UAV-based remote sensing for evaluation of drought tolerance in forage grasses

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Aim and methods

**Aim**
- evaluate UAV-based remote sensing (VIS + thermal camera) as alternative to visual scoring of drought tolerance trials of forage grasses in a breeding context

**Materials and methods**
- 3x 300m² rain-out shelters – 2250 individual plants
- scores by breeder
- drone
  - VIS camera ⇒ gcc (green chromatic coordinate index, gcc =100 G/(R+G+B)), ExG (Excess green Index, ExG=2G-(R+B))
  - Thermal camera ⇒ Tc

**Statistics:**
- correlations
Thermal imaging

Is genotypic difference visually observable from a thermal image?

1 = Lolium perenne, 2n
2 = Lolium perenne, 4n
3 = Festuca arundinacea

seedlings one family
edge plants

Ts (°C)

1 = Lolium perenne, 2n
2 = Lolium perenne, 4n
3 = Festuca arundinacea
Results and conclusions

More efficient screening for drought tolerance?

Table 2  Correlation between VIS (ExG = excess green; g_{cc} = green chromatic coordinate) and thermal (T_c = canopy temperature, °C) image derived parameters estimated at 29 days of drought (6 September) and visual scores. All correlations were significant at the 0.05 level (n=2210)

<table>
<thead>
<tr>
<th>Drone variables</th>
<th>Scores</th>
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<tbody>
<tr>
<td></td>
<td>29 days of drought</td>
</tr>
<tr>
<td>T_c (mean)</td>
<td>-0.619</td>
</tr>
<tr>
<td>T_c (standard deviation)</td>
<td>-0.279</td>
</tr>
<tr>
<td>ExG (mean)</td>
<td>0.809</td>
</tr>
<tr>
<td>ExG (standard deviation)</td>
<td>0.140</td>
</tr>
<tr>
<td>g_{cc} (mean)</td>
<td>0.802</td>
</tr>
<tr>
<td>g_{cc} (standard deviation)</td>
<td>0.603</td>
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- score = amount of green biomass (approx. 6 hours)
- high correlations (also per species, up to 0.866)
- perspective for use of UAV-based remote sensing for drought tolerance
- improvement workflow is needed for real-time processing