### Summary of biological control of crop pests through the manipulation of the farm ecological infrastructure and modification of the tillage regime

The management implications for the main pests are listed below. Please be aware that some pests are not restricted to one crop, management strategies may transfer. Some conflicting management was identified whilst compiling this report and is highlighted accordingly. This summary is intended to give a broad overview of a range of cultural control methods. The full report is available by clicking on the link to the right.

#### Cereals (3179 thousand ha) or (3362 thousand ha including maize)

<table>
<thead>
<tr>
<th>Key Pests</th>
<th>Management implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aphids</strong></td>
<td>1. Insecticide cannot prevent BYDV transmission, but may decelerate the spread.</td>
</tr>
<tr>
<td>e.g. Rose grain aphid</td>
<td>2. Use resistant cultivars (e.g. ‘Rapier’) to lessen chemical inputs.</td>
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<tr>
<td>Metopalophium dirhodum</td>
<td>3. Provide flowering borders (e.g. Phacelia spp.) and increase non-crop structural complexity for natural enemies (e.g. parasitoid wasps).</td>
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<tr>
<td><strong>Frit fly</strong></td>
<td>4. Encourage springtails (as alternative food source) and hoverflies, lacewings, ladybirds, spiders, carabids, and parasitoid wasps as natural enemies.</td>
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<tr>
<td>Omiolleta frict</td>
<td>5. Reduce spring cereal cropping after mild winters or within landscapes dominated by grassland to reduce BYDV transmission.</td>
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<tr>
<td><strong>Gout fly</strong></td>
<td>6. Use artificial flowers in margins to encourage predatory hoverfly larvae early in the season.</td>
</tr>
<tr>
<td>Chilo partialis</td>
<td>13. Encourage parasitoid wasps.</td>
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<tr>
<td>e.g. Tipula sp. larva</td>
<td>15. Spring cereals should be sown as early as possible in high risk areas.</td>
</tr>
<tr>
<td><strong>Orange wheat blossom midge</strong></td>
<td>16. Encourage parasitoid wasps, carabids, and farmland birds.</td>
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<tr>
<td><em>Aphodius rumicis</em></td>
<td>18. In spring cereals, apply 2+ seedbed preparations following grass, aiming for consolidation and a good tilth.</td>
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<tr>
<td>e.g. Ttueus sp. larva</td>
<td>20. Producing a soil cap by rolling may reduce pest emergence and egg laying in Aug-Sep.</td>
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<tr>
<td><strong>Wheat bulb fly</strong></td>
<td>21. If chemical treatment is required, apply early to protect parasitoids.</td>
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<tr>
<td>Delia coarctata</td>
<td>23. Cultivate soil in dry conditions if pest was a problem in the previous season.</td>
</tr>
<tr>
<td>e.g. Apetes striolus larva</td>
<td>24. Promote grassy margins with hedges to increase carabids, and reduce slug incidence.</td>
</tr>
<tr>
<td><strong>Dermatocera reticulatum</strong></td>
<td>25. Multiple cultivations in dry conditions will reduce slug survival, particularly if a fine, firm seedbed is produced.</td>
</tr>
<tr>
<td>e.g. Grey field slug</td>
<td>26. Use a narrower drill coulter to hinder slug movement.</td>
</tr>
<tr>
<td>Deracera reticulatum</td>
<td>27. Under lower tillage regimes, remove debris and stubble (slug habitat).</td>
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<tr>
<td><strong>Hole worm</strong></td>
<td>28. Wheat can be drilled deeper in cloddy soils.</td>
</tr>
<tr>
<td>Delia coarctata</td>
<td>29. If the previous approaches fail, apply metaldehyde only in Sep, and consider iron (ferric) phosphate as an alternative, although the latter is deleterious to earthworms.</td>
</tr>
<tr>
<td>e.g. Aphodius striolus larva</td>
<td>30. Encourage fungal parasites, predatory flies, carabids, and rove beetles.</td>
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To view the full report – click here.
## Sustainable Control of Crop Pests

### OSR (675 thousand ha)

<table>
<thead>
<tr>
<th>Key pests</th>
<th>Management implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aphids</strong>&lt;br&gt;  <img src="image1.png" alt="Cabbage aphids" />&lt;br&gt; <em>e.g.</em> Cabbage aphids <em>Brevicoryne brassicae</em></td>
<td>1. Encourage parasitoids, carabids, spiders, ladybirds, lacewings, and predatory flies.&lt;br&gt; 2. Increasing the area of semi-natural habitat, particularly flowering margins, will increase hoverfly populations.&lt;br&gt; 3. Avoid spring and winter rape crops in close proximity to hinder cabbage aphid colonization&lt;br&gt; 4. Use artificial flowers in margins to encourage predatory hoverfly larvae early in the season.</td>
</tr>
<tr>
<td><strong>Brassica pod midge</strong>&lt;br&gt;  <img src="image2.png" alt="Pod midge larvae" />&lt;br&gt; <em>Dasineura brassicae</em></td>
<td>5. Biostimulant application (e.g. nitrophenolate) may improve yield against pest, and is not considered toxic to other flora and fauna.&lt;br&gt; 6. Encourage parasitoid wasps and carabids.&lt;br&gt; 7. Avoid spring and winter rape crops in close proximity to hinder pest colonization&lt;br&gt; 8. Pod midge damage requires weevil boring, so control of weevils are most important (see below).</td>
</tr>
<tr>
<td><strong>Cabbage root fly</strong>&lt;br&gt;  <img src="image3.png" alt="Cabbage root fly larvae" />&lt;br&gt; <em>Dermatobia hominis</em></td>
<td>9. Encourage parasitoid wasps, carabids, rove beetles, and predatory flies.&lt;br&gt; 10. In previously infested areas, use OSR in fields surrounded by hedges and woods, and avoid OSR crops in fields surrounded by field banks.&lt;br&gt; 11. Avoid spring brassicas close to fields that were previously damaged by root fly.&lt;br&gt; 12. Consider a finger weeder-type action&lt;br&gt; 13. Resistance to pyrethroids is confirmed for the UK.&lt;br&gt; 14. Encourage parasitoid wasps, wolf spiders, and carabids.</td>
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<tr>
<td><strong>Flea beetles</strong>&lt;br&gt;  <img src="image4.png" alt="Flea beetle" />&lt;br&gt; <em>e.g.</em> Cabbage stem flea beetle <em>Psylliodes chrysocephala</em></td>
<td>13. Resistance to pyrethroids is confirmed for the UK.&lt;br&gt; 14. Encourage parasitoid wasps, wolf spiders, and carabids.&lt;br&gt; 15. Zero/reduced-tillage systems reduce pest incidence, while shallow tillage allows for some natural enemy survival.</td>
</tr>
<tr>
<td><strong>Leatherjackets</strong>&lt;br&gt;  <img src="image5.png" alt="Leatherjackets" />&lt;br&gt; <em>e.g.</em> Leatherjackets <em>Tipula sp.</em> larvae</td>
<td>16. Sowing early and higher plant densities (increase seeding rates and wider row spacing) will reduce pest incidence.&lt;br&gt; 17. Consider using turnip rape as a bordering trap crop around OSR.</td>
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<tr>
<td><strong>Pollen beetle</strong>&lt;br&gt;  <img src="image6.png" alt="Pollen beetle" />&lt;br&gt; <em>Meligethes aeneus</em></td>
<td>18. Encourage parasitoid wasps, carabids, and farmland birds.&lt;br&gt; 19. Following grass, plough from Jul to early-Aug and bury herbage.</td>
</tr>
<tr>
<td><strong>Slugs</strong>&lt;br&gt;  <img src="image7.png" alt="Slugs" />&lt;br&gt; <em>e.g.</em> Grey field slug <em>Deroceras reticulatum</em></td>
<td>30. Promote grassy margins with hedges to increase carabids, and reduce slug incidence.</td>
</tr>
<tr>
<td><strong>Weevils</strong>&lt;br&gt;  <img src="image8.png" alt="Weevils" />&lt;br&gt; <em>e.g.</em> Cabbage seed weevil <em>Ceutorhynchus assimilis</em></td>
<td>35. Cabbage seed weevil resistance to neonicotinoids partly confirmed in Poland.</td>
</tr>
</tbody>
</table>
Sustainable Control of Crop Pests

Potatoes (141 thousand ha)

<table>
<thead>
<tr>
<th>Key pests</th>
<th>Management implications</th>
</tr>
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</table>
| **Aphids** | 1. Insecticide cannot prevent PVY transmission, but may decelerate the spread.  
2. Use maize, lucerne, or wheat as trap crops to reduce PVY-virus transmission.  
3. Encourage hoverflies lacewings, ladybirds, spiders, carabids, parasitoid wasps and springtails.  
4. Increasing the area of semi-natural habitat, particularly flowering margins, will increase hoverfly populations.  
5. Use seed potato varieties that resist aphids, and verified by Seed Potato Classification Scheme.  
6. Use artificial flowers in margins to encourage predatory hoverfly larvae early in the season.  
7. Protect potatoes from PVY transmitted by probing bird cherry-oat aphids, use maize (preferred), lucerne, or wheat as a non-virus host trap crop. |
| ![Peach-potato aphid](image)  
*Myzus persicae* |  
| **Slugs** | 8. Promote grassy margins with hedges to increase carabids, and reduce slug incidence.  
9. Multiple cultivations in dry conditions will reduce slug incidence, particularly if a fine, firm seedbed is produced.  
10. Use a narrower drill coulter to hinder slug movement.  
11. Under lower tillage regimes, remove debris and stubble (slug habitat).  
12. If the previous approaches fail, apply metaldehyde only in Sep, and consider iron (ferric) phosphate as an alternative, although the latter is deleterious to earthworms. |
| ![Grey field slug](image)  
*Deroceras reticulatum* |  
| **Wireworms** | 13. Neonicotinoids are ineffective, but biocidal compounds and plant meals may produce better control.  
14. Encourage parasitoid wasps, predatory flies, and farmland birds.  
15. Avoid potatoes if pest risk is high, and lift early if damage is suspected.  
16. Use pea trap crops or mixed trap crops (e.g. buckwheat, wheat, beans). |
| ![Agriotes lineatus (larva)](image)  
*Larva* |  

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By Scott Bauer  
*e.g. Peach-potato aphid*  
*Myzus persicae*

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By AfroBrazilian (CC-BY-SA-3.0)  
*e.g. Grey field slug*  
*Deroceras reticulatum*

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By Danny Steaven (CC-BY-SA-3.0)  
*e.g. Agriotes lineatus*  
*Larva*

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By Frank Parkinson  
*Agricultural Trust*
### Peas & field beans (139 thousand ha)

<table>
<thead>
<tr>
<th>Key pests</th>
<th>Management implications</th>
</tr>
</thead>
</table>
| **Aphids** | 1. Insecticide cannot prevent PSbMV, PEMV, and BLRV, but may decelerate the spread.  
2. Encourage ladybirds, hoverflies, spiders, fungal pathogens, and parasitoid wasps.  
3. Use artificial flowers in margins to encourage predatory hoverfly larvae early in the season.  
4. Intercropping (e.g. using ‘Dragonhead’ of the mint family) in field beans reduces pest and enhances natural enemy populations.  
5. Consider using biofertilizers and intercropping to reduce pest incidence. |
| **Bean seed flies** | 6. Encourage spiders, rove beetles, pathogenic fungi, and parasitoid wasps.  
7. Burying organic matter from previous crop will reduce egg laying.  
8. Consider a finger weeder-type action to reduce pest emergence, and to allow access for parasitoids to pest hosts. |
10. Risk is greater when pest was present on previous crop, so consider altering rotation.  
11. Consider mustard and nigella oil vapours which act as strong repellent.  
12. Select resistant cultivars, delay sowing to reduce seed damage. |
| **Leatherjackets** | 13. Encourage parasitoid wasps, carabids, and farmland birds.  
14. Following grass, plough from Jul to early-Aug and bury herbage.  
15. Thorough seedbed consolidation and a good tilth should be aimed for.  
16. Producing a soil cap by rolling may reduce pest emergence and egg laying in Aug-Sep. |
| **Pea and bean weevil** | 17. Increased soil-N will increase plant vigour and prevent damage.  
18. Encourage carabid and rove beetles, and consider the application of pathogenic nematodes.  
19. Avoid pea and bean cropping close to other legumes (esp. clover and lucerne), uncultivated grassland, and fields recently cropped with pea and bean.  
20. Zero-tilled pea fields will reduce pest incidence and damage.  
21. Select resistant cultivars, which will increase pest susceptibility to pathogenic nematodes. |
| **Pea moth** | 22. Encourage parasitoid wasps.  
23. Plough in unharvested green peas before the larvae can leave the dry pods.  
24. Early maturing pea varieties, or later/early sown peas may miss the pest flight period and any damage. |
| **Slugs** | 25. Promote grassy margins with hedges to increase carabids, and reduce slug incidence.  
26. Multiple cultivations in dry conditions will reduce slug survival, particularly if a fine, firm seedbed is produced.  
27. Use a narrower drill coulter to hinder slug movement.  
28. Under lower tillage regimes, remove debris and stubble (slug habitat).  
29. If the previous approaches fail, apply metaldehyde only in Sep, and consider iron (ferric) phosphate as an alternative, although the latter is deleterious to earthworms. |
| **Thrips** | 30. Encourage spiders, ladybirds, predatory flies, and lacewings by diversifying landscape.  
31. Consider inoculating crops with fungal endophyte to increase plant resistance to pests.  
32. Sow late emerging crops to prevent pea and field thrips in high risk areas. |
| **Wireworms** | 33. Neonicotinoids are ineffective, but biocidal compounds and plant biofumigant meals may produce better control.  
34. Spray/apply fungal spores when rain is not forecast for 2 days following.  
35. Encourage parasitoid wasps, predatory flies, and farmland birds. |
## Sustainable Control of Crop Pests

### Vegetables grown outdoors (116 thousand ha)

<table>
<thead>
<tr>
<th>Key pests</th>
<th>Management implications</th>
</tr>
</thead>
</table>
| **Aphids** | 1. Encourage parasitoids, carabids, spiders, ladybirds, lacewings, and predatory flies.  
2. Increasing the area of semi-natural habitat, particularly flowering margins, will increase hoverfly populations.  
3. The use of straw mulch [conflicts with veg point: 19] reduces spider cannibalism for better aphid control.  
4. Select brassica crops with high chlorophyll and water content will reduce aphid abundance. Selecting for thin leaves and low protein content can reduce honeydew damage.  
5. Consider using a fine mesh netting over vegetable crops.  
6. Use artificial flowers in margins to encourage predatory hoverfly larvae early in the season. |
| ![Aphids](image) | e.g. Potato aphids *Macrosiphum euphorbiace* |
| **Cabbage root fly and bean seed flies (BSF)** | 7. Encourage parasitoid wasps, carabids, rove beetles, and predatory flies.  
8. In previously infested areas, use OSR in fields surrounded by hedges and woods, and avoid OSR crops in fields surrounded by field banks.  
9. A fine mesh netting on vegetables will reduce root fly infestations.  
10. Use finger weeder to reduce pest emergence, and to allow access for parasitoids to pest hosts.  
11. Avoid spring brassicas close to fields that were previously damaged by root fly. |
| ![Cabbage root fly](image) | e.g. BSF pupa Daw alatum |
| **Cutworms** | 12. Consider bio-insecticides (e.g. Bt) or pathogenic nematode application.  
13. Young larvae are susceptible to irrigation when feeding on foliage. |
| ![Cutworms](image) | e.g. *Agriotes lineatus* |
| **Diamond-back moth** | 14. Consider neem-based insecticide, which reduces pests and has little effect on ladybird predators.  
15. Consider other bio-insecticides (e.g. Bt) which can cause complete mortality and encourage natural enemies.  
16. Encourage spiders (particularly wold spiders) for early season suppression and parasitoid wasps.  
17. Intercropping vegetable brassicas with tomatoes may increase parasitoids and reduce pests. |
| ![Diamond-back moth](image) | *Plutella xylostella* |
| **Leatherjackets** | 18. Encourage parasitoid wasps, carabids, and farmland birds.  
19. Following grass, plough from Jul to early-Aug and bury herbage [conflicts with veg point: 1].  
20. Thorough seedbed consolidation and a good tilth should be aimed for.  
21. Establish vegetable brassicas after mid-June (after main pest feeding stops).  
22. Producing a soil cap by rolling may reduce pest emergence and egg laying in Aug-Sep. |
| ![Leatherjackets](image) | e.g. *Tipula sp. larva* |
| **Silver Y moth** | 23. Consider bio-insecticides (e.g. Bt).  
24. Encourage parasitoid wasps, though this would not provide immediate control. |
| ![Silver Y moth](image) | *Yponomeuta padella* |
| **Slugs** | 25. Promote grassy margins with hedges to increase carabids, and reduce slug incidence.  
26. Multiple cultivations in dry conditions will reduce slug survival, particularly if a fine, firm seedbed is produced.  
27. Use a narrower drill coulter to hinder slug movement.  
28. Under lower tillage regimes, remove debris and stubble (slug habitat) [conflicts with veg point: 3].  
29. Cultural control is needed for vegetables sown when natural enemies are inactive and slugs are active (e.g. Brussels sprouts).  
30. If the previous approaches fail, apply metaldehyde only in Sep, and consider iron (ferric) phosphate as an alternative, although the latter is deleterious to earthworms. |
| ![Slugs](image) | e.g. Grey field slug *Deroceras reticulatum* |
| **Thrips** | 31. Onion thrip resistance to pyrethroids is confirmed for the UK.  
32. Row application technique ensures a more even fungicide and insecticide application in leeks.  
33. Encourage spiders, ladybirds, predatory flies, and lacewings by diversifying landscape.  
34. Consider inoculating crops with fungal endophyte to increase plant resistance to pests.  
35. Intercropping in onion crops can reduce infestations.  
36. Consider irrigation to reduce pest incidence. |
| ![Thrips](image) | e.g. Onion thrip *Thrips tabaci* |
| **Wireworms** | 37. Neonicotinoids are ineffective, but biocidal compounds and plant meals may produce better control.  
38. Spray apply fungal spores when rain is not forecast for 2 days following. |
| ![Wireworms](image) | e.g. Agriotes lineatus larva |