Potential impact on GB potatoes of the Community Strategy for Endocrine Disruptors (ED's)

Report Authors: Sarah Wynn, Susan Twining, Faye Ritchie, Sarah Cook, Sacha White, ADAS
Mike Storey, AHDB Potato Council

Report No. 2014/7

Additional copies of this report and a list of other publications can be obtained from:

Publications

Potato Council
Agriculture & Horticulture Development Board
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel: 02476 692051
Fax: 02476 789902
E-mail: publications@potato.org.uk

Our reports, and lists of publications, are also available at www.potato.org.uk

CONTENTS

Potential impact on GB potatoes of the Community Strategy for Endocrine Disruptors (ED's)

Crop – Potatoes (2013 baseline)*

GB area –122,022 ha

Total GB crop –5.5 million tonnes

Estimated farm-gate value - £900 million

1. Introduction

This is one of a series of expert returns compiled across a range of different crops. These returns identified which pesticides would be affected by changes in pesticide availability due to the potential classification as endocrine disruptors and estimated the likely reduction in value of the crops as a result of yield loss, assuming no new chemistry.

2. Methodology

The endocrine disruptor hazard criteria were divided into three groups, based on a paper produced by WRC (2013)[§] and information provided by ECPA (European Crop Protection Association) (Annex 1);

- Scenario 1 - Active substances more likely to pose a risk
- Scenario 2 - Active substances less likely to pose a risk
- Scenario 3 - Potential endocrine disruptors – further information needed

Each scenario is cumulative with the active substances in scenario 1 being lost in scenario 2 and the active substances from scenarios 1 and 2 also being lost in scenario 3. Details of the active substances included in each scenario are provided in Annex 1.

The active substances in scenario 1 are those considered most likely to be defined as endocrine disruptors and are, therefore, the ones that are more likely to be withdrawn following the publication of the final definition. The active substances in scenario 2 are less likely to be defined as endocrine disruptors, unless the EU opt to take a stringent definition as the final definition. These active substances therefore have the potential to be lost, but the risk is less than for those in scenario 1. Those active substances in scenario 3 have a higher level of uncertainty around them as there is insufficient information available about their endocrine disruption properties to categorise them in either scenario 1 or 2. Nor can they be assumed to be completely safe from being defined as endocrine disruptors. Therefore the fate of these active substances is less certain, with the expectation that not all of these active substances would end up defined as endocrine disruptors, but some will. For

the purposes of this assessment it is assumed that all active substances in scenario 3 will be lost.

For each scenario the expert calculated the yield loss due to withdrawal of each active substance, in the year that the active substances were lost (assuming that the active substances were all lost in the same year). In situations where a mixture containing the active is used in the crop it was assumed that that partner product would also be lost, unless available in mixture with another active ingredient that remains, or as a straight (unless otherwise stated).

All impacts are purely based on yield loss, i.e. do not include the changes in production costs from alternative control measures, unless clearly stated. All yield impacts and resultant reductions in industry value are annual, based on the year of loss and therefore do not take into account development of resistance (although where relevant this is commented on in the text). Yield losses and reduction in value of the industry are calculated to the farmgate and will therefore be considerably greater for some crops if processing/packing value were included.

Where possible yield losses have taken account of the proportion of the crop area treated with an active substance (using Pesticide Usage Survey statistics[#], or industry statistics) and the resultant loss of yield on that area (i.e. a weighted yield loss). This yield loss should be the typical yield loss in a 'normal' year.

2.1. Scenario 1 – Loss of Endocrine Disruptors more likely to pose a risk[§]

Active	Importance	Estimated economic loss (farmgate)
Fungicides		
Mancozeb	Mancozeb is a dithiocarbamate fungicide with multi-site action and was applied to 80% of the potato area (total 122,022 ha) in 2012 (average number of applications 4.4 per crop). It is routinely applied in tank-mix/co-formulated with fungicides of different modes of action. Loss of mancozeb would not cause significant yield loss immediately, but would require growers to switch to more expensive chemistry to maintain effective control resulting in reduced gross margins. This is estimated at an additional £8/ha/application (affecting 4.4 sprays, on 80% of the area, in the foliar blight programme - figures from PUS Report 250, 2012)	£3.4M of extra costs

Herbicides		
Linuron	Linuron is one of the 3 main Broad Leafed Weed (BLW) herbicides used for weed control in potato crops in the UK. In the 2012 pesticide usage survey 60 % of ware potatoes were treated with linuron. However other actives are available and although weeds will still be largely controlled, it is estimated yields will be impacted by 10% and some additional herbicide costs will be incurred.	£52.2M
Insecticides		
Thiacloprid	Thiacloprid is the second most widely used foliar insecticide in potatoes with 22% of ware potatoes treated in 2012, (Pesticide Usage Survey, Report 250, 2012). It is used for aphid control in potatoes, however alternatives are available, e.g., lambda-cyhalothrin, esvenvalerate, flonicamid, oxamyl, pirimicarb, pymetrozine and thiamethoxam. Four of these are widely used; lambda-cyhalothrin (21% of crop area treated), pymetrozine (13%), esvenvalerate (6%) and oxamyl (13%) (Pesticide Usage Survey, Report 250, 2012).	None
Cypermethrin	Cypermethrin is used to control aphids, caterpillars and cutworms in potato crops. <1% ha of potato crop were treated with the insecticide in 2012 (Pusstats, Fera), however it does not feature in the top 5 used in ware potato crops (Pesticide Usage Survey, Report 250, 2012). Alternative insecticides are available for aphids, e.g., lambda-cyhalothrin, esvenvalerate, flonicamid, oxamyl, pirimicarb, pymetrozine and thiamethoxam. For caterpillars and cutworms alternative insecticides are available. Lambda-cyhalothrin is the alternative for caterpillars. For cutworms, the alternative insecticidal treatments are lambda-cyhalothrin and chlorpyrifos.	None
Estimated economic loss (farmgate)		**£ 55.6M**

Discussion

Loss of mancozeb. It is estimated that annual yield loss from moderate late blight is in the region of 7%, with a further 0.3% due to losses in store with a lost yield potential of 400,000 tonnes (based on a crop area of 122,000 ha). Two active ingredients representing two chemical groups would be lost immediately with scenario 1 as these are available as co-formulations with mancozeb zoxamide, and benthiavalicarb). In the short term, it is likely that the use of other active ingredients will increase as will associated costs. Yield impacts from loss of mancozeb are limited in the short term as control can be provided by alternative chemistry. Mancozeb is a key active ingredient in fungicide resistance management for late blight due to multisite activity and no resistance to this product has been reported for

late blight or other plant pathogens since its introduction in the 1960s. This is in contrast to several other late blight products, where reduced or loss of fungicide sensitivity has been identified in laboratory mutants or field isolates for *P. infestans* and/or other plant pathogenic fungi. Early blight (*Alternaria* spp.) is now considered a major problem for some growers and increased costs through loss of mancozeb would also incorporate the switch to alternative chemistry for the effective control of early blight, where products co-formulated with mancozeb and as tank mixes with mancozeb are extensively used for this. It is expected that production would remain unchanged (i.e. no loss of yield or value), however cost of production would increase. For control of both early and late blight this would require on average 4.4 spray applications to be replaced with more expensive chemistry equivalent to £8 extra per spray or £35.20 per ha, across 80% of the crop area, or £3.4M.

Loss of linuron. Linuron is one of the most frequently used pre-emergence herbicides on the GB ware crop. Loss of this active would limit the pre- and post-emergence options in the crop. In mixture with metribuzin or prosulfocarb, linuron significantly increases the spectrum of weed species control particularly black bindweed and fat-hen. The withdrawal of linuron would increase the reliance on metribuzin, which could cause problems due to variety and soil type restrictions and prosulfocarb, pendimethalin and clomazone which have gaps in their spectrum of control. Withdrawal of this product will result in some reductions in in yield (10%), but and also incur some additional herbicide costs.

Loss of thiacloprid. While the loss of this active would result in the removal of one of the most widely used insecticides in potatoes, alternative treatments for aphids are available meaning that yield reductions should be minimal.

Loss of cypermethrin. This active is used on a relatively small proportion of potato crops and a number of alternative actives are available for use against aphids, caterpillars and cutworms. Yield losses to these pests should therefore be minimal.

2.2 Scenario 2 – Loss of Endocrine Disruptors less likely to pose a risk[§]

Active	Importance	Estimated economic loss (farmgate)
Fungicides		
Mancozeb	As in Scenario 1 above	£3.4M of extra costs
Herbicides		
Linuron	As in Scenario 1 above	£52.2M
Metribuzin	Metribuzin is one of the 3 main broadleaved weed herbicides giving residual weed control in potato crops in the UK. In the 2012 pesticide usage survey 62% of UK ware crops were treated with this active. Yield losses from weeds vary but figures assume a 10-39% yield loss.	£56M - £218M
Insecticides		
Thiacloprid	As Scenario 1 above	None
Cypermethrin	As Scenario 1 above	None
Estimated economic loss (farmgate)		**£112M - £274M**

Discussion

Loss of metribuzin. The loss of metribuzin would cause significant problems with weed control in potato crops, particularly on organic soils where other residual herbicides are ineffective due to high levels of organic matter. Its loss along with linuron will compromise weed control in potatoes, leaving a wide range of weeds including fat-hen, pansy, pale persicaria, redshank and poppy with limited control. On organic soils control from herbicides would be inadequate, with reliance on mechanical weed control which would increase costs by £30/ha[1]. On mineral soils other options including prosulfocarb, flufenacet, pendimethalin, clomazone, bentazone and rimsulfuron have some activity on selected weeds, but do not cover the full spectrum, with sulphonyl ureas affected by increasing resistance in some weeds, and bentazone a problem in some water catchments. These actives may also be tank-mixed with either linuron or metribuzin to achieve reliable control, so loss of either would have a knock-on effect. The loss of metribuzin alone and in combination with linuron could therefore cause large yield effects and increase harvesting problems, as well as increasing costs of trying to control weeds with more limited chemical options and cultural control methods particularly on organic soils. Yield losses could range from 14-80%[2], Orke & Dehne (2004) quoted an average

[1] Clayton R, Parker B, Ballingall M & Davies K (2008) Impact of reduced pesticide availability on control of potato cyst nematodes and weeds in potato crops. http://www.potato.org.uk/sites/default/files/%5Bcurrent-page%3Aarg%3A%3F%5D/Reduced%20pesticide%20PCN%20case%20report%20Sept%2008_0.pdf

[2] Bond W. & Turner R (2005) Weed Management Outline for Potatoes. http://old.gardenorganic.org.uk/organicweeds/downloads/potato.pdf

yield loss of 39%[3] due to weeds. Yield impacts from weeds are very variable depending on soils and weather so gross margin impacts based on a range of yield losses, including no yield loss, were calculated. This ranged from £55.8M (10% yield loss) to £217.7M (39% yield loss).

2.3. Scenario 3 – Loss of products which may be categorised as endocrine disruptors[§]

Active	Importance	Estimated economic loss (farmgate)
Fungicides		
Mancozeb	As Scenario 1 above	£3.4M of extra costs
Fluazinam	Applied to 91% of the potato area in 2012 and included in the late blight fungicide programme for foliar and tuber blight control. A multi-site product and an alternative tank-mix partner to mancozeb for straight dimethomorph. Other products can be used in the short term with increased costs (£6/ha for 3.1 sprays on 91% of crop area in the blight programme) but no direct yield impact.	£2.1M of extra costs
Cymoxanil	Applied to 89% of potato area in 2012 (with most crops receiving over 4 in-season applications). Provides curative activity and has a unique mode of action. Included in tank mixes/in co-formulations to improve late blight control.	None
Mandipropamid	Loss of mandipropamid would mean no CAA fungicides (as straight products) available for late bight control. It was applied to 65% of crops in 2012 (typically 2 applications per year). In the short term other products can be used and costs would be similar.	None
Herbicides		
Linuron	As Scenario 1 above	£52.2M
Metribuzin	As Scenario 2 above	£56M - £218M
Glufosinate-ammonium	Only available for use as a harvest aid.	None

[3] Oerke EC & Dehne HW (2004) Safeguarding production – losses in major crops and the role of crop production. Crop Protection, 275-285

Insecticides		
Cypermethrin	As Scenario 1 above	None
Thiacloprid	Thiacloprid is the second most widely used foliar insecticide in potatoes, with 22% of potatoes treated in 2012 (Pesticide Usage Survey, 2012) covering 57928 ha (Pusstats, FERA). It is used for aphid control in potatoes, however alternatives, which are not at risk of the endocrine disruptor ban, are available, e.g. esvenvalerate, flonicamid, oxamyl, pirimicarb, pymetrozine and thiamethoxam.	None
Chlorpyrifos	Chlorpyrifos is used to control cutworms in potato crops. Since its peak usage in 1997 (1200 ha treated) (Pusstats, Fera) this active is now little used. The alternative chemical treatment for cutworm is lambda-cyhalothrin, however this is at risk from the endocrine disruptor ban.	See lambda-cyhalothrin below
Lambda-cyhalothrin	Lambda-cyhalothrin is the most widely used insecticide on potatoes, being applied to 21% of ware potato crop area. This active is used against aphids, beetles, caterpillars, cutworms and weevils. Along with the loss of chlorpyrifos, cypermethrin and thiacloprid, alternative actives for aphid control include esvenvalerate, flonicamid, oxamyl, pirimicarb, pymetrozine and thiamethoxam. However there are no alternative actives available for the control of beetles or weevils, and if cypermethrin is lost, no alternative chemical treatments would be available for the control of caterpillars. Similarly, if cypermethrin and chlorpyrifos are lost there are no alternative actives for the control of cutworms. Yield losses of 0.4% on affected crops (21% that is sprayed) can be expected but might be higher in individual crops.	£0.8M (0.4% yield loss on 21% area)
Sprout suppressants		
Chlorpropham	Chlorpropham (CIPC) is the most important sprout suppressant used to control sprouting in store. There is a stewardship programme[4] in place to highlight good management of the pesticide. Loss of this active would have a very significant impact on storage of potatoes with production likely to drop by 25% from immediate withdrawal and no mitigations (Potato Council report, 2013).	£226M
Estimated economic loss (farmgate)		**£340M-£502M**

[4] Potato Industry CIPC Stewardship. see http://www.cipccompliant.co.uk/

Discussion

Loss of fungicides. Fluazanim, cymoxanil and mandipropamid were, after mancozeb, three of the most frequently applied fungicides in 2012. The ratings included on the Euroblight Fungicide Table[5] indicate there would be a greater reliance on products with protectant rather than curative activity if cymoxanil and mandipropamid were lost. Scenario 3 would result in the loss of 7 modes of action overall from the blight fungicide programme, with only one active ingredient with multisite activity (propamocarb-hydrochloride) remaining. This would have serious consequences for preventing fungicide resistance development in late blight as well as significantly compromising control if curative activity is required.

Loss of glufosinate ammonium. Only available for use as a harvest aid. Alternatives are available.

Loss of thiacloprid. While the loss of this active would result in the removal of one of the most widely used insecticides in potatoes, alternative treatments for aphids are available (even with the loss of the aphicides, cypermethrin and lambda-cyhalothrin). Yield reductions from aphids should therefore be minimal.

Loss of cypermethrin. This active is used on a relatively small proportion of potato crops. The availability of alternative actives for the control aphids (even with the loss of the aphicides cypermethrin and lambda-cyhalothrin). Yield reductions to aphids should therefore be minimal.

Loss of chlorpyrifos. While the loss of this active removes one of the two remaining insecticides for control of cutworm (lambda-cyhalothrin, see below), it is used on a very small proportion of potato crops.

Loss of lambda-cyhalothrin. The loss of this active removes the most widely used insecticide on potatoes. While alternatives are available for the control of aphids, no alternatives exist for cutworms, beetles, weevils and caterpillars. Cutworm is considered a sporadic pest of potatoes and damage affects tuber quality more than yield, which in severe cases can result in crop rejection. However, potato is considered among the crop hosts least susceptible to cutworm attack. Furthermore, the early larval stages (1st and 2nd instars) suffer high levels of mortality during periods of heavy rainfall meaning that this pest is usually only a problem in dry years. While irrigation represents an alternative control measure, the loss of this active, along with chlorpyrifos and cypermethrin, would mean that no alternative chemical treatments are available for cutworm. However, due to its sporadic nature and the low susceptibility of potato, it is considered that untreated reductions in yield would be £0.8M - 0.4% on affected crops. Along with the loss of cypermethrin, no alternatives would be available for the control of other caterpillar pests, however

[5] http://euroblight.net/control-strategies/euroblight-fungicide-table/

these are not considered important pests of potato and damage is likely to be insignificant. Similarly, while no alternative actives are available for beetles and weevils, these are not considered important problems either and untreated yield losses to these are also considered to be minimal.

Loss of chlorpropham. Chlorpropham is a sprout suppressant for which there is no suitable alternative available to some businesses, particularly in the potato processing sector. Loss of chlorpropham would severely affect GB potato production, reducing value by £226M. The consequences of storage yield loss, particularly to the processing supply chain would additionally result in closure of potato processing plants and loss of UK manufacturing jobs.

3. Conclusion

The loss of endocrine disruptors in the GB potato sector could cost the industry £340M - £502M in yield loss which is a drop of 35-56% in current farm-gate value.

The two main issues are yield losses from difficulty in controlling weeds through loss of metribuzin (and to a lesser extent linuron) (£52M - £270M) with no clear alternative chemistry with the same spectrum, and loss of chlorpropham, which could cause storage losses worth £226M.

Impacts from insecticide losses are relatively small in the short term with alternatives available at a similar cost. The main issue is the control of cutworm and caterpillar, both of which are intermittent problems with the total impact from yield impacts around £0.8M.

Losses of foliar fungicides on potatoes is unlikely to have a significant impact on yield in the short term, with alternative chemistry likely to maintain current yields even if all 4 active ingredients are lost, but at increased cost (£5.5M). The loss of multi-site actives such as mancozeb, as well as single site products with alternative modes of action, (loss of 7 modes of action) will have consequences for the implementation of late blight resistance management strategies which will impact on yield as well as gross margins in the longer term. For example, making full use of fungicides that impact on several metabolic pathways is one of four guidelines currently recommended to manage fungicide resistance and includes the dithiocarbamates, chlorothalonil and fluazinam. Withdrawal of mancozeb would leave chlorothalonil, fluazinam, propamocarb-hydrochloride and copper as the remaining multisite active ingredients. Chlorothalonil is a minor active ingredient for control of late blight. There have been reports of fluazinam insensitivity in the late blight population in the Netherlands, although these strains appear to be less competitive compared to other strains such as 13_A2. Copper is only used on organic crops and there are maximum limits implemented by some industry schemes for propamocarb-hydrochloride. It would therefore be difficult to build an anti-

resistance strategy on these remaining 4 active ingredients with multi-site activity in late blight programmes. The latter would be the only multi-site active ingredient remaining if all three scenarios were implemented.

***Note**: The losses calculated relate only to anticipated average annual yield loss. It is expected than in some years losses may be significantly higher or lower than this. No estimates are included for any additional costs that may be necessary following the loss of an active ingredient e.g. alternative sprays, additional labour for mechanical weeding, the use of crop covers to prevent insect damage, increased grading and storage costs and higher levels of crop wastage*

4. References

*AHDB Potato Council Market Information data 2013 - http://www.potato.org.uk/market-information

§ WRC Endocrine Disruptors Report (June 2013) - http://www.randd.defra.gov.uk%2FDocument.aspx%3FDocument%3D11345_PS2812finalreportfull.pdf&ei=1ux9VIDdIsTXaoudgcAP&usg=AFQjCNGGzHiujjdOgqEju1Ki4P7NzonXIQ

Pesticide Usage Survey Data - http://pusstats.fera.defra.gov.uk/index.cfm

.

Annex 1 Active substances included in each scenario, based on WRC and ECPA data

ED more likely to pose a risk Human and Ecotox ***Approvals likely to be lost*** ***SCENARIO 1***	*ED less likely to pose a risk* ***Approvals at risk*** ***SCENARIO 2***	*Potential ED – further info. Required* ***Approvals at risk*** ***SCENARIO 3***
Fungicides		
WRC report Mancozeb Iprodione Myclobutanil Prochloraz Tebuconazole **Additional active substances in ECPA report AND currently approved in UK** Cyproconazole Epoxiconazole Fenbuconaxole Maneb Metconazole	**WRC report** Bupirimate Thiophanate-methyl **Additional active substances in ECPA report AND currently approved in UK** Difenoconazole Folpet Fluquinconazole Fuberidazole Penconazole Propiconazole Tetraconazole Triademenol Triticonazole	**WRC report** Carbendazim Cymoxanil Fluazinam Fosetyl aluminium Hymexazol Mandipropamid Prothioconazole Silthiofam Thiram Chlorothalonil
Herbicides		
WRC report Ioxynil Linuron **Additional active substances in ECPA report AND currently approved in UK** Amitrole	**WRC report** Metribuzin Propyzamide **Additional active substances in ECPA report AND currently approved in UK** Carbetamide Chlorotoluron Fluometuron Picloram Triflusulfuron	**WRC report** 2,4-D Chlorpropham Dimethenamid-P Ethofumesate Fluazifop-p-butyl Glufosinate-ammonium Lenacil S-metolachlor Pinoxaden Tepraloxydim Terbuthylazine
Insecticides		
Abamectin Thiacloprid Cypermethrin Fenoxycarb	Spiromesifen **Additional active substances in ECPA report AND currently approved in UK** Deltamethrin	Chlorpyrifos Clothianidin Beta-cyfluthrin Lambda-cyhalothrin Spinosad Spirotetramat Dimethoate Malathion
Plant growth regulators		
		Chlorpropham (sprout suppressant – also included as herbicide)
TOTAL ACTIVE SUBSTANCES AFFECTED		
17	**20**	**29**