## SUMMARY

- Soil constraints rarely in isolation
- Most amelioration options are permanent
- Cheapest or trendiest may not be best
- If can deal with more than one then bonus
- R&D (south);
  - Effectiveness of soil wetters
  - NWS agronomy
  - OM/topsoil inclusion
  - Grower initiated activities

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### SOIL CONSTRAINTS


Boron toxicity susceptibility
Flood hazard
Inherent fertility
Permeability
Physical crop-rooting depth
Soil water storage

**Subsoil acidity**
Subsoil alkalinity

**Subsurface compaction susceptibility**
Surface soil structure decline susceptibility
Salinity
Topsoil acidity
Water erosion hazard
Waterlogging/inundation risk

**Water repellence susceptibility**
Wind erosion hazard
Workability
Subsoil acidity (pHw) < 5.6 at 15–25 cm

Moderate or greater subsurface compaction susceptibility
Soil water repellence susceptibility

Moderate or greater water repellence susceptibility

Resource Management Technical Report (11-2016), Dennis van Geel

Process for amelioration

- Before amelioration
  - Dig some holes/pits
  - Look for hazards below surface
  - Develop an plan
  - Test strips if uncertain
  - Seek technical advice if needed
2016 test strip ~1km long >3 soil types after large rainfall event

2017 unincorporated clay less plants than NWS

Management options for a compacted repellent deep sandy duplex – yield responses over 5 years

Comparing options

Steve Davies, DPIRD
Managing multiple constraints

Tillage impacts on grain yield response

- Severe repellence
- One-way plough reduced repellence by 43%
- Mouldboard reduced repellence to nil
Emergence (plants/m²)

- 2015 barley
- 2016 canola

Barley LSD 10% = 13 plants/m²
Canola LSD 10% = 11 plants/m²

More response in 2015 than 2016
Canola more sensitive to tillage

Grain yield (t/ha)

- 2015 barley
- 2016 canola

Barley LSD 5% = 0.75 t/ha
Canola LSD 5% = 0.22 t/ha

Tillage increased yield in both years
Wetter had more positive effect in 2015
Wetter placement (2016)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain Yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>5.2</td>
</tr>
<tr>
<td>In-furrow 2L/ha</td>
<td>5.0</td>
</tr>
<tr>
<td>On-furrow 2L/ha</td>
<td>5.1</td>
</tr>
<tr>
<td>In-furrow 4L/ha</td>
<td>5.0</td>
</tr>
<tr>
<td>On-furrow 4L/ha</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Darkan compared to Kojonup:
- No response at Kojonup, small effect at Darkan.
- LureH2O in-furrow little better than on-furrow at Darkan (ns).

Loamy gravel, barley 2016

NWS by drone:
- 2016 wetter on furrow with barley
- Wetter on furrow 2017 only
**Can we use drones?**

**Aims:**
- Assess whole plot over time
- Proportion of plot affected
- Obtain DATA, not just photo

**Data can give:**
- Rate of change in growth (i.e. staggered emergence)
- Levels of non-wetting based on crop development
- Follow through until flowering

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**MBP/spading effects on agronomy**

**Herbicide interactions**
- Trials at Corrigin and Esperance - (Tom Edwards)
- Pre-emergent (Corrigin)
- SU’s x pre-emergent (Esperance)

**Nutrition**
- Nutrient deficit during establishment
- Sink/storage of nutrients in root zone
- Mineralised N later
- Protein effects

**Weed seeds**
- Effective burial
- Depth
**Barley Grain Yield - Ongerup 2016**

- Trenching Trial

<table>
<thead>
<tr>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>2000</td>
</tr>
<tr>
<td>3000</td>
</tr>
<tr>
<td>4000</td>
</tr>
<tr>
<td>5000</td>
</tr>
</tbody>
</table>

*error bars = +/- SD of means*

- **Dalyup Claying Experiment (1999-2014)**

<table>
<thead>
<tr>
<th>Clay t/ha</th>
<th>Clay%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>0.9</td>
</tr>
<tr>
<td>100</td>
<td>1.0</td>
</tr>
<tr>
<td>200</td>
<td>3.1</td>
</tr>
<tr>
<td>300</td>
<td>6.6</td>
</tr>
</tbody>
</table>

*6% Clay 300t/ha  0.8% Clay 0 t/ha*

David Hall, DPIRD
### Clay quality

#### Clay Pit Survey (n=82)

<table>
<thead>
<tr>
<th>Clay</th>
<th>EC mS/m</th>
<th>pHCa ppm</th>
<th>P ppm</th>
<th>K ppm</th>
<th>S ppm</th>
<th>CEC me/100g</th>
<th>Boron ppm</th>
<th>PRI ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Av</td>
<td>40</td>
<td>0.4</td>
<td>6.8</td>
<td>3</td>
<td>320</td>
<td>51</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Max</td>
<td>75</td>
<td>2.3</td>
<td>8.7</td>
<td>13</td>
<td>1090</td>
<td>337</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>Min</td>
<td>10</td>
<td>0.0</td>
<td>4.7</td>
<td>1</td>
<td>19</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

- **Nutrient benefit**
- **Potential issue**
- **Nutrient limitation**

Ideal clay content → between 3 - 6%

Claying → long term solution + improving soil nutrition

Poor incorporation → crusting and emergence issues

Test clays before applying (Standard test + Clay%, PRI, Boron)

**Supporting your success**

David Hall, DAFWA

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### Delving

#### Beaumont (2016)

- Spading MED <0.1
- Grizzly MED =0.7-0.2
- Non wetting sand
- Control MED 1.7
- Enamel-like domed Clay @ 25cm 2.5mPa
- Compacted clay @40cm 4mPa

**Supporting your success**

Giacomo Betti, Steve Davies, DPIRD
Extra incorporation didn't improve yield
Likely frost effect on control but not quantified

Clay x incorporation trial, 2016
- Yellow sandplain, Moora
- Severe repellence
- Barley

Giacomo Betti, Steve Davies, DPIRD
Clay x incorporation trial, 2016

- Frost & tillage

DAW00241 Farming systems for frost; Garren Knell, ConsultAg Narrogin
Possible causes:

- Stubble burial (Yr 1)
- Phenology change
- Improved nutrition
- Soil heat bank
- “Mulching”

Take home messages

- If possible address multiple constraints at same time (eg lime before tillage)
- Wetters do work… just not perfect in all soils all the time
- Tillage is effective for NWS… but investigate what’s below first
- Claying is long term… but test first and incorporate
- Working on new R&D areas
Thank you
Visit dpird.wa.gov.au

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Subsoil acidity (pHw) <5.6 at 15–25cm

Area where subsoil acidity is one of few (1–3) constraints

Moderate or greater subsurface compaction susceptibility
Area where subsurface compaction is one of few (1–3) constraints

Moderate or greater water repellence susceptibility
Area where water repellence is one of few (1–3) constraints