
- **Frosts**: 25 per year
- **Tall fescue forage yield**: 7300 kg DM ha\(^{-1}\) annual average
Materials and methods

• Tall fescue yield trials from 2010 to 2017: 3 year terms

• 12 trials

• 2 Cultivars with and without AR584 endophyte

<table>
<thead>
<tr>
<th></th>
<th>INIA Aurora</th>
<th>INIA Fortuna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>3 ±2</td>
<td>25 ±8</td>
</tr>
<tr>
<td>E+</td>
<td>91 ±5</td>
<td>93 ±3</td>
</tr>
</tbody>
</table>

• 6.25 m2 plots - 4 reps - RCB design

• Seasonal and annual dry matter (DM) production
Results
Annual forage yield (kg ha\(^{-1}\) DM) year 1

<table>
<thead>
<tr>
<th>Trials</th>
<th>E+ &gt; Nil</th>
<th>Δ %</th>
<th>Δ kg</th>
<th>significant ((\alpha=0.05))</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Aurora</td>
<td>12</td>
<td>10</td>
<td>5</td>
<td>381</td>
</tr>
<tr>
<td>I. Fortuna</td>
<td>12</td>
<td>7</td>
<td>2</td>
<td>194</td>
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</tbody>
</table>
Annual forage yield (kg ha\(^{-1}\) DM) year 2

<table>
<thead>
<tr>
<th></th>
<th>Trials</th>
<th>E+ &gt; Nil</th>
<th>Δ %</th>
<th>Δ kg</th>
<th>significant (α=0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Aurora</td>
<td>11</td>
<td>10</td>
<td>6</td>
<td>412</td>
<td>0</td>
</tr>
<tr>
<td>I. Fortuna</td>
<td>11</td>
<td>8</td>
<td>3</td>
<td>146</td>
<td>1</td>
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</table>
### Annual forage yield (kg ha$^{-1}$ DM) year 3

**Table:**

<table>
<thead>
<tr>
<th>Trials</th>
<th>$E+ &gt; \text{Nil}$</th>
<th>$\Delta %$</th>
<th>$\Delta \text{kg}$</th>
<th>Significant ($\alpha=0.05$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Aurora</td>
<td>8</td>
<td>7</td>
<td>13</td>
<td>710</td>
</tr>
<tr>
<td>I. Fortuna</td>
<td>9</td>
<td>6</td>
<td>2</td>
<td>146</td>
</tr>
</tbody>
</table>
Seasonal forage yield (kg ha\(^{-1}\) DM): Autumn

<table>
<thead>
<tr>
<th></th>
<th>Significant ((\alpha=0.05))</th>
<th>(\Delta) %</th>
<th>(\Delta) kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Aurora</td>
<td>6</td>
<td>11</td>
<td>157</td>
</tr>
<tr>
<td>I. Fortuna</td>
<td>6</td>
<td>18</td>
<td>87</td>
</tr>
</tbody>
</table>

1\(^{st}\) Autumn

2\(^{nd}\) Autumn

3\(^{rd}\) Autumn

I. Aurora

I. Fortuna
Seasonal forage yield (kg ha⁻¹ DM): Winter

<table>
<thead>
<tr>
<th></th>
<th>I. Aurora</th>
<th>I. Fortuna</th>
</tr>
</thead>
<tbody>
<tr>
<td>significant (α=0.05)</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Δ %</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Δ kg</td>
<td>144</td>
<td>31</td>
</tr>
</tbody>
</table>
Seasonal forage yield (kg ha\(^{-1}\) DM): Spring

<table>
<thead>
<tr>
<th></th>
<th>significant ((\alpha=0.05))</th>
<th>(\Delta) %</th>
<th>(\Delta) kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Aurora</td>
<td>4</td>
<td>5</td>
<td>143</td>
</tr>
<tr>
<td>I. Fortuna</td>
<td>2 (1)</td>
<td>2</td>
<td>15</td>
</tr>
</tbody>
</table>
All trials together:

1st year

I. Aurora

- E+ Nil

Pr > |t| 0.022

I. Fortuna

- E+ Nil

Pr > |t| 0.246

2nd year

I. Aurora

- E+ Nil

Pr > |t| 0.017

I. Fortuna

- E+ Nil

Pr > |t| 0.227

3rd year

I. Aurora

- E+ Nil

Pr > |t| 0.222

I. Fortuna

- E+ Nil

Pr > |t| 0.824

**Legend:**

- E+: Green
- Nil: Light Green
All trials together:

1st Autumn

Pr > |t| 0.0288

1st Winter

1st Spring

2nd Autumn

Pr > |t| 0.002

2nd Winter

2nd Spring

3rd Autumn

3rd Winter

3rd Spring
Summary and conclusions

• E+ version yields more than Nil version
• Difference up to 5% but often not significant
• Differences mainly in autumn after the summer stress
• What can be expected under farming conditions?
Thank you!