Grower Summary

FV 334 / HortLINK HL019

Perennial field margins with combined agronomical and ecological benefits for vegetable rotation schemes

Annual 2014

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Before using all pesticides check the approval status and conditions of use.

Read the label before use: use pesticides safely.

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Project Number:	FV 334 / HortLINK HL019
Project Title:	Perennial field margins with combined agronomical and ecological benefits for vegetable rotation schemes
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Contractor/(s):	Lancaster University
Industry Representative:	Nathan Dellicott Barfoots of Botley
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Further information

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GROWER SUMMARY

Headline

- The successful conclusion of 4 years of establishing perennial margins at the experimental field site has shown the superior nature of flowering field margins as a resource for multiple groups of beneficial insects.
- Yield increases adjacent to established margins were seen in some crops indicating the increased numbers of biocontrol agents and parasitism translated into increased pest control and improved crop yield.
- Nearer to flowering field margins good trends were seen for reduced pest incidence and increased natural enemy activity in all years of the study.
- Four individual seed mixes tailored to soil type and budget are recommended. Further options for growers are available through the Automated Margins project (HDC FV 334a) at http://www.stockbridgetechnology.co.uk/Automated_Margins/

Background

The horticultural industry faces a range of issues linked to crop protection. These include a reduction in the available products approved for use, the potential for increasing resistance in the target organisms, increasing pressures from consumers and retailers for residue-free produce and a need to comply with legislation and industry initiatives (e.g. Water Framework and Voluntary Initiative). These pressures have resulted in the need for a more considered approach to pesticide use and for the full exploitation of the range of alternative methods available for maintaining pest populations below economic damage thresholds.

The development of stewardship schemes that encourage the management of the farmed environment in a way that increases levels of biodiversity, provides an opportunity to combine conservation objectives with the benefit of enhanced pest control (either through conservation biological control or through other methods such as trap cropping). Current stewardship options include pollen and nectar mixes targeting bees and butterflies, as well as separate margin prescriptions to encourage farmland birds. Previous work by members of the research team involved in the current project has developed the concept of designing flowering field margins for the specific purpose of optimizing biological pest control. The current project looks to build upon the above research and seeks to combine the biodiversity and pest-control benefits of perennial field margins, providing growers with a direct economic benefit in addition to the expected subsidies from stewardship schemes.

The expected deliverables from this work included:

1. Development of a seed mixture for perennial field margins that has the potential to optimize joint pest control and conservation benefits while minimizing potential risks for vegetable rotation schemes.
2. Quantification of the impact of field margins on biological control agents, pests, pollinators and farmland birds.
3. Development of the use of flowering field margins as part of an insecticide assisted trap-cropping approach.
4. Development of field margins that support predator population build-up through provision of non-pest prey in field margins.
5. Assessment of the feasibility of using banker plants in field margins and development of these plants as sentinels to monitor levels of biological control agents.
6. Development of a database on the compatibility of available chemical control options with various biological control agents to optimize integrated pest management decisions.
7. Quantification of the impact of perennial field margins on pest levels, crop quantity/quality and pest management costs.
8. Communication of best practice to commercial growers in the form of ‘blueprints’ for margin establishment and management, drawing upon knowledge generated in the proposed project as well as in ongoing European biodiversity projects.

Summary of the project and main conclusions

Objective 1 - Development of the seed mixture

Despite harsh winter/spring conditions in the four successive years since their initial sowing, many of the flowering plants sown established and survived well in experimental margins at the project field site, STC. Year on year plant surveys at STC have shown increased overall flower coverage.

Commercial flowering margins sown in 2011/2012 established well in some cases, with weeds suppressed as margins developed. Sown forbs failed at one commercial site in 2013, despite good establishment in 2012. It appears that lack of mowing in 2012 combined with earlier sowing of this margin in the autumn of 2011 was the causal factor, supporting the importance of margin management, particularly in the first season. Flowering margins at other sites fared relatively well into their second year, maintaining or increasing their percentage cover of sown flowers despite a lack of management (though it is likely that management would be required in 2013 to prevent declines in margin quality in 2014). One flowering field margin was accidentally ploughed under at the end of 2012 and no further establishment data was collected from it. However, casual observation suggests that this margin recovered well with primarily annual species re-establishing themselves, presumably as a result of self-seeding.

Data collected throughout the project suggests that the selection of plants included in experimental flowering margins was capable of providing a diverse floral resource throughout the season, with selected species providing benefits when floral resources are otherwise notably scarce.

Based on data from experimental and commercial scale margins, four individual seed mixes have been recommended. These have been tailored for soil type and budget and indicate which of the included species are non-native (allowing growers to omit these if desired).
Further details are provided in the Science Section.

Objective 2 – Establish field margins and quantify margin impact on selected target species

Both 2010 and 2011 crop surveys showed lower aphid occurrence nearer to flowering field margins in some crops at STC, in a number of instances in conjunction with increased predator/parasitoid numbers, indicating that predation/parasitism has been an underlying

mechanism explaining these patterns. Though trends were not as apparent for 2012 data, which were compromised by low invertebrate counts following poor weather, 2013 data again supported a beneficial effect of field margins on in-crop natural enemies and aphid counts, at least in those crops where reasonable numbers of insects were recorded. Commercial counts could not be analysed statistically.

Visual surveys of flowering and control field margins at STC in all years of the project (2010-2013) clearly demonstrated the superior nature of flowering field margins as a resource for multiple groups of beneficial insects. Commercial counts (2012 and 2013) supported this result, though data could not be analysed statistically due to a lack of replication. Counts of target groups from pitfall and water traps suggest that 'activity-abundance' data do not necessarily match visual count (i.e. abundance) data, perhaps as a result of decreased insect movement in FMs for many groups.

The effect of flowering vs grassy margins on insect over-wintering groups varied throughout the project. By the end of the project in 2013 this was neutral for all groups considered, though the superior nature of margins *per se* as overwintering sites (vs crop fields) was confirmed in a number of cases.

Further details are provided in the Science Section.

Objective 3 - Development of the trap-cropping approach.

Two trap plant species, chervil (with carrots) and yellow mustard (with cabbage) were trialled in the field plots at STC in 2011 with varying success. Future work at STC will continue to investigate the benefits of a combined field margin / trap crop approach for *Brassica* pest insects.

Objective 4/5 – Development of banker plant species.

Banker plants are plants which harbour non-pest prey (primarily aphids) that can support pest natural enemies, e.g. when crop-based prey is scarce. In early years of the project teasel had been found to be the best banker plant / sentinel species, though this trend was not continued into 2013 when yarrow and tansy performed better. Inclusion of multiple banker plant species in field margin seed mixes can thus be recommended to insure against variation in aphid loads on any given banker plant between years. Based on the results of the current study, a combination of teasel, yarrow and tansy is suggested to boost the number,

longevity and diversity of non-pest aphids in flowering margins. Of these, teasel appears to hold most promise as a sentinel species due to the ease of observing aphids and pest natural enemies on flowering stems.

Further details are provided in the Science Section.

Objective 6 – Development of a compatibility database of chemical control options.

Compatibility matrices have been developed for all crops. Updates to all matrices have been made as part of the project following identification of gaps.

Objective 7 - Quantification of margin impact on pests, crops and pest management costs.

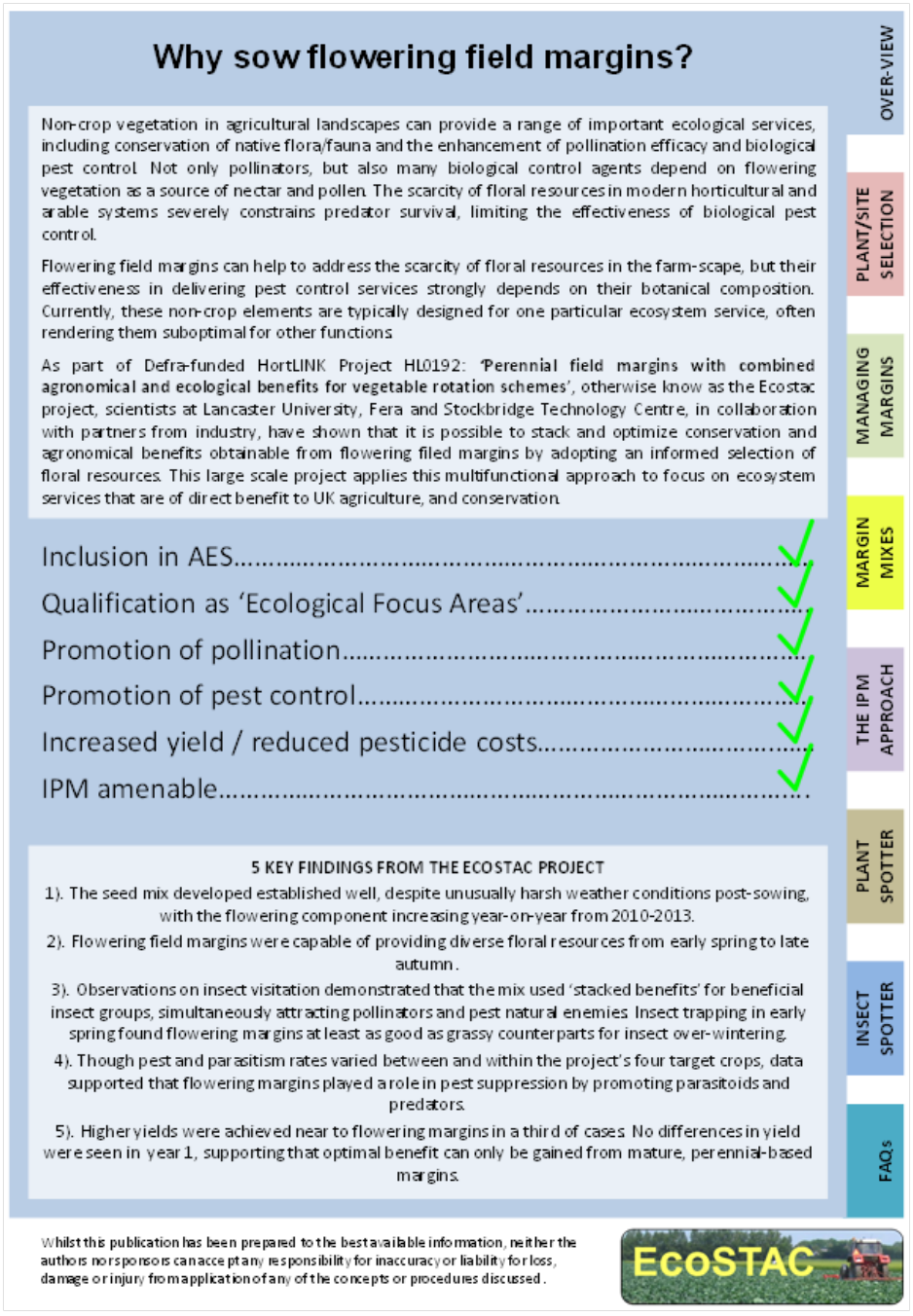
Flowering margins at STC had no effect on crop yield and quality parameters in 2010, though the poor nature of the pea crop prevented reliable analysis. All crops performed relatively well in 2011, with substantial yield increases (up to 40%) adjacent to flowering margins in the case of peas, wheat and cabbages. This strongly indicates that the increased numbers of biocontrol agents and parasitism recorded in conjunction with the flowering margins translated into increased pest control and improved crop yield. 2012 data again demonstrated increased yield near to flowering margins for peas and cabbages. For 2013 data there were fewer effects of sampling site on yield, possibly as high mammalian herbivory had an over-riding effect. Unexpectedly, 2013 yield in carrots was lower nearer to flowering field margins than at other sites. That yield was never increased in carrots in previous years, unlike in the other three crops, perhaps suggests that either the FM seed mix was less well suited to this crop than others, or that the crop itself is less well suited to FMs (at least in terms of deriving yield benefits from it).
Further details are provided in the Science Section.

Objective 8 – Communicate best practice.

Delivery of information, primarily via platform presentations at appropriate events has featured strongly throughout the project. As part of the project a Communication Group was initiated, which has now met twice (12th March 2012 and 22nd April 2013), with at least one further meeting planned in 2014 soon after project completion. This group will continue to liaise in future years to ensure optimal uptake of project results.

Blueprints for growers have been drafted as part of the project. It is hoped that these will be further developed by relevant project partners to be of optimal use to end-users. Samples of the final seed mixes have also been made available to selected growers through the project's 'Farmers to Follow' initiative.

Further details are provided in the Technology Transfer section.



Financial benefits

In accordance with the Government's longstanding policy of minimizing the use of pesticides, the boosting of native biological control agents through functional field margins should make it possible to reduce pesticide inputs while maintaining crop yield and quality. In addition to financial savings associated with reduced pesticide use, economic benefits will also result from use of functional field margins that can count towards stewardship accreditation. Previous contacts with Natural England may have contributed toward recent modifications to ELS options. These should make it logistically and economically more beneficial to include flowering plants within future RPDE schemes such as NELMS.

Action Points

- Growers wishing to sow field margins with flowering seed mixes should use prescriptions that provide floral resources to a broad range of beneficial insects, whilst limiting flower associated pests from obtaining benefits. Four such seed mixes have been recommended for use by growers and are available from Stockbridge Technology Centre through our 'Famers to Follow' Programme, or for purchase.
- Growers should select seed mixes containing flowers that provide alternate prey for beneficial insects, as well as nectar and pollen.
- Growers should use the compendium provided to optimize returns from their flowering field margins, following guidelines therein for site preparation, sowing, aftercare and general management.
- Growers should appreciate that returns in terms of yield benefit may not be realised year-on-year through the use of FMs, but that such returns are achievable if appropriate seed mixes are properly selected, sown and maintained as managed field margins.