Potential of cover crops for weed management in organic cropping

NJF SEMINAR 495
4th NJF Organic Conference
June 19 – 21, 2017 in Mikkeli, Finland
Track 1A: Cover crops and weed management
Implications

From unwanted weeds in cereal cropping → Companion plants
Implications

- Integrated weed management (IWM) strategies call for diverse control/cropping methods

- High priority for sustainable measures
  - Effective control of harmful weed species
  - Maintenance of biodiversity in crop stands
  - Taking care of soil (chemical & physical)

Smart use of **COVER CROPS** in crop rotation
Cover Crop Management

- Species / Cultivars / Mixtures
- Seed rates
- Sowing time
- Cover / Catch
- Short term / Long term
- Target weed species
- Services (N, soil structure, feed)
Background and Objectives

- Cereal-dominated crop rotations
- Selection pressure in weed population
- IWM focus on aggressive weed species

Replace harmful weed species with gentle COVER CROPS

During.....After.....Between the crop growing period
Objectives

**PRODIVA project HYPOTHESES**

WP 1 : Improved weed management with....

- Selected competitive *cover crop species*
- Improved *cover crop establishment*

*More project info: Crop diversification and weeds (PRODIVA)*

http://coreorganicplus.org/research-projects/prodiva/
News from Finland

by Jukka Salonen
## Cover crops in field experiments in Finland 2015–2016

- **Spring–sown:**
  - TRFPR: Red clover (*Trifolium pratense* L.)
  - TRFRE: White clover (*Trifolium repens* L.)
  - TRFHY: Alsike clover (Trifolium hybridum)
  - TRFRM: Persian clover (*Trifolium resupinatum* var. majus)
  - TRFSU: Subterranean clover (*Trifolium subterraneum* L.)
  - TRFIN: Crimson clover (*Trifolium incarnatum*)
  - MEDLU: Black medic (*Medicago lupulina* L.)
  - MEUAL: White sweet clover (*Melilotus alba Med.*)
  - LOLMU: Italian ryegrass (*Lolium multiflorum* Lam.)
  - LOLPE: English/Perennial ryegrass (*Lolium perenne* L.)
  - PLHPR: Timothy (*Phleum pratense* L.)
  - FESPR: Meadow fescue (*Festuca pratensis* Huds.)
  - FESAR: Tall fescue (*Festuca arundinacea* Schreb.)
  - SECCE: Winter rye (*Secale cereale* L.)

- **After Harvest:**
  - VICSA: Common vetch (*Vicia sativa* L.)
  - RAPSA: Oilseed radish (*Raphanus sativus* L.)
  - LOLMW: Westerwold ryegrass (*Lolium multiflorum* Lam. var. westerwoldicum)
Field trial in Jokioinen, Finland 2015

- Previous crops:
  - 2013: Oats with undersown clover/grass mixture
  - 2014: Clover/Grass mixture (ploughed autumn 2014)

- Field experiment in 2015
  - Spring Barley with 6 cover crop mixtures
    - Cover crops sown in spring barley in May at the same time with the main crop
    - Oilseed turnip rape (BRSSS) as model WEED
    - In addition to the natural weed infestation
CC mixtures in Jokioinen 2015

- **C1**: No cover crops (CCs) in spring barley
- **C2**: TRFPR (8 kg ha\(^{-1}\)) + TRFRE (4 kg ha\(^{-1}\))
- **C3**: MEDLU(6) + TRFRE(2) + TRFRM(3) + TRFIN(4)
- **C4**: TRFPR(12) + TRFRE(6)
- **C5**: SECCE(100)
- **C6**: MEDLU(20) + LOLMU(8)

TRFxx = Clovers
MEDLU = Black medic
SECCE = Winter rye
LOLMU = Italian ryegrass
Biomass of BRSSS in August 2015

No statistical diff. btw CC mixtures

Concl: Difficult to prevent early emerging weeds with CCs

PRODIVA project 2015–2018
**Yield response in spring barley**

![Barley Yield Graph](image)

- **Cover Crop Mixtures:** C1, C2, C3, C4, C5, C6
- **Barley Yield (kg ha⁻¹):**
  - **C1:** 3000 kg ha⁻¹
  - **C2:** 4000 kg ha⁻¹
  - **C3:** 3500 kg ha⁻¹
  - **C4:** 3750 kg ha⁻¹
  - **C5:** 3250 kg ha⁻¹
  - **C6:** 2750 kg ha⁻¹

- **Note:** C5 = rye as CC

**PRODIVA project 2015-2018**
Findings and Speculation (FI)

- Cover Crops (CCs) are too slow against spring-emerging and tall-growing annual weeds in spring cereals

- CCs suppress weed growth in late summer and after harvest (Effect on weed seed production?)

- Red Clover, Alsike Clover and White Clover are most promising in Northern conditions. Sowing at the same time with spring cereals in clay soils but delayed in light soils

- Delayed sowing of more vigorous CCs, like Italian ryegrass

- Tolerable yield loss with suitable CCs sown at proper time

- Cover Crop cropping is well subsidized in Finland (100 €/ha)
News from Latvia

by Livija Zarina

Viola arvensis
Chenopodium album
Galeopsis spp.
Veronica arvensis
Lamium purpureum
Fumaria officinalis
Centaurea cyanus
Apera spica-venti
Elytrigia repens
Equisetum arvense
Cirsium arvensis
Sonchus arvensis
Polygonum convolvulus
Artemisia vulgaris
SITE
Priekuli, LTE field
cia.123 m above sea level,
(57° 18'49"N, 5° 20"E)

SOIL
1. LTE:sod–podzolic loamy sand
2. OF field: sod gleyic soil

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2014</th>
<th>2014</th>
<th>2015</th>
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<tbody>
<tr>
<td>$pH_{KCl}$</td>
<td>5.7</td>
<td>5.6</td>
<td>6.1</td>
<td>6.0</td>
</tr>
<tr>
<td>SOM, g kg$^{-1}$</td>
<td>25</td>
<td>21</td>
<td>54</td>
<td>54</td>
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<tr>
<td>$P_2O_5$, mg kg$^{-1}$</td>
<td>128</td>
<td>126</td>
<td>95</td>
<td>101</td>
</tr>
<tr>
<td>$K_2O$, mg kg$^{-1}$</td>
<td>135</td>
<td>109</td>
<td>72</td>
<td>84</td>
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</table>

Crop rotation LTE

Crop rotation OF
Spring barley with clover as undersown grasses– winter rye– potatoes.
How work was carried out?

Two experiments

1. Grass/clover mixture (Trifolium pratense L. and Phleum pratense L.) as under-sowing in spring barley (Hordeum vulgare L.) was grown for one and two seasons in six field crop rotation in long-term experimental field.

2. Red clover ‘Raunis’, white clover ‘Daile’, and ryegrass as undersown in spring barley ‘Ruja’ was grown for two seasons on peaty sod gleyic soil at organically managed field.

Numbers of weed plants in spring (BBCH 20–29) were recorded using 0.1 m² frame in 10 places; plant biomass of under-sown crops and weeds were sampled within 1.0 × 1.0 m squares after the first cut in the following year after harvesting of main crop (barley).
**Key results and discussion**

*Undersowing effect in two 6-field rotations, LTE*

![Graph showing undersowing effect in two 6-field rotations, LTE. The graph compares weed biomass (g DM m²) after one 6-year cycle and after two 6-year cycles for crop rotations with 1-year and 2-year grass-clover.*]
The most common weed species in 6 field crop rotation in spring barley with grasses undersown

<table>
<thead>
<tr>
<th>Crop rotation</th>
<th>1(^{st}) rotation</th>
<th>2(^{nd}) rotation</th>
<th>3(^{rd}) rotation</th>
<th>4(^{th}) rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. barley – <strong>grasses</strong> – barley – rye – barley – potato</td>
<td>CHEAL VICHI ELYRE RAPRA TRIIN</td>
<td>CHEAL TRIIN RAPRA CENCY VICHI</td>
<td>CHEAL TRIIN SPRAR RAPRA TAROF</td>
<td>CHEAL GALSS SPRAR CENCY TRIIN</td>
</tr>
<tr>
<td>2. barley – <strong>grasses</strong> – grasses – rye – barley – potato</td>
<td>CHEAL RAPRA TRIIN SPRAR VICHI</td>
<td>CHEAL VICHI SPRAR CENCY GALSS</td>
<td>CHEAL SPRAR THLAR STEME CENCY</td>
<td>CHEAL SPRAR CENCY CAPBP STEME</td>
</tr>
</tbody>
</table>
Weed proportion in sward of perennial grasses depending crop rotation cycle, %
\( (LSD_{95}-2.01) \)

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<thead>
<tr>
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<th>2\textsuperscript{nd} rotation</th>
<th>3\textsuperscript{rd} rotation</th>
<th>4\textsuperscript{th} rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. barley – grasses – barley – rye – barley – potato</td>
<td>4.3 a</td>
<td>4.9 a</td>
<td>6.5 b</td>
<td>7.1 c</td>
</tr>
<tr>
<td>2. barley – grasses – grasses – rye – barley – potato</td>
<td>4.2 a</td>
<td>4.9 a</td>
<td>6.1 ab</td>
<td>6.4 b</td>
</tr>
</tbody>
</table>
Yield, ‘Rūja’, t ha⁻¹

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield (t ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B+ red clover</td>
<td>3.7</td>
</tr>
<tr>
<td>B+ white clover</td>
<td>3.7</td>
</tr>
<tr>
<td>B+ hybrid ryegrass</td>
<td>3.6</td>
</tr>
<tr>
<td>B+ perennial ryegrass</td>
<td>3.5</td>
</tr>
<tr>
<td>Control</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Weed biomass, g m⁻²

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Biomass (g m⁻²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B+ red clover</td>
<td>82</td>
</tr>
<tr>
<td>B+ white clover</td>
<td>51</td>
</tr>
<tr>
<td>B+ hybrid ryegrass</td>
<td>63</td>
</tr>
<tr>
<td>B+ perennial ryegrass</td>
<td>56</td>
</tr>
<tr>
<td>Control</td>
<td>83</td>
</tr>
</tbody>
</table>
Pictures of weeds by PRODIVA partners
From LTE:
under–sown in spring cereals can improve weed management, but effect decreasing through period: starting 3–rd rotation weed proportion going up, therefore VERY IMPORTANT is to respect agronomical factors.
From OF field

Yield reductions caused by weeds can be reduced with successful choice of cover crops which are grown together with the main crop, but we need respect field conditions very carefully.

Red clover?
Potential of cover crops for weed management in organic cropping

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Partners of the PRODIVA project
http://coreorganicplus.org/research-projects/prodiva/