Final Project Summary

New approaches to weed control in oilseed rape

Project number	RD-2009-3605	**Final Project Report**	PR530
Start date	August 2009	**End date**	January 2013
HGCA funding	£85,812	**Total cost**	£85,812

What was the challenge/demand for the work?

Studies in Catchment Sensitive Farming areas in Scotland and England have shown that pesticides commonly used in winter oilseed rape, notably the herbicides propyzamide, carbetamide, metazachlor and clopyralid, are reaching water courses at levels frequently exceeding the Drinking Water Directive (DWD) limit of 0.1ug/l. By reducing the impact of these products and/or replacing them through the use of existing technology, these concerns can be met. This is thus the background to the proposed project.

The aim of this project is to evaluate novel and cost-effective approaches to alternative weed control options in oilseed rape, planted on a wide row system, using a combination of non-selective and selective herbicides, delivered to specific areas. By targeting weed control, either to the inter-row gap of crops drilled on wide row spacings or over the crop row, reductions in herbicide or indeed elimination of herbicides can be achieved.

Specifically, this research project examined a range of approaches seeking to address the following objectives:

- Determine the effectiveness of a technique based on a simple repositioning (and twisting) of conventional nozzles set at an angle to the spray boom and at a low boom height, to apply a non-selective (or non-crop-safe) herbicide between the crop rows.
- Evaluate the use of a shielding systems and shrouded inter-row CDA applicator for delivering the non-selective herbicide between crop rows.
- Assess the potential for vehicle guidance systems (RTK DGPS or vision based) to improve the accuracy and effectiveness of inter-row treatments.
- Evaluate the impact of combining directed non-selective treatments between crop rows with directed selective treatments applied over the crop rows.
- Examine the scope for non-chemical control in the inter-rows using a guided mechanical hoe.

How did the project address this?

The project ran for three years. In year one of the project (2009/10) there were two field studies (one undertaken by SAC and one through NIAB TAG). The aim of the project in year one was to screen a range of approaches to targeting the delivery of glyphosate to the inter-row gap of winter oilseed grown on plots drilled on 50 cm rows. Treatments included the use of even-spray nozzles ("01" 25° and "02" 45°) which delivered narrow spray footprints, twisting of conventional nozzles and testing a Varidome CDA delivery system. All treatments were applied at two different spray timings (GS 13 and GS 15). The delivery of the inter-row weed control made use of a purpose-built experimental test rig, designed and built by Dr Paul Millar of NIAB TAG (picture below). The third partner, the Organic Research Council (ORC), looked at the use of a tined mechanical hoe set up to provide weed control in the intra-row gap of winter rape drilled in wide rows.

SAC test rig, year using CDA sprayer ORC using inter-row cultivator

The aim of year two was to assess the most promising delivery nozzle configurations from year one, use simple shielding to protect the crop and as in year one, time treatments at different growth stages of the crop, GS13 and GS15. These treatments were carried out at the SRUC site at Boghall farm, Edinburgh. NIAB TAG took to integrate shielded even-spray nozzles with novel precision targeting systems (RTK GPS and Vision Guidance) as supplied by the project collaborators, John Deere and Tillett and Hague, respectively. To get the best results from both systems, the trial was drilled with long 20 metre plots drilled with a RTK precision drill. The co-ordinates from the drill were then transferred directly into the RTK precision sprayer. To get the best results from the Vision Guidance system, a front-mounted rig developed for targeted spot and patch application in vegetable crops was adapted such that the system could operate with shielded nozzles – see picture below.

Pictures below show the simple shield coupled with vision guidance

Plate shields and vision guidance

In year three of the project, SRUC tested different types of shielding: a simple shield and an all-round shield from Garfords combined with different even spray nozzles (“01” 25° and “02” 40°). The shields were tested at two growth stages, GS13 and GS15 and on two contrasting varieties, the hybrid Excalibur and the conventional variety Catana. NIAB TAG took to further examine the RTK GPS to target sequential application of glyphosate inter-row and using the technique to sequence with targeted Kerb intra-row (over the row).

In year three ORC further evaluates the use of Vision Guidance as a means of guiding a mechanical hoe.

What outputs has the project delivered?

- The results of year one of the project confirmed that even-spray nozzles gave optimum weed control, limited crop damage and were practical to use. The CDA delivery system proved more difficult to set up than the conventional nozzles but was worth further evaluation. Shielding was identified as necessary to limit drift.
- The ORC inter-row cultivator was successful in giving weed control comparable to conventional weed control.

- The results of year two showed that both RTK DGP and Vision Guidance combined with even-spray nozzle arrangements were successful in limiting damage from glyphosate applied inter-row but found that RTK was simpler to set up and is more commonly available commercially. Weed control from both applications was good, as shown in Table 1 and 2. It was found that Vision Guidance coupled to an inter-row cultivator gave weed control equivalent to standard weed control (metazachlor). This result would be particularly useful in organic systems.
- It was found in year two that timing the application of glyphosate earlier, at GS 13 compared to GS 15, reduced the potential for damage even when shielded, as the inter-row gap becomes narrower at the later growth stage. However a sequence of glyphosate applied at GS 13 followed by a second at GS 15 was successful and could be useful to take out secondary flushes of weeds.

Table 1
NIAB TAG Results, Autumn 2010,
Vision Guidance – Grass weeds

	Between row			
	Treated	*SEM*	*Untreated*	*SEM*
+S +VG	0.7	0.33	5.4	1.19
+S - VG	0.9	0.06	2.8	0.14
S + VG	1.2	0.45	2.5	0.58
-S - VG	0.4	0.08	3.7	0.14
average	0.8		3.6	

78% control of grass weeds between the rows
Note S = Shield and SEM = Standard Error of the Mean
VG = Vision Guidance

Table 2
NIAB TAG Results, Autumn 2010,
RTK – Oilseed rape

	Between row			
	Treated	*SEM*	*Untreated*	*SEM*
+S +RTK	0.4	0.30	6.4	1.25
+S – RTK	0.6	0.37	7.0	0.64
-S + RTK	0.6	0.43	9.1	1.00
-S - RTK	1.0	0.53	9.2	1.28
average	0.7		7.9	

92% control of volunteer OSR between the rows
Note SEM = Standard Error of the Mean

- In year two, variety type was found not to be important. Open-pollinated varieties were shown to compensate as well as hybrids against wide row widths and low plant populations. There was no difference in crop damage between hybrid and conventional variety types with inter-row application of glyphosate.
- As in year one, there was perhaps indication that the Micron system was not ideal for applying glyphosate to the inter-row gap in winter rape. In this study, this system tended to result in more crop damage and reductions in yield. The CDA system did not cope well with uneven ground. This is not to say the system could be ideal in flat seed beds in well cultivated vegetables crops.

Results in year three showed that:

- The benefits of shielding were clear but there was no significant distinction between shield types at the early application at GS 13. The Garfords shield was more effective in reducing crop damage where wider even-spray nozzles were used at the later spray timings of 5–6 leaves. The study showed a well-timed application at 3–4 leaves with a narrow even-spray nozzle was as effective in terms of yield as an overall residual herbicide, despite slightly inferior weed control.
- There was some tendency for better weed control with the conventional shield at the later application timings.

- Comparing the two nozzles types there was a clear benefit from using a shield when using the wider even spray nozzle but not necessarily with the narrower “01” 25° nozzle.
- A sequence of glyphosate at GS 13 and GS 15 was better than a single application.
- Shielding reduced damage when used at later timings.
- A sequence of glyphosate inter-row and Kerb intra-row was as good as an over-all application of Kerb but at a considerable lower dose/hectare.

Who will benefit from this project and why?

- Increasingly growers are establishing their crop on wide rows using GPS systems which are now becoming standard on modern tractors. Should it become necessary in some catchment areas, or as a result of EU Directives, to reduce the reliance on residual herbicides in winter rape, this research will become very relevant.
- The simple plate type shields that can be produced in the farm workshop or over-all shields can be purchased from Garfords. Garfords already supply Vision Guidance units for use in vegetables.
- Where residual herbicides such as propyzamide, carbetamide and metazachlor are coming under pressure in certain river catchment areas, the use of a targeted application of a non-selective herbicide or reduced rates of residuals can help to reduce the impact of these important herbicides on the environment.
- Monsanto will be able to use the results of this project to help get an application for Roundup for use “in crop”.
- The results of this this project will stimulate further studies into the use of alternative non-selective herbicides on other row crops.
- The organic sector will have research to provide data to support the use of guided mechanical hoes that can give as effective weed control as conventional herbicides. This technique could become more widely used in conventional systems to control weeds in the absence of suitable post-emergence herbicides.

If the challenge has not been specifically met, state why and how this could be overcome

The project could have had a basic test for glyphosate residues in plant tissues to provide data to support the registration of glyphosate for use in the crop at the young plant stage. Further work is being sponsored by Monsanto.

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Lead partner	Mark Ballingall, SRUC
Scientific partners	NIAB TAG, ORC
Industry partners	Monsanto, Garfords, Tillett and Hague Technology Ltd, John Deere
Government sponsor	