MULTISPECTRAL IMAGING IN SEED TESTING

BIRTE BOELT
bb@agro.au.dk
MULTISPECTRAL IMAGING (MSI)

- Light emitting diodes in the range from UV, VIS to NIR
- Reflected light is captured in raw images
- Information from each pixel, exposed to each wavelength is stored in data files
- Transformed images provide information about surface characters

MSI IN SEED QUALITY ASSESSMENT

Collaborative project with the aim to

- develop multispectral imaging technology for fast, cost-efficient, and non-destructive analysis of seed quality
- work with commercial seed lots
- test and document accuracy
- implement and/or identify barriers
EXAMPLE I: SEED HEALTH IN MALTING BARLEY

DISCRIMINATION OF FUSARCIUM SPECIES

- Naturally infected barley seeds of European origin, 2012-16
- Reference method Next Generation Sequencing
- Model developed for red and grey signatures
- Automated system implemented in Viking Malt

Boelt et al. 2018. Seed Science Research
doi.org/10.1017/S0960258518000235
EXAMPLE II: PURE SEED - SPINACH

Polygonum convolvulus
Galeopsis tetrahit
Galium aparine
EXAMPLE II: PURE SEED - SPINACH

SPINACH AND THREE WEED SPECIES

Spinach
Galium aparine
Polygonym convolvulus
Raphanus sativus
### EXAMPLE II: PURE SEED - SPINACH

**TRAINING WITH COMMERCIAL SEED LOTS**

#### Classifier performance on test set with 57,115 seeds

<table>
<thead>
<tr>
<th>Reference</th>
<th>Cereal</th>
<th>Spinach</th>
<th>Cleavers</th>
<th>Black bindweed</th>
<th>Radish</th>
<th>Rapeseed</th>
<th>Hemp-nettle</th>
<th>Total</th>
<th>Error</th>
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<td>Cereal</td>
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<td>0</td>
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<td>7.5</td>
<td>1.5</td>
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<tr>
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<td>0</td>
<td>99.7</td>
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<td>0</td>
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<td>0.5</td>
<td>0</td>
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<tr>
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<td>0.5</td>
<td>0.9</td>
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<td>2.1</td>
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</table>
Spinach samples of 2,250 seeds with 10 *Galium aparine*

- Detection rate spinach 99.2 – 99.7%
- All *Galium aparine* seeds were found
EXAMPLE II: PURE SEED - SPINACH
IMPLEMENTATION IN SEED INDUSTRY

- Automated system implemented adjacent to the process line in Vikima Seed analysing samples of 8,000 seeds in 10-12 minutes
SEED VIABILITY - GRASSES

- Does early counts of radicle emergence correlate with the number of normal seedlings?
- Commercial seed lots
  - 2 grass species
  - 4 varieties
  - 3 harvest years
- Reference: Standard germination test, ISTA
EXAMPLE III: SEED VIABILITY – GRASSES

RADICLE EMERGENCE/NORMAL SEEDLINGS

Perennial ryegrass

Red fescue

![Graph showing seed viability of Perennial ryegrass and Red fescue.](image-url)
EXAMPLE III: SEED VIABILITY – GRASSES
EARLY “COUNTS” OF RADICLE EMERGENCE

Day 2  Day 3  Day 4

Final normal seedlings (%)

Videometer prediction (%)

Cultivar
- Calibra
- Capri
- Esquire
- Mathilde

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AARHUS UNIVERSITY
DEPARTMENT OF AGROECOLOGY
A scatter plot showing the relationship between the Videometer prediction on day 3 (%) and the final normal seedlings (%). The plot is divided into four quadrants:

- **True positive**: Points in the top right quadrant where both prediction and final seedlings are above a certain threshold.
- **False negative**: Points in the bottom left quadrant where the prediction is above the threshold but the final seedlings are below it.
- **True negative**: Points in the bottom right quadrant where both are below the threshold.
- **False positive**: Points in the top left quadrant where the prediction is below the threshold but the final seedlings are above it.

The cultivars shown are Corail, Gondolin, Maxima, and Mystic.
EXAMPLE III: SEED VIABILITY – GRASSES

PREDICTION ACCURACY, PRELIMINARY

Red fescue day 3: 22%

Red fescue day 4: 75%
CONCLUSION: MSI - SEED QUALITY ASSESSMENT

Implementation:
- Automated on-line systems in malting barley and spinach
- Lab-model – early radicle counts

Barriers:
- Methods based on weight
- Characters related to surface
- Training and validation

ATC-workshops
CONCLUSION: MSI - SEED TESTING

Seed health:
- Symptoms on seed surface ✓

Pure seed:
- The purity analysis ÷ (by weight)
- Determination of other seeds ✓
  - ISTA: TCOM project: ATC, PUR

Seed viability:
- The germination test ÷
- Radicle emergence ✓
  - ISTA: Vigour comm., TCOM project: GER, ATC
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