Research Review No. 70

Summary

March 2009

Pesticide availability for cereals and oilseeds following revision of Directive 91/414/EEC; effects of losses and new research priorities

by

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This is the final report of a review lasting for six months which started in August 2008. The work was funded by a contract of £31,000 from HGCA (Project No. 3513).

Summary

Pesticides are fundamental to the way combinable crops are currently grown in the UK. They provide us with a relatively cheap and efficient way of controlling the major weeds, pests and diseases that affect combinable crops. These pesticides are currently under pressure as a result of changing legislation in Europe (revision of 91/414/EEC) and the implementation of the Water Framework Directive. Other pressures are also being applied in the form of increasingly resistant target organisms and the presence of pesticide residues in food products. These pressures are all leading to potential reductions in the availability of pesticides for the control of organisms harmful to plant health.

This report reviews the most important scenarios that could affect the availability of pesticides for use in wheat, winter barley, spring barley, oats and oilseed rape. It looks at the effects of the losses of pesticides on the weeds, pests and diseases they control and the resultant level of production and value that the crop could achieve.

ADAS experts determined the most important weeds, pests and diseases that affect each of the crops, and the proportion of crops affected by each. This was done through expert knowledge and the use of survey information. For each weed, pest or disease, plus lodging, estimates of total yield impact in business as usual and untreated situations were established, on an area weighted basis, using survey information and trials data supported by expert knowledge. ADAS experts then used their knowledge of the weed, pest or disease, supported by any relevant trials information to determine the effects of pesticide losses on yields in each of the scenarios.

It is uncertain as to exactly what the revision of 91/414/EEC will lead to as the final wording has not been agreed, although there are clear indications that the losses of pesticides will not be as severe as was once forecast. In this report a number of scenarios, based on a PSD report released in December 2008, were assessed to determine the effect on combinable crops. After a vote in the European Parliament (13th January 2009), it is likely that the least severe of the four PSD scenarios (scenario 2c) will be close to the final outcome, however, much will depend on final implementation. If this is the case it would result in the loss of about 23 active ingredients, of which only 20 are approved for use in the UK. Of these 20 active ingredients, 15 are used in the production of wheat, barley, oats or oilseed rape. Of the UK approved actives that are at risk 11 are fungicides, 6 herbicides, 2 insecticides and 1 rodenticide.

The greatest economic losses to cereals that occur as a result of scenario 2c are due to the loss of pendimethalin. This is a keystone of black-grass resistance management and also an important general herbicide. Although there are generally plenty of alternatives for broad-leaved weed control, the control of grass weeds, black-grass in particular, will become more difficult with resistance likely to become more of a problem. The loss of important triazole fungicides will make the control of foliar diseases such as Septoria and Yellow rust in wheat more difficult, as the remaining

chemistry is not as robust as some of the active ingredients that will be lost. This will lead to slight reductions in production (about 1%). As relatively few insecticides are lost, and there are plenty of alternatives, the effect of this scenario on pests is minimal.

In oilseed rape the losses of pesticides to scenario 2c are unlikely to cause significant losses to production. There remain plenty of alternatives for the control of major weeds, pests and diseases.

It is not just the revision of 91/414/EEC that is likely to cause large scale losses of pesticide actives. The implementation of the Water Framework Directive (WFD) is likely to impact on a number of important active substances. The active substances that are most likely to be affected are those that are used on a large area and or used at high rates. This makes herbicides particularly vulnerable as large areas of combinable crops have high rates of active substance applied to them in the form of herbicides. As a result, about 10 herbicides are causing concerns with relation to the WFD. This includes a number of important actives for the control of grass weeds in oilseed rape (propyzamide, carbetamide and metazachlor). If restrictions or withdrawals for the use of these chemicals occur it could make the control of black-grass and other grass weeds almost impossible. If cropping systems remained the same, in affected areas, this could lead to yield losses similar to those seen in untreated crops of about 35%.

Oilseed rape is currently the main break crop used in cereal rotations. The herbicides that are available for the control of black-grass in rape have different modes of action compared to those that can be used in wheat. This makes the rape break crop a useful tool for cleaning black-grass infested fields prior to planting with cereals. This alternative chemistry is also an important part of the resistance strategy used to control black-grass. In the absence of effective herbicides in the break-crop, with alternative chemistry, there is the risk that herbicide resistance could develop more rapidly than at present and spread further. This therefore will lead to indirect losses of wheat and cereal yields as a result of resistance build-up.

Many of the insecticides are likely to be at risk from the WFD. As a result there could potentially be very limited options for the control of some pest species. At present, the level of pest infestation seen tends to cause minimal damage at an industry scale, the exception being aphids carrying virus and slugs. Slugs in particular could be difficult to control as metaldehyde is already under scrutiny because it is being found in water. If it is lost the area that is treated with methiocarb is likely to increase, putting it at similar risk of starting to appear in water. This could potentially leave growers with no good molluscicides for the control of slugs.

The loss of active substances to the WFD will be additional to any losses from the revision of 91/414/EEC. This could lead to larger impacts when combined as compared to when looked at in isolation.

Other reasons for loss of existing active substances include them failing to achieve Annex 1 listing before end December 2009, concern over residue levels in food or market acceptability, and development of resistance.

Under 91/414/EEC all active substances had to be reassessed for approval onto Annex 1. There are a number of active substances that are still going through this process. These substances have yet to provide sufficient data to meet the criteria required for inclusion in annex 1. Companies have until June 2009 to provide data for the active substances affected, or they will not be assessed. If they are not included in Annex 1 before end December 2010 they will cease to be approved. Notable active substances affected include a range of older grass weed herbicides, used in the control of volunteer cereals; metaldehyde, used for the control of slugs; and tefluthrin used as a seed dressing for wheat bulb fly control.

There are certain pesticides that are used on a wide range of crops are relatively high rates that are starting to show up in residue tests on certain food stuffs, e.g. glyphosate and chlormequat in cereals. If these pesticides continue to show up in food at levels that are considered unsafe then restrictions could be put on their use, but in any case there are pressures to reduce the levels found, such as through minimising use.

New products and options will become available. There are some new herbicides (ethametasulfuron), insecticides (indoxacarb, rynaxypyr, cyazapyr & spirotetramat) and fungicides (carboxamides) that are due to come on to the market within the next few years. Provided these pass the new approval requirements they will provide additional options for the control of charlock and cranesbill in OSR, Lepidoptera and sucking pests in a range of crops and additional boscalid like fungicides which are likely to provide extra control options for *Septoria tritici.* There are also some new breeding technologies being developed by BASF to produce non-genetically modified herbicide resistant crop plants. These are still in early development in North America with only limited crops available, the herbicide they are resistant to, imidazolinone, does not however give high levels of control of black-grass so would be of limited use in UK situations.

Table ES1 - Key reasons for change in availability of crop protection options, the major substances at risk, their impact and likely timescale

Measure	Major active substances at risk	Key impacts	Timescale
Revision of 91/414/EEC	pendimethalin linuron	Grass-weeds	2011-2020 (see Table 76 for details)
	epoxiconazole and other triazoles	Septoria and yellow rust	2011-2020 (see Table 78 for details)
Failure to achieve Annex 1 listing	metaldehyde	Slugs	By December 2010
	tefluthrin Older grass weed herbicides	Wheat bulb fly Volunteer cereal control	
WFD	propyzamide carbetamide metazachlor	Grass-weeds in OSR	2009 onwards
	metaldehyde	Slugs	Now
	chlorothalonil Insecticides	Septoria All pests	2009 onwards 2009 onwards
Market acceptability	chlormequat	Lodging	Now
	glyphosate	Harvest aid Weed control	Now

The main economic impacts of the important weeds, pest and diseases, plus lodging, are summarised in Table ES2.

The major impacts are in wheat, because of its dominant significance. Totalled across all cereals and oilseed rape the following potential impacts (£M per year) have been identified:

- Improvements over Business as Usual – assuming no current options are lost
  - Reduction in crop lodging is the largest potential opportunity for increases in production (£94M) as a result of reducing existing losses.
  - Improvements in take all control are estimated to be worth £68M.
  - Weeds and oilseed rape account for other significant opportunities
- Losses due to revision on 91/414/EEC
  - The largest overall impact is in loss of black-grass control (£185M). Other weed control will also cause significant losses (cleavers £34M, annual meadow-grass (£41M) and rye-grass (£22M)
  - Losses from disease are highest for yellow rust (£27M)
- Water Framework Directive – could potentially have the most significant impact:
  - Reduction in black-grass control could cost over £500M per year. Rye-grass over £200M and £89M for annual meadow-grass.
  - Loss of septoria control could cost £57M.
  - Inability to control slugs could amount to nearly £50M per year

Table ES3 summarises in a matrix the major areas of loss and priority. These have been mapped into the existing HGCA R&D Strategy where possible. Headings that were not relevant have been excluded, and we have highlighted where we have amalgamated (nutrition), amended (formulation) or added (pesticide risk) headings. This table includes the major implications, which we have prioritised using the existing 1-3 scale based on importance and likelihood of success. The relevant research and knowledge transfer opportunities are included.

Table ES2 – Estimated annual losses to UK cereals and oilseeds industry from weeds, pests, diseases and lodging (£M)

Losses to industry £M		Weeds					Pests						Diseases													PGRs
Crop	Scenario	Black-grass	Cleavers	Annual Meadow Grass	Rye-grass	Volunteer cereals	Aphids autumn	Slugs	OWBM	Wheat Bulb Fly	CSFB	Pollen beetle	S. tritici	Take all	Yellow rust	Eyespot	Fusarium	Net blotch	Mildew	Rhynchosporium	BYDV	Phoma (L. maculans)	Light Leaf spot	Turnip yellows	Sclerotinia	Lodging
Wheat	Revision 91/414/EEC (2c)	151.9	24.0	25.8	18.5								16.2		27.7	6.9										
	WFD	352.4		48.8	129.2		18.9	30.7	6.2	1.4			57.7		4.6											
	Untreated	398.7	113.1	62.8	147.7		26.0	22.2	5.7	1.6			100.3	7.9	-15.2	-61.3										63.5
	Business as usual	35.1	20.1	18.2	14.2		18.9	2.5	2.1	0.7			6.9	57.7	6.9	11.5										40.4
Winter Barley	Revision 91/414/EEC (2c)	33.0	4.9	5.3	4.0											1.2	1.2									
	WFD	76.5		9.9	28.1		4.1	4.7																		
	Untreated	61.2	18.1	10.8	22.7		4.7	1.3						2.7		-8.4	-9.5	-4.8								17.7
	Business as usual	5.3	3.1	2.8	2.2		2.8	0.4						10.5		2.8	3.2	1.5								8.8
Spring Barley	Revision 91/414/EEC (2c)		4.3	7.6																0.7						
	WFD	9.9		28.9	3.9		0.5													0.5						
	Untreated	11.3	5.4	5.4	4.6		0.4												-4.2	-3.5	-6.4					7.2
	Business as usual	1.0	1.4	3.8	0.4		0.1												2.9	2.4	1.7					6.0
Oats	Revision 91/414/EEC (2c)	0.1	1.5	3.2																	0.0					
	WFD	2.1		1.5	0.8		0.9														0.0					
	Untreated	2.5	1.1	4.2	1.0		0.4												-0.9		-0.5					3.5
	Business as usual	0.2	0.3	0.8	0.1		0.3												0.2		0.1					2.6
OSR	Revision 91/414/EEC (2c)																									
	WFD	88.2			42.2		6.6	13.8			2.0	0.9														
	Untreated	41.5	-32.7		-3.4	185.2	4.7	9.5			-0.9	-1.7										36.4	30.3	15.5	8.4	48.3
	Business as usual	2.9	1.3		1.8	1.3	1.3	1.7			2.0	0.2										26.3	17.5	17.5	8.4	36.6
Total	Revision 91/414/EEC (2c)	185.0	34.7	41.9	22.4								16.2		27.7	8.1	1.2			0.7						
	WFD	529.2		89.2	204.2		30.9	49.3	6.2	1.4	2.0	0.9	57.7		4.6					0.5						
	Untreated	515.2	104.9	83.2	172.5	185.2	36.1	33.0	5.7	1.6	-0.9	-1.7	100.3	10.7	-15.2	-69.8	-9.5	-4.8	-5.1	-3.5	-6.8	36.4	30.3	15.5	8.4	140.1
	Business as usual	44.5	26.2	25.6	18.7	1.3	23.4	4.6	2.1	0.7	2.0	0.2	6.9	68.2	6.9	14.4	3.2	1.5	3.0	2.4	1.8	26.3	17.5	17.5	8.4	94.4
	Significant losses of	£50-£100M				£100-£200M				£200M+																

Table ES3 - Crop protection priorities: summary matrix

	Crop protection priorities - cereals and oilseeds	Weeds				Pests						Diseases												PGRs	Research activities	Knowledge transfer
		Black-grass	Cleavers	Annual Meadow Grass	Rye-grass	Aphids autumn	Slugs	OWBM	Wheat Bulb Fly	CSFB	Pollen beetle	S. tritici	Take all	Yellow rust	Eyespot	Fusarium	Net blotch	Mildew	Rhynchosporium	BYDV	Phoma (L. maculans)	Light Leaf spot	Turnip yellows	Sclerotinia	Lodging		
AMALGAMATED	HGCA recommended lists	3			3							1	2	2							2	2	2		1	Develop measurement for competitive ability of varieties against major weeds	Include competitivity score in RL Ensure relevant scores to reduce lodging risk in RL
	Breeding and genetics					3		*	?			1	2	2							2	2	2		1	Improve genetic resistance to pests & disease Transfer traits already identified in previous work into varieties	Highlight priorities to plant breeding companies Ensure resistance scores are included in RL
	Nutrition	3			3							3		3			3	3	3		3	3		3		Understand impact of reduced nutrient levels on need for weed, pest and disease control	
	Disease management											1*	1	1							2*	2	2			Improve control of take-all, septoria and oilseed rape diseases Determining the priorities for chlorothalonil use within a crop rotation to minimise the risk of it reaching water.	Highlight the need for constraining the total use of chlorothalonil
	Soil management	2			2																					Develop decision tools to allow better integration of soil and weed management	Highlight interactions between soil management and weed management
	Pest management					2	1*																			Improve ability to target and maximise effectiveness of slug control Ensure new insecticides are protected from development of resistance Improve control of autumn aphids	Communicate existing best practice and interact with metaldehyde stewardship. Monitor annex 1 listings to ensure metaldehyde and tefluthrin are added to list
	Weed management	1	2	2	2																					Improve ability to predict and manage grass weeds within a rotation Identify new opportunities for grass weed control in oilseed rape	
AMENDED	Pesticide application & formulation	1		1	1		1																			Develop opportunities for improved formulation and application to minimise risk of water contamination Understand major routes by which pesticides reach water	
	Precision farming	1		1	1		1																			Enable better targeting (both spatial and temporal) of high risk actives such as herbicides and slug pellets	Promote existing knowledge and technology to better target applications
NEW	Pesticide risk management	1		1	1		1					1													1	Develop tools to ensure total pesticide use in a catchment meets both efficacy and water quality requirements Develop improved prediction tools to reduce unnecessary pesticide applications Improve linking of crop state and variety to risk of lodging	Promote existing knowledge on the need for pesticide applications Promote existing knowledge and include emerging infoirmation

KEY
based on economic impact and likelihood of achievement

1 **First priority** 2 **Second priority** 3 **Third priority**

* **Existing work** ? **needs discussion**