# Grower Summary

## CP 134

“eyeSpot” – leaf specific herbicide applicator for weed control in field vegetables

Annual 2017

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### Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.
Before using all pesticides check the approval status and conditions of use.
Read the label before use: use pesticides safely.

### Further information

If you would like a copy of the full report, please email the AHDB Horticulture office (hort.info.@ahdb.org.uk), quoting your AHDB Horticulture number, alternatively contact AHDB Horticulture at the address below.

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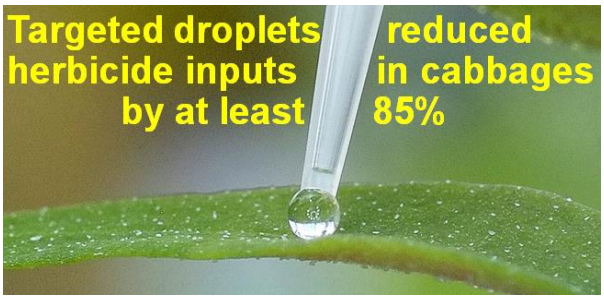
| **Project title:** | "eyeSpot" – leaf specific herbicide applicator for weed control in field vegetables |
| **Project number:** | CP 134 |
| **Project leader:** | Alistair Murdoch, University of Reading |
| **Report:** | Annual Report, 2017 |
| **Previous report:** | Annual Report for 2016 |
| **Key staff:** | Dr Alistair Murdoch (PI), Mr Nikolaus Koukiasis (PhD student), Mr Paul de la Warr (software engineer), Mr Liam Doherty, Mrs Caroline Hadley and Mr Richard Casebow (technical staff). Miss Fern Price (Undergraduate student intern) |
| **Location of project:** | University of Reading: (a) Agriculture Building, Earley Gate, (b) Controlled Environment Laboratory, Whiteknights and (c) Crop Research Unit, Sonning Farm<br>Linked activities (not funded by AHDB): Concurrent Solutions, Benton, Kentucky, USA |
| **Industry Representative:** | Mr Phil Lilley, Hammond Produce Ltd., New Farm, Redhill, Nottingham NG5 8PB |
| **Date project commenced:** | 1 April 2015 |
| **Expected completion date:** | 30 September 2018 |

# GROWER SUMMARY

## Headline




- Precision targeting of glyphosate droplets to leaves of weeds in field trials with savoy cabbages was shown to reduce amounts of herbicide applied by 85% compared to a single inter-row spray and by 94% compared to a pendimethalin pre-emergence spray.
- Glasshouse trials showed efficacy of droplet applications of glufosinate-ammonium so that if approval for use of glyphosate were to be withdrawn, an alternative product is available.
- Use of alternative products is also essential to avoid the risk of herbicide resistance.
- Three sequential treatments with droplets achieved the maximum crop yield and weed suppression. This strategy is also mitigates risks of herbicide resistance, since weeds surviving an initial treatment, would be retreated on a subsequent visit.

## Background

Weeds and their control play a vital role in maintaining vegetable yields and quality and herbicides are a highly efficient method of managing weeds. However, improper or inappropriate use of herbicides may have adverse effects on human health and the environment. Even though their use is subject to stringent regulation in the UK, the EC Regulation No. 1107/2009, the Water Framework Directive (2000/60/EC) and the Sustainable Use Directive (2009/128/EC) are leading to the loss of herbicide actives and make it more difficult for new compounds to gain approval. This predicament is worse for field vegetable growers because of their reliance on a limited and old range of herbicides which require a lot of funding and effort in order to keep them in the market.

This project represents a paradigm shift to post-emergence weed control in field vegetables. Some use of chemicals is retained, but it explores an engineering solution rather than chemistry and genetics (e.g. herbicide-tolerant crops). Moreover, the concept is no direct application of herbicides to the soil, none to the crop, simply leaf-specific droplet applications

of a non-selective, systemic herbicide to the leaves of unwanted plants (i.e. weeds). It is the ultimate in precision agriculture. Overall objectives are to:

- minimize herbicide inputs and meet demand for more sustainable crop production, providing an efficient and effective means of controlling weeds in vegetables where few post-emergence herbicide options are allowed or available;
- eliminate herbicide drift and run-off to the soil, crop and non-target organisms; and
- provide an engineering alternative to herbicide tolerant crops (whether by conventional plant breeding or by genetic modification).

Plant specific weeding by hand is what growers have traditionally done. Individual plants are examined and if unwanted are hoed or removed. Such a task is dull, difficult, dirty and perhaps even dangerous and of course economically impossible on a large field scale. The project therefore explores the possibility of achieving leaf-specific weed control using an autonomous platform. If successful, this state of the art project will demonstrate a pre-commercial system as an alternative to other systems which approximate to plant specific weed control using directed sprays, lasers or electrocution. The former is currently available and the latter two are the subject of research. Each method has advantages and disadvantages, which are not discussed here, but a comparison of the directed spraying option with eyeSpot is available on request. The system here is designed to control all weeds in the field including young seedlings before they have had any yield or quality impact on the crop. The immediate application is to field vegetables after transplanting or drilling into bare soil.

## Summary

Precision targeting of glyphosate droplets to leaves of weeds is a leading edge procedure. We have been applying droplets manually this year for proof of concept and for evaluation of potential benefits while the automated droplet applicator is being developed. The droplets very small (1-2 microlitres) – so that one teaspoonful (5 ml) would be enough to treat 2500-5000

individual weeds if one droplet is put on each weed. Nevertheless, the droplets are much larger than those used when spraying so that there is no risk of either spray drift but nor are they large enough for spatter. In the experiments carried out in 2016/17, droplets were applied manually – mostly by Nikos Koukiasas, the PhD student on the project, and also by Fern Price-Jones an undergraduate summer intern funded by the University. In 2017, we hope to repeat and extend these trials in the UK and also carry out tests with an automated applicator in the USA.

The herbicide must be non-selective since the same product is applied to all weeds but no application is made to the crop. The chemical must also move from the point of application to other leaves and the roots. Glyphosate is therefore ideally suited to this application and we have used Roundup® Biactive GL (360 g/l, SL, Monsanto (UK) Ltd.) in this year's trials although we plan to use other formulations. To avoid risks of resistance and to provide an alternative, we have also successfully applied glufosinate ammonium (Harvest®, 150 g/L, SL, Bayer CropScience Ltd.) in glasshouse trials over the past year.

The dose applied is approximately based on the area of ground covered by an individual weed. In this way we can calculate how much herbicide would have been applied to the same ground area if one assumes that the amount, which would have been applied by conventional spraying, were sprayed uniformly. It is therefore possible to estimate exactly how much product is in the equivalent of the "recommended" dose for an individual weed plant. We have constructed dose-response curves on this basis.

In this year's (2016) field trials with savoy cabbages, we have shown that we can reduce herbicide inputs by 94% compared to a pendimethalin pre-emergence spray (Stomp Aqua®, 455 g/l pendimethalin, CS, BASF plc). Three sequential treatments, with droplets 3, 5 and 7 weeks after transplanting the seedlings, achieved the highest crop yield among weed control treatments, and weed suppression and was actually superior to the pendimethalin treatment. Note that the triple treatment also mitigates risks of herbicide resistance, since weeds surviving or omitted in an initial treatment, would be retreated on a subsequent visit.

- Glasshouse trials showed efficacy of droplet applications of glufosinate-ammonium so that if approval for use of glyphosate were to be withdrawn, an alternative product is available.
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## Financial Benefits

Evaluation of the economics is planned for 2018

## Action Points

No action needs to be taken by growers at this stage in the eyeSpot project.