
# Grower Summary

Review and guidance for integrated management of economically significant weeds, pests and diseases in a range of horticultural and other edible field crops.

**CP 211**

Final report 2022

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| **Project title:** | Review and guidance for integrated management of economically significant weeds, pests and diseases in a range of horticultural and other edible field crops. |
| **Project number:** | **CP 211** |
| **Project Number:** | |
| **Project leader:** | Caroline Young, ADAS |
| **Report:** | Final report, March 2022 |
| **Previous report:** | N/A |
| **Key staff:** | ADAS: Sarah Cook, Erika Wedgwood, Jude Bennison, Elysia Bartel, Jonathan Blake, Angela Huckle, Janet Allen, Kevin Godfrey, Catherine Eyre, Lilly Butters.<br>SRUC: Helen Rees, Mark Bowsher-Gibbs, Henry Creissen |
| **Date project commenced:** | 1st Nov 2021 |

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## AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

[Name]

[Position]

[Organisation]

Signature ..... Date .....

[Name]

[Position]

[Organisation]

Signature ..... Date .....

**Report authorised by:**

[Name]

[Position]

[Organisation]

Signature ..... Date .....

[Name]

[Position]

[Organisation]

Signature ..... Date .....

# GROWER SUMMARY

## Headline

Integrated Pest Management (IPM) is widely used to reduce chemical inputs for pest, disease and weed control in many horticultural and arable crops. Strategies include cultural control techniques, monitoring and forecasting methods and the use of bioprotectants (invertebrate biocontrols, semiochemicals, microbials and natural substances). This review highlighted key non-chemical methods that growers are currently using but could be more widely adopted, such as decision support tools and cultural control methods including variety choice and crop hygiene. In addition, the review identified a wide range of crop and pest specific approaches that with further development, may also provide alternative and sustainable solutions. The review identified where more knowledge exchange is needed to facilitate adoption of effective practices and where further research is needed to further understand and develop new strategies.

## Background

This project was designed to consider IPM strategies on 'non-broadacre' crops in the UK. This follows on from AHDB Research Review 98, which considered the 'broadacre' crops of wheat, barley, oilseed rape and potatoes in the same way. The review was written by ADAS and SRUC, who took responsibility for specific crops as indicated below.

The following crops were included in the current review:

- Field vegetables - carrot, onion, leafy and root brassicas, endive and lettuce. (ADAS)
- Arable crops – rye, triticale, fodder crops, linseed, peas and beans (fresh and dry harvested). (SRUC)
- Top fruit - apple and pear. (ADAS)
- Soft fruit - strawberry, raspberry and grapevine. (ADAS)

## Summary

Integrated Pest Management is an effective approach to control pests, diseases, and weeds economically with reduced chemical plant protection product input. Within the horticulture sector, IPM is already widely adopted, and in some cases is the only viable option. In soft fruit crops, for example, there are no currently available chemical plant protection products for vine weevil control, therefore this pest can only be controlled through a carefully planned IPM

programme using a combination of cultural and biological methods. This review has identified over 1500 IPM strategies for non-broadacre crops which either could be used more by growers or where there is little potential for increased use as growers are already adopting them, or strategies that justify further research and development.

The review examines the pest, disease and weed problems considered to be of greatest economic importance for each crop with the four groups, and existing and potential ways to reduce their impact other than by using conventional plant protection products. Measures were reviewed starting with those at crop planning, and then during pre-cropping, before turning to those enacted within the crop. On completion of the review, the perceived effectiveness of each measure, its speed of action, its ease of implementation and the cost of doing it were each rated and utilised in an equation that incorporated the likely greater potential use over the current use. The resulting tables created were then filtered to identify priorities for attention where there was potential for an increase in use of a given strategy. Those measures having a low strength of evidence were recommended for further research before greater knowledge exchange. Strong evidence of effectiveness was found for 368 of these IPM strategies (including many decision support systems, variety choice and good hygiene). Here further uptake may require more knowledge exchange with growers for them to be fully implemented. The tables provide pointers to the review and should be read in conjunction with the full text of the review.

For 343 strategies, more research to develop the methods and to fully understand how to implement them is required. Across the crops, the number of references (~1000) emphasises the volume of research that has already been carried out in this area, however there is a need for further research to improve our understanding and uptake of the various components of IPM. Research tends to focus on a particular measure; however, it is the implementation of a series of steps that will culminate in the ultimate protection of the crop; from planning where the crop is to grow, pre-cropping decisions ensuring the growing area and the seeds or plants to be grown are as free from pests and pathogens as possible, to finally implementing in-crop husbandry. Each crop situation is unique, but this review provides details of measures, both established and more recently developed, that can be integrated within individual crop management plans.

## Soft Fruit (strawberry, raspberry and grapevine)

Of the 450 control strategy combinations identified, the highest priority scores focused on pests and diseases rather than weeds.

Spotted winged drosophila (SWD) IPM control measures were prioritised for greater adoption across the three crop types. On raspberry and strawberry these measures included decision support, hygiene and mass monitoring, which although already practised, were considered to have scope for further uptake. Sterile male technique was also highlighted as a novel approach for SWD control but one that would to benefit from further research, validation and knowledge exchange to support uptake. Raspberry cane midge and blackberry leaf midge are key pests of raspberry that have no effective chemical control options. Breeding less susceptible varieties was identified as a potential method for the control of both these pests, however soft fruit growers often have little choice in selecting varieties to grow as these are stipulated by their marketing group. Similarly, breeding strawberry varieties less susceptible to thrips damage was identified as a potential control method, as although western flower thrips is well controlled by predatory mites in IPM, other thrips species are not and it has been observed that some varieties are more commonly damaged than others. Aphid control is an increasing problem in both strawberry and raspberry due to the shortage of available aphicides. Biological control with a range of aphid parasitoid species is used by some growers and there is scope for wider uptake with further KE, however growers consider this to be an expensive option.

Several approaches to powdery mildew and botrytis control in strawberry were highlighted, with potential for greater attention to the production of clean stock, maintaining crop hygiene and manipulating the environment to reduce infection. More research is needed on the use of microbial bioprotectants within IPM. Less widely employed strategies for powdery mildew control such as hot-water treatment of propagation material and UV-C, are supported by good evidence and could be more widely utilised.

## Arable crops (rye, triticale, fodder crops, linseed, peas and beans).

A total of 334 non-chemical strategies were considered to control the main pests of these crops. The leading strategies considered to have the greatest potential are discussed below.

*Rye and triticale*

Varietal choice for the control of yellow and brown rust of rye and triticale was top of the priority lists, although this clearly represents a simple and easy to implement solution, it is noted that selecting less susceptible varieties can narrow variety choice and may result in growers having to accept some other less favourable features. Weed and volunteer control in preceding crops may also prevent rusts from bridging between old and new crops. Hygiene and prevention was also prioritised for the control of annual grasses and ergot, also noted was the potential for non-chemical control of ergot and annual grassweeds through primary and secondary cultivations.

*Fodder crops*

Non-chemical control strategies for flea beetle and clubroot were considered of highest economic importance. The use of soil testing and stubble management could help to control both, undersowing for flea beetle may also have potential although less is known about this. Decision support, and hygiene and prevention for clubroot and rhizoctonia could be more widely used, to good effect.

*Peas and beans (fresh and dry harvested)*

Due to the economic importance of grassweed control within the rotation, non-chemical approaches such as cultivations (primary and secondary), fallow, undersowing companion crops as well as hygiene and prevention were all prioritised as effective approaches that could be more widely utilised. The use of bioprotectants for the control of Sclerotinia (in peas and beans) and pea moth although not currently used much were noted as effective, and both could be more widely implemented. In the case of pea moth control the strength of evidence is such that more work on bioprotectants may be required to validate this approach.

## Top Fruit (apple and pear)

Strategies for the control of invertebrate pests were highlighted in particular. The potential for increased use of bioprotectants (both microbial and macrobiological) was identified for the control of pear sucker, caterpillars, aphids, and fruit tree red spider mite on apples and pears,. There is good evidence that they are effective, and greater awareness could result in wider use.

The use of pruning, physical exclusion, and decision support systems for caterpillar control in apples and pears were also considered as an approach that could be more widely adopted, however more research may be required for validation.

Aphid control strategies prioritised (in addition to the use of bioprotectants as previously mentioned), included nutrient management and variety or rootstock choice. Evidence is strong that these work. Other strategies such as the use of undersowing or companion cropping or the physical exclusion of aphids from the plant were also highlighted and as approaches with potential, but a lack of validating research may be currently limiting uptake.

For the control of apple scab, pruning and canopy management, plus monitoring and forecasting to aid decisions on control measures are already commonly practised, and there is good evidence that they are effective and could be more widely adopted. Microbial bioprotectants and the end-of-season use of urea to aid infested leaf decomposition are less widely used but have been shown to be effective so have potential for greater use.

Hygiene and prevention strategies for the control of weeds in apple and pear orchards were also highlighted as approaches that are practised but could more widely used. Mechanical weed control is less common but is effective, and its use could be expanded.

## Field Vegetables

Strategies with the greatest further potential use focused on diseases and pests rather than weeds as weed control strategies were generally already being widely implemented and there was less scope for greater use.

Disease control here tended to focus on pre-cropping approaches, with rotations and selection of low-risk locations already often used but with some greater potential where soil-borne pathogens are a risk. For the control of cavity spot of carrot and sclerotinia there is good evidence that hygiene techniques, such as cleaning equipment to reduce the movement of infested soil, are effective and could be implemented more widely. The use of soil tests was identified as an approach with potential for greater uptake for onion white rot and fusarium and carrot cavity spot, following recent developments in molecular techniques, although the evidence of the value of such pre-planting soil tests is currently limited. In the root brassicas, as well as rotation, there was recognition of the need for spatial separation from other brassicas to reduce foliar diseases.

The use of precision irrigation to reduce soil water and canopy humidity was highlighted for lettuce, onion and carrot crops as a way to reduce disease spread and infection success. Similarly, well-timed irrigation of brassica crops, aided by pheromone traps and a prediction model can avoid the need for chemical pesticides by washing the young cutworms off the plants. Irrigation of lettuce crops can reduce damage by lettuce root aphid.

Decision support and monitoring were identified as approaches that could and should be used more for the control of pests and diseases of all field vegetables. Much is already known in this area and decision support tools are already in use. More knowledge exchange could lead to greater uptake, however the future availability of some of these decision support systems is currently uncertain.

Breeding commercial varieties of carrot and lettuce with resistance to carrot fly and aphids respectively was identified as a potential method for contributing towards control of these pests within IPM but research and development would be needed. Pre-sowing soil sampling to predict the risk of damage to carrot by free-living nematodes offers a valuable decision support tool, however threshold numbers of different nematode genera and species need to be reviewed and validated.

## Financial Benefits

Non-chemical control strategies within IPM programmes are a vital part of crop protection. They can bring significant financial benefits; extending the life of chemical plant protection products by reducing the development of resistance, reducing the number or applications or replacing them altogether. Where chemical solutions are no longer available or are not effective, non-chemical control strategies may offer the only viable long term form of control. This review identified non-chemical approaches available for management of the major pests, weeds and diseases of a wide range of field crops and poly tunnel-grown soft fruit. However, uptake of some measures could be greater, and it is recognised that this may sometimes relate to the implications of adoption. The main trade-offs when adopting IPM measures have therefore been identified in this review. However, the longer-term financial benefits from sustainable non-chemical management of pests, diseases and weeds can only be considered by each individual grower and/or via collaboration in on-farm research and development projects focussed on the development of integrated management programmes.

## Action Points

1. Check the prioritised strategies at the rear of this report and also read the relevant sections in the text in order to identify the non-chemical control strategies with good potential that are not already being used.
2. Consider the practicality and value of the approach and its suitability for use in each situation taking account of any potential trade-offs.
3. Seek further information or advice from a consultant or agronomist if needed.
4. Implement strategies which are likely to have a net positive effect on crop margins and which have other key benefits such as not disrupting biological control programmes already being used, increasing biodiversity and improving soil health.