BCPC 58th Annual Weeds Review - 2021
“"IWM –it’s not just about weeds””

Farming systems, soil management and weeds – holistic approaches in crop production

Dr Alastair Leake  *FRAgS FIAgrM CEnv*
Project Director – The Allerton Project
Loddington, UK
BCPC 58th Annual Weeds Review - 2021
“IWM – it’s not just about weeds”
Farming Systems

• Mixed Organic Farming
• All-Arable Organic Farming (stockless rotations)
• Integrated Farm Management
• “Conventional” farming – maximising production
• Conservation Agriculture
• Regenerative Agriculture
Mixed Organic Farming
Mixed Organic Farming – key principles

- Fertility restoring phases alternated with cash cropping (exploitative)
- Based around legumes in both phases
- FYM allows fertility to be shifted from the pastoral phase to the arable phase
- Soil type, condition and weed pressure determines the length of the arable phase
Mixed Organic Farming – weed control

- 3 years grass/white clover => w.wheat => w.oats => w.beans => s.oats undersown grass/white clover
- Important to control docks and thistles in the ley period
- Sequential stale-seedbeds prior to drilling
- Delayed drilling of winter sown crops until mid-November
- Double seed-rate – up to 250kg/ha in WW
- Mechanical weeding in spring if conditions allow
- Photo control at drilling
Weed emergence day/night sown + with/without cowl

The Effect of Cultivation Timing on Weed Density With and Without Cowl

<table>
<thead>
<tr>
<th>Time of Cultivation</th>
<th>With Cowl</th>
<th>Without Cowl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
<td>148.8</td>
<td>154.4</td>
</tr>
<tr>
<td>Night</td>
<td>105.6</td>
<td>121.6</td>
</tr>
</tbody>
</table>

Bulson, Welsh 1996
Chickweed infestation – 1st wheat after grass
Mechanical Control - Harrowcomb weeder
Mechanical Weeding – lessons learnt

• Only effective when soil surface is dry
• Cereals are resilient – broad leaved crops less so
• Nitrogen mineralisation useful
• Harrow-comb weeders are selective – trailing weeds susceptible, tap rooted weeds resistant
• Inter-row harrows are non-selective – including wildlife & the crop!
• Row spacing in cereals can increase to 20-25cm before yield is adversely affected
Mechanical Weeding – lessons learnt

• Only effective when soil surface is dry
• Cereals are resilient – broad leaved crops less so
• Nitrogen mineralisation useful
• Harrow-comb weeders are selective – trailing weeds susceptible, tap rooted weeds resistant
• Inter-row harrows are non-selective – including wildlife & the crop!
• Row spacing in cereals can increase to 20-25cm before yield is adversely affected
Inter-row hoeing
White Lupins – Inter-row hoe for weed control
Guided inter-row hoe
Charlock in calabrese
Fat hen in cauliflower
All-Arable Organic Farming (Stockless)

- Huge infrastructure and management barriers to bringing back stock to all-arable farms
- Strong market demand for organic cereals for human and livestock rations
- Mower/topper replaces the stock
- Rotational principles unchanged; Grass/Red clover => WW => WO => W.Beans => WW => S.Oats/Grass/Red Clover undersown => cut and mulched for 1 year
Stockless Organic Farming – weed control

• Cut and mulch to prevent seeding during fertility building
• Same techniques as in mixed farming
• Thermal control in potatoes
• Hand rogueing
• Crop destruction
Weed Management in stockless organic farming
Increasing dock infestation
Crop destruction – wild oat infestation
Environmentally friendly weed control?
Integrated Farm Management

• “combining cultural, biological and mechanical control techniques with judicious use of chemical control”
• Modified herbicide dose rates
• Threshold approaches?
• Reduced tillage
Threshold approaches?
Traditional crop establishment
Minimising Soil Disturbance
Trash Rake
Trash Raked Stubble
Trash Raked Stubble
Improving the cropped environment for wildlife
Grey partridge chick diet

First week
• 95% insects

First & second week
• 80% insects
Grey partridge chick survival v. insects
(each point is a year)
Enhancing habitat within the crop – spring germinating weeds
Enhanced In-crop habitat for insects
Yield compromised
Conservation Agriculture – guiding principles

• Minimum soil disturbance
• Maximum soil cover
• Diverse crop rotation
European Conservation Agricultural Federation 1999
7 National Associations => 15
SOWAP

Soil and Water Protection

European Collaborative Study
Switch cultivation for benefit

- Sediment kg/ha
  - Plough: 0, 1000, 2000
  - CT: 0, 1000, 2000

- Total P kg/ha
  - Plough: 0, 0.02
  - CT: 0, 0.02

- Available P kg/ha
  - Plough: 0
  - CT: 0

Runoff l/ha
- Plough: 20000, 10000, 0
- CT: 20000, 10000, 0

LIFE project, IACR, SMI
Earthworm Tubes of Conventional and Conservation Tillage
Min-till Sugar Beet, SOWAP
Ploughed Sugar Beet, SOWAP
Cover Crops

• Grown through autumn/winter
• Green cover all year
• Retain nutrients
• Increase organic matter
• Reduce soil erosion
• Stabilise environment
• Buffer extreme weather
• Reduce weed problems (Blackgrass)
• Provide pollen/nectar/cover
Direct Drilled Cover Crop
Impossible Field!
Impossible Field- Problem Solved!
Radish & Oat Cover Crop
Early Sown Crops
Direct Drilling into green covers
Direct Drilling into Cover Crop
Herbicide Application
Six Weeks from Drilling
Little Weed Emergence
Retained Moisture
Dry Soil
Wheat Direct Drilled Into Grass Ley
Conservation Agriculture and Sustainable Farming Systems project
European Conservation agriculture project: 2017-2022

Purpose of study
Develop an understanding of a cereal cropping system based on Conservation Agriculture principles so when moving towards a more sustainable cropping system, adoption can be quicker and more reliable for growers and the wider agricultural industry.
Conservation agriculture project

*Three systems*

**Conventional:** 15-20 cm depth inversion cultivation

**Sustainable System 1:** 10-15 cm depth non-inversion cultivation

**Sustainable System 2:** 0-10 cm depth light cultivation
In summary:

All results are comparing Sustainable System 2 (direct drill / light till) against the Conventional System (plough) averaged across the seasons (Lenham 2 years and Loddington 3 years)

<table>
<thead>
<tr>
<th></th>
<th>Bird sightings</th>
<th>Earthworm numbers</th>
<th>Soil GHG emissions</th>
<th>Carbon footprint</th>
<th>Crop Establishment</th>
<th>Yield t/ha</th>
<th>Fuel use l/ha</th>
<th>Work rate ha/hr</th>
<th>Operation cost £/ha</th>
<th>Grain margin £/ha</th>
<th>Net profit £/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lenham - Light land site</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>105%</td>
<td>49%</td>
<td>17%</td>
<td>9%</td>
<td>3%</td>
<td>3%</td>
<td>65%</td>
<td>54%</td>
<td>8%</td>
<td>8%</td>
<td>18%</td>
</tr>
<tr>
<td><strong>Lodgington - Heavy land site</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>90%</td>
<td>5%</td>
<td>16%</td>
<td>10%</td>
<td>8%</td>
<td>9%</td>
<td>50%</td>
<td>46%</td>
<td>10%</td>
<td>9%</td>
<td>5%</td>
</tr>
</tbody>
</table>
20 years on MinTill – blackgrass saturation
Blackgrass emerging after ploughing
Ploughed after 20 years – abundant charlock
• Upper Pond North 7.9ha
Pests, disease and weed issues with reduced tillage
Rough seedbed after ploughing
Suction sampling insects
Biological control in OSR
Regenerative Agriculture – guiding principles

• Diversity in cropping
• Protection of the soil
• Maintain living roots
• Minimise soil disturbance
• Integrate livestock
Transition from ley to arable – direct-drilled hybrid barley
Conclusions

• Diverse crop rotations assist in crop management
• Weed populations interact with rotation and soil cultivations
• Field history is an important determinant of weed pressure
• Ley periods are a valuable tool in depleting short lived arable weeds
• Employing multiple control strategies enables a progressively step-wise approach to weed management
• Short-term changes in cultivation strategies can assist containment