Strip tillage, definition and description of use; in what circumstances could it replace ploughing?

Nathan Morris
• Tillage can be divided into two broad categories –
  – Conventional tillage
    • full-width tillage and may involve one, three or perhaps up to 15 tillage passes. There is less than 15 percent crop residue on the soil surface.
    (CTIC - www.ctic.purdue.edu)

  – Conservation tillage
    • Conservation tillage (CT) refers to a system of raising crops with minimal disturbance of soil while retaining crop residue on soil surface. European Conservation Agriculture Federation.
    (ECAF - http://www.ecaf.org/)
UK tillage definitions

- ‘Conservation’ tillage is a term used internationally although it does not accurately describe the tillage operations used within UK conditions.

- In the UK tillage is divided into two broad categories:
  - Inversion tillage
    - Usually encompassing a sequence of operations to produce a seedbed using the plough as the primary cultivation.
  - Non-inversion tillage
    - Typically cultivating to 10-20 cm depth incorporating straw residue into the soil whilst retaining ≥ 30% of crop residue on the soil surface.
    - Deep tine / sub-cast techniques (>25 cm depth) are commonly used for establishing oilseed rape in a ‘single pass’.
    - Other ‘single pass’ systems such as the Claydon Drill or Mzuri drill.
    - Direct drilling or strip tillage is also included as a non-inversion approach whereby the soil is undisturbed except for a small zone around the seed.
Classification of tillage systems

Tillage System

Inversion Tillage
- Conventional Tillage
  - Primary tillage (Mouldboard plough)
  - Secondary tillage (Surface tillage)

Non-inversion Tillage
- Non-inversion tillage (deep cultivation 10-20cm)
- Strip tillage — only cultivates a band of soil whilst retaining undisturbed soil and surface crop residue
- Direct drilling

Decreasing tillage intensity

Taken from: Morris et al. 2010 Soil & Tillage Research 108 (2010) 1–15
Strip tillage definition

• Strip tillage has been defined by the Conservation Technology Information Centre (CTIC) as a modification to a direct drilling system where disturbance of less than one third of the total field area is cultivated.

(CTIC - www.ctic.purdue.edu)
Strip tillage - General history

- Developed in the Northern Corn Belt of the U.S.
- Modification to direct drilling.
- Conservation tillage system.
- Become popular to reduce crop establishment costs and soil erosion.
- Used mainly in maize/soybean rotation cropping sequences in the U.S.
- Popular in cold, wet soils where direct drilling produces low yields.
Strip tillage

- Strips created in autumn or spring.
- <1/3 field area cultivated.
- Creates a narrow, tilled strip 20-25 cm wide.
- Raised strip 7-10 cm high when created.
- Settles to 1-2 cm in spring prior to drilling.
- Strip is free from straw residue.
- Between row area left with straw residue on surface.

Image courtesy of Purdue University, Lafayette, Indiana, USA.
Implement design

- Parallel linkage maintains working depth
- Star wheel removes straw residue
- Large diameter disc coulter (smooth or fluted)
- Winged or knife tine
- Closing discs (smooth or notched) to create “berm”
Fuel use and work rates

<table>
<thead>
<tr>
<th>Tillage treatment</th>
<th>Ha/hr</th>
<th>Mins/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plough</td>
<td>0.80</td>
<td>75</td>
</tr>
<tr>
<td>Strip Till</td>
<td>1.02</td>
<td>60</td>
</tr>
</tbody>
</table>

Graph: Fuel use (l/ha)

- 5-furrow plough: 28 l/ha
- 4 "unit" strip till: ~10 l/ha

Tillage treatment
So why strip tillage?

- Reduced fuel use.
- Reduced number of field passes – Typically field operations are completed in 1 to 2 passes.
- Reduction in soil erosion – American research has indicated that wind velocity is reduced by up to 50% at the soil surface.
- Increased soil moisture retention.
- Potential for improving soil structure – greater load-bearing capacity and lower sensitivity to soil compaction.
Oilseed rape establishment

Margins based on diesel at 65p/pl and oilseed rape at £375/tonne
Oilseed rape establishment

Margins based on diesel at 65ppl and oilseed rape at £375/tonne
Oilseed rape establishment

Margins based on diesel at 65ppl and oilseed rape at £375/tonne
Sugar beet

Sugar beet - adjusted yield t/ha

Yield response to cultivation timing

Potential for sugar beet yield to be comparable to plough tillage and as part of the BBRO funded 3-year project.
Development of strip tillage on medium soils

Treatments:
1) Strip tillage with rolling basket
2) Strip tillage without rolling basket
3) Strip tillage with rolling basket + pre-cultivation
4) Strip tillage without rolling basket + pre-cultivation
5) Plough
Strip tillage
Development of strip tillage on medium soils

6% yield increase with rolling basket

Adjusted yield (t/ha)

<table>
<thead>
<tr>
<th></th>
<th>Strip tillage</th>
<th>Strip tillage + pre cultivation</th>
<th>Average</th>
<th>Strip tillage</th>
<th>Strip tillage + pre cultivation</th>
<th>Average</th>
<th>Plough</th>
</tr>
</thead>
<tbody>
<tr>
<td>With rolling basket</td>
<td>105 ± 5</td>
<td>100 ± 5</td>
<td>103 ± 5</td>
<td>105 ± 5</td>
<td>100 ± 5</td>
<td>103 ± 5</td>
<td>110 ± 5</td>
</tr>
<tr>
<td>Without rolling basket</td>
<td>95 ± 5</td>
<td>95 ± 5</td>
<td>95 ± 5</td>
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<td>95 ± 5</td>
<td>95 ± 5</td>
<td>105 ± 5</td>
</tr>
</tbody>
</table>

LSD = 17.962
CV = 8.83
When is it suitable to use strip tillage?

• Generally wide row crops are the most suitable crops including:
  o OSR
  o Maize
  o Sugar beet
  o Beans??

• Soil types;
  o Cultivation timing depends on soil type
    o For soils >10% clay content cultivation should be completed in autumn.
    o For light land and organic soils these can be cultivated in the spring.