Precise Application of Fertiliser

FAI meeting May 2017

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Teagasc CELUP
Oak Park Crops Research
But are we more precise today?
Why Consider Spreaders

♦ Fertiliser is expensive and impacts on:
  ▶ Costs
  ▶ Production
  ▶ Environment

♦ Need to spread:
  ▶ **Accurately:** Calibration
  ▶ **Evenly:** Even across spreading width
The spreader is important!

♦ 100 ha Farm: Winter Wheat 9t/ha 8 years

€7,000 Spreader → €266,000 Fertiliser → £1,008,000 Wheat (green)

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Striping: Need to Spread Evenly
Striping: Need to Spread Evenly
Lodging: Need to Spread Evenly
Today’s Challenges

♦ Wide bout widths:
  ▶ 12m ► 18m ► 24m ► 27/28m ► 30m ► 42m ?

♦ Fertiliser
  ▶ Variable Quality
  ▶ Urea products

♦ Field Vs test hall conditions

♦ All 3 in combination – biggest challenge

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Spreaders must spread Evenly!

Evenly across bout width

Coefficient of Variation (CV):
- Rates variation / evenness
- Good CV (Low): 4.4%
Spreads must spread evenly!

Poorer CV (Higher): 16%
CV & Wheat loss (€/ha): Sample

- CV to loss relationship: Not universal
- Different causes – different impacts
- Lodging not included
Even Spreading

♦ Machine design
♦ Fertiliser characteristics
♦ Machine setting
♦ Field conditions - Wind
The Machine!
The Machine!
Machine Design

♦ Spreading elements
  ▶ Discs (shape, speed)
  ▶ Vanes (length, shape, position)
  ▶ Fertiliser delivery point onto disc

♦ Influences
  ▶ Basic spread pattern; overlapped pattern + bout width capability
  ▶ Impact of fertiliser type and wind
  ▶ Adaptability to Headland spreading, reducing bout width (short ground) etc.

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Building up a spread pattern

CV: 6.7%

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Triangular pattern: forgiving

CV: 4.8 - 6.7 %
Shouldered pattern: unforgiving!

CV: 8.7 - 13.4 %
Good Spreader

♦ Good basic spread pattern
  ▶ Triangular – wide base – wide overlap
  ▶ Capable of required bout width with fert to be used
  ▶ Supported by test results – preferably independent

♦ Easy to set for fertiliser and bout width
  ▶ Simple and/or clear method
  ▶ Good supporting material
    ▶ Fert classification and setting
Fertiliser Physical Quality
Fertiliser characteristics

- Granule **size**, **shape**, **density** and **strength**

Influences:
- Movement on disc
- Throw off from vanes
- Movement through air
- Breakage into smaller particles and dust
Fertiliser characteristics

- **Size:** Larger: Captures more energy – easier throw
- **Shape:** Rounded: Rolls easier on disc; smoother through air
- **Strength:** Prevents breaking to dust / smaller particles

- **Ideal:**
  - 80% of particles in 2-4mm range
  - **But** larger will be better i.e. 3.3mm+
  - Rounded and smooth
  - Blend components: mean particle size within 10% of overall mean
  - Strong particles that do not break

- **Interaction between fertiliser and spreader**
Fertiliser characteristics

Density:
- High density: A given size with more weight to capture more energy
- Golf ball v table tennis ball
- Distance and wind

Fertiliser Types
Most: 1kg / litre
Urea: 0.7-0.8 kg / litre

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Urea – (increased interest)

- Lower Density – All Urea
- Different size distribution: not always poorer
- Particle Strength: may be weaker

- Huge variation in size distribution and strength
  - Depends on manufacturing plant
  - Lots of options available to Irish suppliers
  - Farmers must seek good physical quality
CAN: Size distribution (%)
NPK: Size distribution (%)
UREA 1: Size distribution (%)
UREA 2: Size distribution

- 92% of samples fall within the 2-3.3mm size range.

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Urea 3: Size distribution

98% in the 2-3.3mm size range.

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Size distribution

NPK

Urea 2

Urea 1

Urea 3
Urea—generally

♦ Not a uniform product: supplier dependent
♦ Density is always a challenge
♦ More sensitive to wind
♦ Will not throw as far as similarly sized high density product. - May restrict tramline / bout width
♦ Will suit some machines more than others
♦ Needs careful setting
Fertiliser characteristics

- Prills or Granules - not really important
- Depends on size, shape, density

Granules - Large  Prills - Large  Prills - Small

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Good Quality Fertiliser: Triangular

CV: 6.7%

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Good Quality Fertiliser: Triangular

CV: 6.7%
Good Quality Fert: Windy conditions

Spread rate (%) vs. Width (m)

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Poorer Quality Fertiliser: Shouldered

CV: 8.7%
Poorer Quality Fertiliser: Shouldered

Spread rate (%) vs Width (m)

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Fertiliser blends

- Different components (N, P, K etc) – different physical characteristics
- Risk of segregated spread
- Ideally:
  - Blend components: mean particle size within 10% of mean
  - Similar shape and strength
- In practice:
  - Similar spread characteristics required
Fertiliser blends – Urea

- Urea blends: N + S, N + K, N + P products
  - Different density components!
  - Risk of segregation
    - (N near the tractor; S, P, K between trams ? ?)
  - Not impossible to get a good spread, but difficult!
    - Larger low density components matched with smaller high density?
  - Onus is on the manufacturers to provide:
    - machine specific information at desired bout width
    - Even spreading of components must be verified
    - Some fert supply companies very active in this area

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Setting the spreader Evenness.
Setting the spreader: Evenness

♦ Determined by:
  ▶ Bout width
  ▶ Fertiliser quality

♦ Setting / selection of:
  ▶ Disc type and speed
  ▶ Vane type, length, number, angle
  ▶ Fertiliser drop position
  ▶ Spreader / Disc angle and height over crop

♦ Manufacturers resources
Setting resources 1: Test halls

- Huge numbers of fertilisers
- Range of bouts
- But ‘perfect’ conditions
Setting resources 2: characterisation
Setting resources 3: Matching product
4. Your settings

Your machine

DPX
EXPERT/MAGNUM/1205/1505/1805/GLX

Set of vanes

18–28

Working width

24

Width settings*

145

Rate settings*

<table>
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<tr>
<th></th>
<th>250 kg/ha</th>
<th>300 kg/ha</th>
<th>350 kg/ha</th>
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<tbody>
<tr>
<td>10 km/h</td>
<td>20</td>
<td>32</td>
<td>36</td>
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<tr>
<td>12 km/h</td>
<td>32</td>
<td>36</td>
<td>41</td>
</tr>
<tr>
<td>14 km/h</td>
<td>36</td>
<td>41</td>
<td>45</td>
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</tbody>
</table>

Special settings*

none

Selected fertiliser:

KOCH FERTILIZER PRODUCTS SAS
NUXOR 46 (TB)
Density: 0.74
Field checking of evenness

- Tray tests
  - Full width to check overall pattern
  - Time consuming and difficult to set up
  - Part widths to indicate correct setting
Getting the Rate Right:

Calibration
Applying the correct rate

- Fertiliser Flow characteristics vary
  - Between fertiliser types
  - Between batches
  - Depending on weather conditions

- Individual machine settings can vary

- Calibration essential
  - Fertiliser flow rate
  - Tractor forward speed
  - Correct bout width

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Calibration practice

♦ Manufacturers support
  ▶ Rate charts
  ▶ Web-based, Phone App material
  ▶ Tests of Irish fertiliser
  ▶ Test kits (sieve test and ID charts)
  ▶ Flow testers
  ▶ Calibration procedures and kits

♦ On-board weighing and automatic calibration

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Advanced Control systems

♦ Constant application rate with:
  ▶ Variable forward speed or variable fert flow rate

♦ Vary application rate ‘on the go’
  ▶ Manually (+/- certain percentages)
  ▶ Variable rate Precision Ag type system

♦ Controlled headland operation
  ▶ Auto headland shut on/off
  ▶ Graduated shut off for angled headland etc
  ▶ Using GPS to determine position
Spreader development
More Advanced Control systems!

♦ Argus Twin
♦ Radar measurement
♦ Adjust drop point

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More Advanced Control systems!

- Argus Twin
- Radar measurement
- Adjust drop point
Precision Fertiliser?

- Grid soil testing
- Spatially variable application P, K and lime
Precision Fertiliser?

- Crop reflectance
- Spatially variable application N
Farmstar N sensing - France
Yara N Sensor

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E bee drone with Sequoia

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NITROGEN RECOMMENDATION - DETAILED RECOMMENDATION

Flight date: 11/05/2016
Average Nitrogen Absorbed: 115 kg N/ha
Average Dry Matter: 4.1 T/ha

AVERAGE DOSE 99 KG N/HA

<table>
<thead>
<tr>
<th>Dose to apply</th>
<th>Surface</th>
<th>%</th>
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<tr>
<td>37 kg N/ha</td>
<td>2.9 ha</td>
<td>5</td>
</tr>
<tr>
<td>64 kg N/ha</td>
<td>8.8 ha</td>
<td>15</td>
</tr>
<tr>
<td>83 kg N/ha</td>
<td>8.8 ha</td>
<td>15</td>
</tr>
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<td>99 kg N/ha</td>
<td>8.8 ha</td>
<td>15</td>
</tr>
<tr>
<td>112 kg N/ha</td>
<td>8.8 ha</td>
<td>15</td>
</tr>
<tr>
<td>121 kg N/ha</td>
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<td>15</td>
</tr>
<tr>
<td>131 kg N/ha</td>
<td>11.8 ha</td>
<td>20</td>
</tr>
</tbody>
</table>
Crop Reflectance and N

♦ BUT!!!
  ▶ Does it work?
  ▶ Not clear cut: 1% or 3-4% yield improvement?

▲ Need to combine information on:
  Not always clear cut benefits!

More immediate Concern:
Apply Fertiliser Evenly and Precisely
Finally!
Big Challenges!

- Increased bout widths
- Field vs Test Hall
  - Wind
  - Moving machine, ground contours
  - Machine setting and wear
  - Spreaders differ – good basic patterns: less impact
- Urea
- Spreader manufacturers show best results

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Will a manufacturer show this?
Same data in the brochure!

- Change the scale !!
- Looks far better but its still a poor spread.

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Conclusions

♦ Know the challenges
  ▶ Bout width
  ▶ Fertiliser physical quality
  ▶ Real field conditions

♦ Fertiliser physical quality must be considered
  ▶ Fert blenders / suppliers; merchants; farmers

♦ Choose spreader for bout width and fertiliser

♦ Setting / Adjustment is imperative