

June 2013



Research Review No. 77

Implications of the restriction on the neonicotinoids: imidacloprid, clothianidin and thiamethoxam on crop protection in oilseeds and cereals in the UK

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1. Abstract

On 24 May 2013 a restriction on the use of three pesticides (clothianidin, imidacloprid and thiamethoxam) belonging to the neonicotinoid group was adopted by the European Commission. The restriction will come into force as of 1 December 2013 and will be reviewed (though not necessarily rescinded) within two years. It targets pesticides used in the treatment of crops attractive to bees and for cereals, with the exception of uses in greenhouses and uses after flowering. Of the crops of interest to HGCA, the Commission's decision affects all oilseed crops, all maize crops, and any cereal crops sown between January and June.

Neonicotinoid seed treatments are used in winter and spring oilseed rape (OSR) to control cabbage stem flea beetle (CSFB), flea beetle, peach–potato aphid (which transmits turnip yellows virus (TuYV)) and turnip sawfly.

Approximately 67% of the total OSR area is affected by CSFB. The average yield loss of the area affected is about 1%, although in some instances yield losses may be much higher. Without insecticides, the calculated annual tonnage lost from CSFB is 15,336 t, costing the industry approximately £5 million per year (0.7% of the total crop value). Without neonicotinoid seed treatments, foliar-applied pyrethroid insecticides are the only alternative; however, CSFB resistance to pyrethroids has been identified in Germany and has the potential to spread to the UK. Pyrethroids already account for 88% of the most commonly used insecticides in OSR. Any additional pyrethroid use should be cautious in order to preserve their efficacy and reduce risks of insecticide resistance developing.

Approximately 60% of the total area of OSR is affected by TuYV. The average yield loss from TuYV in untreated crops is 15%, although yield losses of up to 30% can occur. Without insecticides, the calculated annual tonnage lost from TuYV is 206,010 t, costing the industry approximately £67 million per year (9% of the total crop value). There are no alternative insecticides currently available: neonicotinoids are the only approved OSR insecticide for autumn use to which the peach–potato aphid has not developed resistance to in the UK.

Neonicotinoid seed treatments are used in winter and spring linseed to control flax flea beetles. Unfortunately, there is a lack of information on area affected or yield loss caused by the beetle. As with OSR, pyrethroid insecticides are the only alternatives available.

There are cost implications of not treating seed with neonicotinoids. The reduced costs from not treating certified OSR seed with clothianidin-containing formulations is £12.90 per ha and for hybrid OSR is £9.55 per ha. The reduced cost from not treating certified seed with imidacloprid-containing formulations for linseed is £9.00 per ha. For farm-saved OSR seed, the reduced cost from not

treating with thiamethoxam-containing formulations is £16.50 per ha. For linseed, the reduced cost from not treating farm-saved seed with imidacloprid-containing formulations is £8 per ha. The reduced cost for not treating certified seed will be much more than from farm-saved as OSR and linseed are mostly grown from certified seed (79% and 92% of the cropping area respectively). There are no published figures on what proportion of farm-saved seed is treated with a neonicotinoid treatment. For OSR, the additional product costs calculated for additional pyrethroid sprays as alternatives to neonicotinoids for were: £2,387,459 for 1 pyrethroid spray; £4,774,919 for 2 pyrethroid sprays; £7,162,378 for 3 pyrethroid sprays; and £9,549,837 for 4 pyrethroid sprays. For linseed, the additional product costs calculated for additional pyrethroid sprays as alternatives to neonicotinoids for were: £103,042 for 1 pyrethroid spray; £206,084 for 2 pyrethroid sprays; £309,125 for 3 pyrethroid sprays; and £412,167 for 4 pyrethroid sprays.

Maize is treated with clothianidin to control frit fly and wireworm. The only current alternative control is methiocarb, for frit fly. The cropping area of grain maize is relatively low compared with forage maize and other cereals, so the impact will be lower compared to other European countries where maize is widely grown.

Early sown (September to October) cereals tend to be at high risk of barley yellow dwarf virus (BYDV). These are still likely to, and can, receive a neonicotinoid seed treatment. Spring cereals do not have a current approval for neonicotinoid treated seed. It is, therefore, unlikely that the Commission's decision will affect the control of BYDV in cereals.

2. Introduction

Neonicotinoid insecticides are widely used in agriculture to control insect pests, formulated as either seed treatments or foliar sprays. UK-approved substances from the neonicotinoid group currently include acetamiprid, clothianidin, imidacloprid, thiacloprid and thiamethoxam (IRAG, 2009). On 24 May 2013, following the European Food Standards Agency conclusion on the peer review of the pesticide risk assessment for bees for the active substances clothianidin, imidacloprid and thiamethoxam (EFSA, 2013), a restriction on the use was adopted by the European Commission. The restriction will come into force as of 1 December 2013 and will be reviewed (though not necessarily rescinded) within two years. Member States must withdraw or amend existing approvals to comply with the EU restrictions by 30 September 2013. Existing stocks may be used until 30 November. The restriction targets pesticides used in the treatment of crops attractive to bees and for cereals with the exception of uses in greenhouses and uses after flowering (European Commission, 2013). The main elements of the adopted restriction by the Commission are:

- The restriction applies to the use of three neonicotinoids (clothianidin, imidacloprid and thiamethoxam) for seed treatment, soil application (granules) and foliar treatment on plants that are attractive to bees and cereals (with the exception of winter cereals) (Appendix 1).
- The remaining authorised uses are available only to professionals.
- Exceptions will be limited to uses in greenhouses and after flowering.
- The restrictions will apply as of 1 December 2013 at the latest.
- As soon as new information is available, and at the latest within 2 years, the Commission will review the conditions of approval of the three neonicotinoids to take into account relevant scientific and technical developments.

(European Commission, 2013)

Of the crops of interest to HGCA, the Commission's decision affects all oilseed crops, all maize crops, and any cereal crops sown between January and June. This paper reviews the implications of the decision for crop protection. Unfortunately, there is little data on the average yield losses of crops due to pests. The area affected and the average yield loss caused by each pest are, therefore, mostly based on figures published in HGCA Research Review 70 (Clarke *et al.*, 2009). The figures in that review were reached by collating expert opinion from a number of industry sources. The area treated for each crop is based on the most recent Pesticide Usage Survey Report (produced following the Code of Practice for Official Statistics) which includes information on arable crops in the UK in 2010 (Garthwaite *et al.*, 2011).

3. Oilseed rape

3.1. Area treated

- In 2011, the harvest area of oilseed rape (OSR) was 705,000 ha (Defra, 2011), with approximately 97% winter-sown (Garthwaite *et al.*, 2011).
- Of this harvest area, 71% (502,623 ha) had been treated with either thiamethoxam, clothianidin or imidacloprid. The 29% not treated with a neonicotinoid was predominantly attributed to crops grown in the far north or west of the UK (Garthwaite, 2013. Pers. Comm. Mr D Garthwaite, Agricultural & Horticultural Survey Manager, FERA).
- The most commonly used neonicotinoid seed treatments in that year were:
 - o Thiamethoxam, with 34% (243,116 ha) of the harvest area treated.
 - o Imidacloprid, with 20% (139,986 ha) of the harvest area treated.
 - o Clothianidin, with 17% (119,521 ha) of the harvest area treated.

(Garthwaite *et al.*, 2011)

Neonicotinoid seed treatments are used in winter and spring OSR to control cabbage stem flea beetle (CSFB), flea beetle, peach–potato aphid (which transmits turnip yellows virus (TuYV)) (Appendix 2) and turnip sawfly which is usually of minor importance (BCPC, 2013). They also provide subsequent control against cabbage root fly and other aphids. The following information is calculated for both winter and spring OSR.

3.2. Cabbage stem flea beetle in oilseed rape

3.2.1. Implications

- Typically, 67% of the total area of OSR is affected by CSFB (Clarke *et al.*, 2009). This area may vary from year to year depending upon climatic conditions.
- The 5-year average harvested area of OSR is 654,000 ha (Defra, 2013).
- It is, therefore, assumed that 438,180 ha is affected by CSFB annually.
- There is little information available on the annual yield loss caused by this pest, although in 2009 an average annual yield loss of 1% of the area affected by CSFB was assumed (Clarke *et al.*, 2009). In years favourable to CSFB, losses may be much higher.
- The 5-year average annual yield of OSR is 3.5 t/ha (Defra, 2013).
- Therefore, 1% of 438,180 ha x 3.5 t/ha is 15,336 tonnes lost due to CSFB annually.
- The July 2007 to mid-April 2013 average delivered Erith OSR price is £327.13 per tonne (AHDB/HGCA Market Intelligence, 2013).

- Therefore, 15,336 t x £327.13 per tonne = £5,016,963 (£5M) loss due to CSFB if untreated annually.
- To give perspective, the 5-year average production of the whole crop is 2,286,000 tonnes (Defra, 2013), a calculated value of £747,819,000 using the 5-year average OSR price. It is, therefore, assumed that, from an average yield loss of 1%, 0.7% of the total value of the crop could be lost as a result of CSFB in untreated crops annually.

3.2.2. Alternative control

- Without neonicotinoid seed treatments, foliar-applied pyrethroid insecticides are the only alternative (BCPC, 2013).
- Restrictions of use vary depending on the product choice and should be considered on an individual basis.
- CSFB resistance to pyrethroids has been identified in Germany (Heimbach and Muller, 2012). The use of pyrethroid insecticides should be justified by carrying out in-crop monitoring and referring to the HGCA control thresholds (HGCA, 2013).

3.3. Turnip yellows virus in oilseed rape

3.3.1. Implications

- Typically, 60% of the total area of OSR is affected by turnip yellows virus (TuYV) (Clarke *et al.*, 2009) although this may vary from year to year.
- The 5-year average harvested area of OSR is 654,000 ha (Defra, 2013).
- It is therefore assumed that 392,400 ha is affected by TuYV annually.
- The average annual yield loss from TuYV in untreated crops is 15%. This is based on the assumption that 50% infection will cause 12.5% yield loss (Stevens, 2013. Pers. Comm. Dr M. Stevens, BBRO). TuYV can, however, cause yield losses of up to 30% (HGCA, 2012).
- The 5-year average annual yield of OSR is 3.5 t/ha (Defra, 2013).
- It can be calculated that 15% of 392,400 ha x 3.5 t/ha results in 206,010 tonnes lost due to TuYV annually.
- The July 2007 to mid-April 2013 average delivered Erith OSR price is £327.13 per tonne (AHDB/HGCA Market Intelligence, 2013)
- Therefore, 206,010 t x £327.13 per tonne = £67,392,051 (£67M) loss due to TuYV if untreated annually.

- To give perspective, the 5-year average production of the whole crop is 2,286,000 tonnes (Defra, 2013), a calculated value of £747,819,000 using the 5-year average OSR price. It is, therefore, assumed that 9% of the total value of the crop could be lost as a result of TuYV in untreated crops annually.

3.3.2. Alternative control

- Neonicotinoids are the only approved OSR insecticide for autumn use to which the peach–potato aphid (vector of TuYV) has not developed resistance to in the UK (Foster, unpublished. HGCA Project 3768).
- Pyrethroids or pirimicarb are both available alternatives; however, the peach–potato aphid is highly resistant to both. Results from HGCA project 3768 found that in 2012, 100% of all peach–potato aphids tested carried the MACE resistance mechanism which confers resistance to pirimicarb, and 90% of individuals tested carried either the *kdr* or super *kdr* mechanisms conferring resistance to pyrethroids (Foster, unpublished. HGCA Project 3768).

3.4. Changes to pest control in oilseed rape

In 1998, before neonicotinoid seed treatments in OSR were introduced to the UK, 415,000 ha received the insecticide seed treatment gamma-HCH, accounting for 77% of the total area (537,000 ha) planted in that year (Defra, 2013). Gamma-HCH seed treatment was withdrawn from use in 1999 (Oakley, 2000) and replaced by neonicotinoid-based seed treatments.

Currently, there are no insecticide seed treatments approved to replace the loss of clothianidin, thiamethoxam and imidacloprid in OSR (BCPC, 2013).

The green bars in Figure 1 indicate the seasonal distribution of foliar insecticide applications applied to OSR throughout the 2010/2011 cropping year.

Neonicotinoid seed treatments protect the crop for 6–8 weeks (HGCA, 2012). The loss of these is likely to result in a rise in foliar-applied insecticide applications from August to January. These autumn and winter applications currently account for 40% of all insecticide treatments on oilseed rape (Garthwaite *et al.*, 2011). The spectrum of pests targeted by this 40% is shown in Figure 2. It is these pests which neonicotinoids currently control. The only alternative insecticidal control of CSFB is with pyrethroids. For aphid control, options include pyrethroids or pirimicarb; peach–potato aphid populations are likely to be resistant to these (See section 3.3.2). Pyrethroids already account for 88% of the most commonly used insecticides in OSR (Garthwaite *et al.*, 2011). Any

additional pyrethroid use should be cautious in order to preserve their efficacy and reduce the risk of insecticide resistance developing.

The pests targeted from the March to June insecticide application period (60%) are mostly (in terms of current usage) targeted by pyrethroid insecticides; however, there are alternatives available including pymetrozine, pirimicarb (for aphids only), and thiacloprid (a neonicotinoid whose use is not being restricted under the current decision). A rise in the use of these alternatives is expected to counteract the increased use of pyrethroids in the autumn to reduce risks of further resistance.

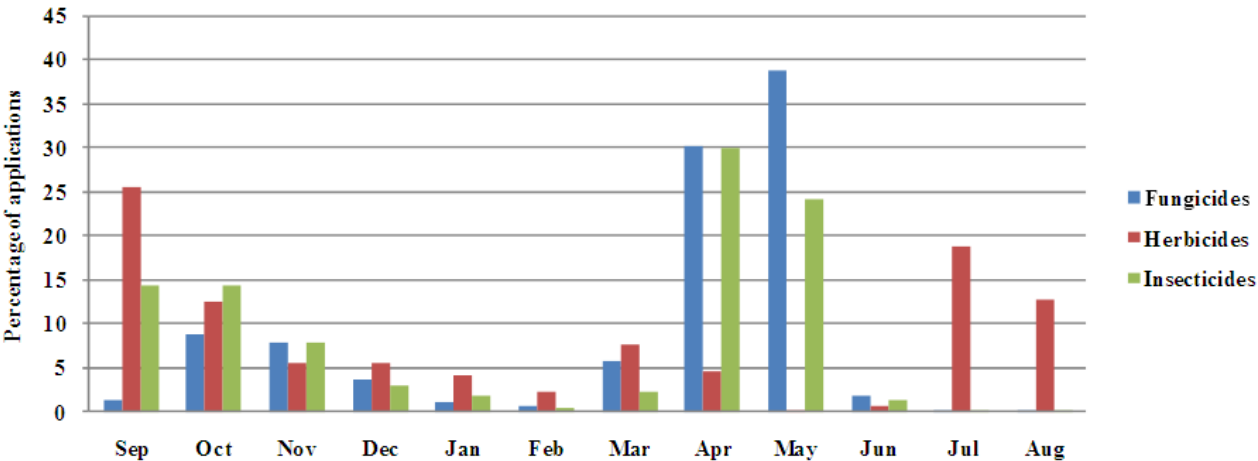


Figure 1. Timing of foliar pesticide applications on winter OSR (Garthwaite *et al.*, 2011)

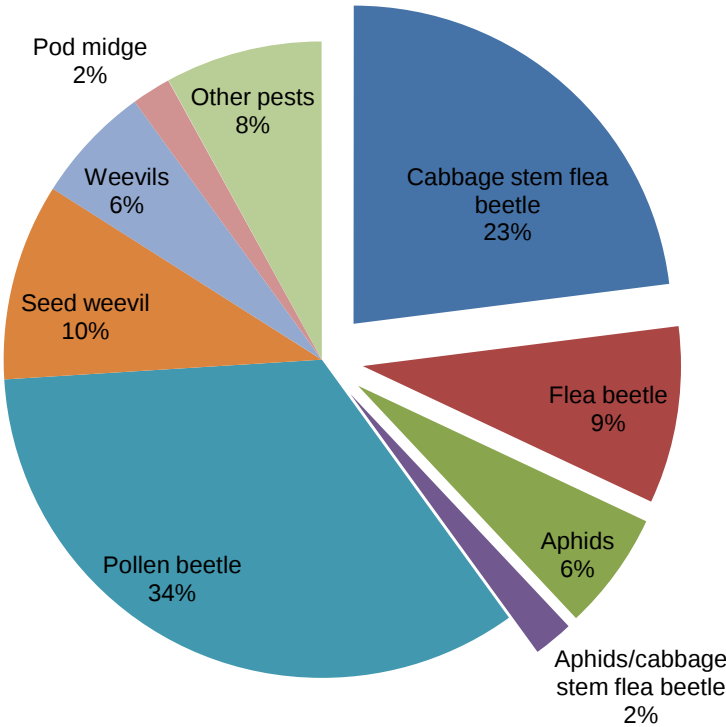


Figure 2. Current reasons for use of insecticides on OSR (where given) highlighting those targeted by neonicotinoid use (exploded slices) (Garthwaite *et al.*, 2011)

3.5. Anticipated changes to crop protection costs for oilseed rape

3.5.1. Seed treatments

In 2010, 79% of the UK crop was grown from certified seed and 21% was grown from farm-saved seed (Garthwaite, 2013. Pers. Comm. Mr D Garthwaite, Agricultural & Horticultural Survey Manager, FERA). Certified seed is usually purchased pre-treated with one of the products listed in Appendix 1. Occasionally, growers save seed from the previously harvested crop to sow the following season. This is commonly referred to as farm-saved seed. Before sowing, the farm-saved seed is cleaned, treated and packed in a similar manner to certified seed. Prices of purchasing certified seed and treating farm-saved seed vary depending on the treatment and variety for certified seed, and the treatment for farm-saved. AHDB was unable to obtain costings from most treatment companies and, therefore, these costs may not represent the costs of similar treatments made by other companies.

Certified seed

In 2010, 79% (556,950 ha) of the UK crop was grown from certified seed (Garthwaite, 2013. Pers. Comm. Mr D Garthwaite, Agricultural & Horticultural Survey Manager, FERA). There are no published figures on what proportion of certified seed is treated with a neonicotinoid treatment; however, it is a reasonable assumption that the proportion of untreated seed is very small (Garthwaite, 2013. Pers. Comm. Mr D Garthwaite, Agricultural & Horticultural Survey Manager, FERA). The prices used in the calculation below were provided by Dalton Seeds and are reported with its permission. The calculations are based on treating conventional and hybrid certified seed treated with prochloraz + thiram (a fungicide seed treatment) with or without the neonicotinoid seed treatment beta-cyfluthrin + clothianidin.

- The average cost per ha of conventional seed treated with prochloraz + thiram and beta-cyfluthrin + clothianidin is about £14.95 per ha.
- The average cost per ha of conventional seed treated with prochloraz + thiram is about £2.05 per ha.
- Based on this, the assumed cost difference of not treating conventional seed with beta-cyfluthrin + Clothianidin is approximately £12.90 per ha.

(Fox, 2013. Pers. Comm. Mr P. Fox, Managing Director of Dalton Seeds)

- The average cost per ha of hybrid seed treated with prochloraz + thiram and beta-cyfluthrin + clothianidin is about £11.05 per ha.
- The average cost per ha of hybrid seed treated with prochloraz + thiram is about £1.50.
- Based on this, the assumed cost difference of not treating hybrid seed with beta-cyfluthrin + clothianidin is approximately £9.55 per ha.

(Fox, 2013. Pers. Comm. Mr P. Fox, Managing Director of Dalton Seeds)

Farm-saved seed

In 2010, 21% (148,050 ha) of the UK crop was grown from farm-saved seed (Garthwaite, 2013. Pers. Comm. Mr D Garthwaite, Agricultural & Horticultural Survey Manager, FERA). There are no published figures on what proportion of farm-saved seed is treated with a neonicotinoid treatment. It is possible to calculate an average cost to the grower for treating with or without a neonicotinoid seed treatment. The prices used in the calculation below were provided by Harlow Agricultural Merchants and are reported with its permission. The calculation is based on treating farm-saved seed with thiram (a fungicide seed treatment) with or without the neonicotinoid seed treatment fludioxonil + metalaxyl-M + thiamethoxam.

- The average cost of cleaning seed, treating with fludioxonil + metalaxyl-M + thiamethoxam and packing is about £4.25 per kg.
- The average cost of cleaning, treating with thiram and packing is about £0.95 per kg.
- Based on this, the assumed cost difference of not treating farm-saved seed with fludioxonil + metalaxyl-M + thiamethoxam is about £3.30 per kg.

(Clark, 2013. Pers. Comm. Mr D. Clark, Seeds Director, Harlow Agricultural Merchants)

- Based on the HGCA Recommended List protocol, plant establishment is aimed at 40 plants/m². This is approximately 5 kg seed per ha, dependant on 1,000 seed weight (Handley, 2013. Pers. Comm. Mr B. Handley, HGCA Recommended Lists Manager).
- Based on this, the cost difference from not treating with fludioxonil + metalaxyl-M + thiamethoxam is £16.50 per ha.

3.5.2. Pyrethroid applications

The cost of additional pyrethroid sprays has been based on:

- The cost of the pyrethroid insecticide deltamethrin, which is £4.75 per ha per application (Nix, 2013).
- The 2010 area treated with thiamethoxam, clothianidin or imidacloprid, which was 502,623 ha, (Garthwaite *et al.*, 2011).

The cost of additional pyrethroid sprays would, therefore, be:

- 1 additional pyrethroid spray: £2,387,459
- 2 additional pyrethroid sprays: £4,774,919
- 3 additional pyrethroid sprays: £7,162,378
- 4 additional pyrethroid sprays: £9,549,837

Please note: the estimated value of CSFB damage in untreated crops is £5 million annually.

4. Linseed

4.1. Area treated

- In 2010, the area of linseed grown in the UK was 43,838 ha (Garthwaite *et al.*, 2011).
- Imidacloprid was applied to 49% (21,693 ha) of the total area grown. (Garthwaite *et al.*, 2011).

Neonicotinoid seed treatments are used in winter and spring linseed to control flax flea beetles. There is a lack of information available that defines usage between spring and winter linseed; the information below, therefore, combines both crops.

4.2. Flea beetle in linseed

4.2.1. Implications

- There is no robust information on area affected by or yield loss from flea beetle.

4.2.2. Alternative control

- As with OSR, pyrethroid insecticides are the only alternatives available and, as with OSR, treatments should be justified.

4.3. Anticipated changes to crop protection costs for linseed

4.3.1. Seed treatments

In 2010, 92% of the UK crop was grown from certified seed and 8% was grown from farm-saved seed (Garthwaite, 2013. Pers. Comm. Mr D Garthwaite, Agricultural & Horticultural Survey Manager, FERA). Certified seed is usually purchased pre treated with one of the products listed in Appendix 1. Again, growers may save seed from the previously harvested crop to sow the following season. Before sowing, the farm-saved seed is cleaned, treated and packed in a similar manner to certified seed. Prices of treating farm-saved seed and purchasing certified seed vary depending on the treatment, and for certified seed, the treatment and variety. AHDB was unable to obtain costings from most treatment companies and therefore these costs may not represent the costs of similar treatments made by other companies.

Certified seed

In 2010, 92% (40,331 ha) of the UK crop was grown from certified seed (Garthwaite, 2013. Pers. Comm. Mr D Garthwaite, Agricultural & Horticultural Survey Manager, FERA). There are no published figures on what proportion of certified seed is treated with a neonicotinoid treatment; however, it is assumed that the proportion of untreated seed is very small (Garthwaite, 2013. Pers.

Comm. Mr D Garthwaite, Agricultural & Horticultural Survey Manager, FERA). The prices used in the calculation below were provided by Dalton Seeds and are reported with its permission. The calculation below is based on treating farm-saved seed with prochloraz (a fungicide seed treatment) with or without the neonicotinoid seed treatment beta-cyfluthrin + imidacloprid.

- The average cost per ha of seed treated with prochloraz and beta-cyfluthrin + imidacloprid is about £15.00 per ha.
- The average cost per ha of seed treated with prochloraz is about £6.00 per ha.
- Based on this, the cost difference of not treating conventional seed with beta-cyfluthrin + imidacloprid is approximately £9.00 per ha.

(Fox, 2013. Pers. Comm. Mr P. Fox, Managing Director of Dalton Seeds)

Farm-saved seed

In 2010, 8% (3,507 ha) of the UK crop was grown from certified seed (Garthwaite, 2013. Pers. Comm. Mr D Garthwaite, Agricultural & Horticultural Survey Manager, FERA). There are no published figures on what proportion of farm-saved seed is treated with a neonicotinoid treatment. It is possible to calculate a reasonable assumption of the average cost to the grower for treating, or not, with a neonicotinoid seed treatment. The prices used in the calculation below were provided by Anglia Grain Services and reported with its permission. The calculation is based on treating farm-saved seed with prochloraz (a fungicide seed treatment) with or without the neonicotinoid seed treatment beta-cyfluthrin + imidacloprid.

- The average cost of cleaning seed, treating with beta-cyfluthrin + imidacloprid and prochloraz, and packing is about £0.46 per kg.
- The average cost of cleaning, treating with prochloraz and packing is about £0.28 per kg.
- Based on this, the assumed cost difference of not treating farm-saved seed with beta-cyfluthrin + imidacloprid is approximately £0.18 per kg.

(Day, 2013. Pers. Comm. Mr N. Day, Sales Director, Anglia Grain Services)

- Based on the HGCA Recommended List protocol, plant establishment is aimed at 600 viable seeds/m². This is approximately 44 kg seed per ha dependant on 1,000 seed weight. This is based on a 1 acre pack of seed weighing 18 kg (www.senova.uk.com).
- Based on this, the cost difference from not treating with beta-cyfluthrin + imidacloprid is approximately £8 per ha.

4.3.2. Pyrethroid applications

The cost of additional pyrethroid sprays has been based on:

- The cost of the pyrethroid insecticide deltamethrin, which is £4.75 per ha per application (Nix, 2013).
- The area of linseed that imidacloprid was applied to in 2010, which was 21,693 ha (Garthwaite *et al.*, 2011).

The cost of additional pyrethroid sprays would, therefore, be:

- 1 additional pyrethroid spray: £103,042
- 2 additional pyrethroid sprays: £206,084
- 3 additional pyrethroid sprays: £309,125
- 4 additional pyrethroid sprays: £412,167

5. Grain maize

Maize is treated with clothianidin to control frit fly and wireworm. The only current alternative control is methiocarb, for frit fly. The UK cropping area of grain maize is currently relatively low, around 3,000 ha, compared with forage maize and other cereals, so the impact will be lower compared to other European countries where maize is widely grown (Nix, 2013).

6. Cereals

The main use of neonicotinoid seed treatments in cereals is to control aphids, particularly those which transmit barley yellow dwarf virus (BYDV) (Appendix 2). Neonicotinoid seed treatments protect cereals from BYDV infection for 6–8 weeks. They also have some activity against wireworms, slugs and leaf hoppers (BCPC, 2013).

6.1. Implications

The Commission's decision states that after 30 November 2013 cereals sown between January and June cannot be treated with thiamethoxam, clothianidin or imidacloprid. Early sown (September to October) cereals tend to be at high risk of barley yellow dwarf virus (BYDV) (HGCA, 2012). These are still likely to, and can, receive a neonicotinoid seed treatment. Spring cereals do not have a current approval for neonicotinoid treated seed. It is therefore unlikely that the Commission's decision will affect the control of BYDV in cereals.

An economic assessment of a situation where thiamethoxam, clothianidin or imidacloprid are not applied to autumn-sown cereals has been calculated in a separate unpublished document should the restrictions ever extend to include autumn-sown cereals.

7. Conclusion

Table 1 encompasses the crop protection implications resulting from the restrictions including the area affected, potential yield losses, and costs to the industry. It is calculated that the total annual cost to the UK industry from not controlling CSFB and TuYV in OSR is approximately £72 million.

Table 1. Summary of crop protection implications of growing OSR resulting from the neonicotinoid restrictions (Clarke *et al.*, 2009; Defra, 2013; AHDB/HGCA Market Intelligence, 2013).

	CSFB	TuYV
Total area of UK crop affected	67%	60%
Total area of UK crop affected	438,180 ha	392,400 ha
Average annual yield loss from affected area	1%	15%
Total annual yield loss using no insecticide treatments	1,5336 t	206,010 t
Cost to UK industry using no insecticide treatments	£5,016,963	£67,392,051
Proportion of total crop value	0.7%	9.0%

Table 2 encompasses the costs to the grower of additional pyrethroid applications for the control of CSFB in OSR and flea beetle in linseed.

Table 2. Total cost of 1 to 4 applications of deltamethrin to 502,623 ha and 21,693 ha (area neonicotinoid treated seed in 2010) for OSR and linseed respectively (Garthwaite *et al.*, 2011; Nix, 2013).

		Cost of additional pyrethroid applications to total crop area affected	
	Cost per ha	OSR	Linseed
1 pyrethroid application	£4.75	£2,387,459	£103,042
2 pyrethroid applications	£9.50	£4,774,919	£206,084
3 pyrethroid applications	£14.25	£7,162,378	£309,125
4 pyrethroid applications	£19.00	£9,549,837	£412,167

Table 3 outlines the calculated reduced costs of excluding a neonicotinoid insecticide from treated seed. The reduced cost from not treating certified seed with a neonicotinoid for conventional OSR is £12.90 per ha for hybrid OSR is £9.55 per ha. The calculated reduced cost from not treating certified seed with a neonicotinoid for linseed is £9.00 per ha. The calculated reduced cost from not treating farm-saved seed with a neonicotinoid for OSR is £16.50 per ha and for linseed is £8.00 per ha. There are no published figures on what proportion of certified and farm-saved seed is treated with a neonicotinoid.

Table 3. Reduced costs per ha of not treating OSR and linseed seed with a neonicotinoid (Garthwaite, 2013. Pers. Comm. Mr D Garthwaite, Agricultural & Horticultural Survey Manager, FERA; Fox, 2013. Pers. Comm. Mr P. Fox, Managing Director of Dalton Seeds; Clark, 2013. Pers. Comm. Mr D. Clark, Seeds Director, Harlow Agricultural Merchants; Day, 2013. Pers. Comm. Mr N. Day, Sales Director, Anglia Grain Services).

		Oilseed rape		Linseed	
		Certified seed	Farm-saved seed	Certified seed	Farm-saved seed
Total area of UK crop grown		79% or 556,950 ha	21% or 148,050 ha	92% or 40,331 ha	8% or 3,507 ha
Cost difference from not treating seed with a neonicotinoid	Conventional variety	£12.90 per ha	£16.50 per ha	£9.00 per ha	£8.00 per ha
	Hybrid variety	£9.55 per ha	N/A	N/A	N/A

This report has focused directly on the implications of changes to crop protection. Other contributing factors resulting from an increase in machinery work days have not been assessed in this report, but should be taken into account. These include mechanical damage to the crop, soil compaction, extra labour and fuel costs, and an increase to the carbon footprint of growing the crop.

8. Useful links and documents

- [Commission Implementing Regulation \(EU\) No 485/2013](#)
- [EU Commission Statement](#)
- [CRD Update](#)
- [AHDB Neonicotinoids web page](#)
- [HGCA Planting Survey Results](#)
- [HGCA Information Sheet 16 – Controlling aphids and virus diseases in cereals and oilseed rape \(Summer 2012\)](#)
- [IRAG UK Position on neonicotinoids](#)
- [Kdr resistance in grain aphids](#)
- [RR70 – HGCA Research Review 70 – Pesticide availability for cereals and oilseeds following revision of Directive 91/414/EEC; effects of losses and new research priorities](#)
- [Pesticide usage survey report 235 – Arable crops](#)

9. References

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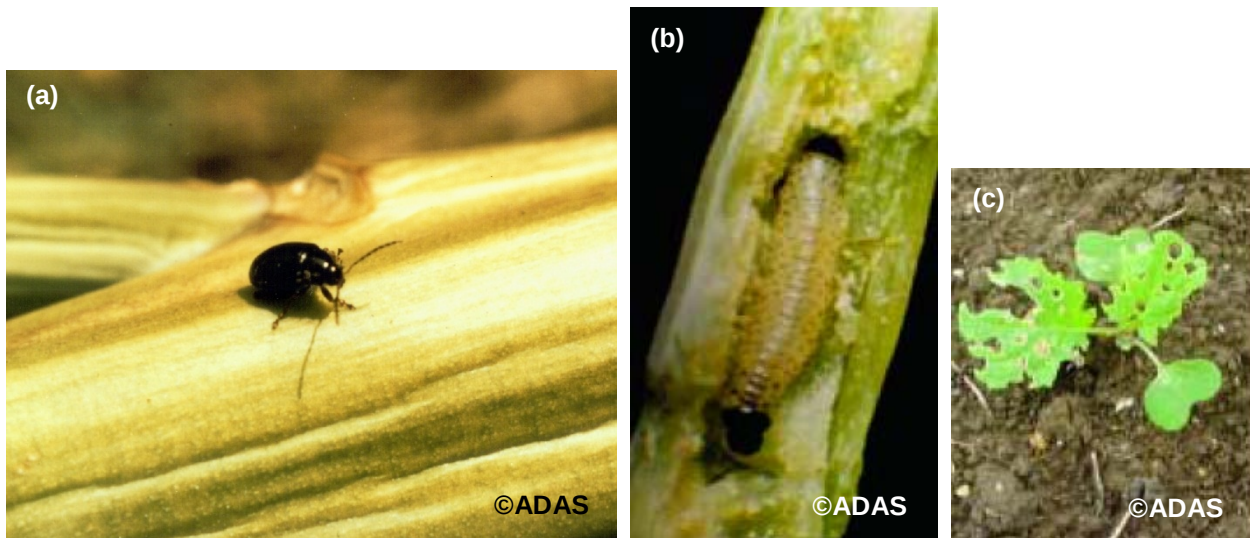
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APPENDIX 1 – Products affected by the restrictions

Product	Details	Pests controlled
Oilseeds		
Chinook Blue	beta-cyfluthrin + imidacloprid Bayer CropScience MAPP 11262 Crops: <u>WOSR, SOSR</u> (EAMUs: <u>Linseed</u> , evening primrose, honesty, mustard)	Cabbage stem flea beetle (<i>Psylliodes chrysocephala</i>) Other flea beetles (<i>Phyllotreta spp</i>)
Chinook Colourless	beta-cyfluthrin + imidacloprid Bayer CropScience MAPP 11206 Crops: <u>WOSR</u> (EAMUs: <u>Linseed</u> , evening primrose, honesty, mustard)	Cabbage stem flea beetle (<i>Psylliodes chrysocephala</i>) Other flea beetles (<i>Phyllotreta spp</i>)
Conquest	Fludioxonil + metalaxyl-M + thiamethoxam AgChem Access MAPP 15031 Crops: <u>WOSR, SOSR, fodder rape, mustard</u>	Flea beetles (<i>Phyllotreta</i> and <i>Psylliodes spp.</i>) Cabbage stem flea beetle (<i>Psylliodes chrysocephala</i>) Peach–potato aphid (<i>Myzus persicae</i>)
Cruiser OSR	Fludioxonil + metalaxyl-M + thiamethoxam Syngenta MAPP 14496 Crops: <u>WOSR, SOSR, fodder rape, mustard</u> (EAMU for <u>linseed</u> for disease)	Flea beetles (<i>Phyllotreta</i> and <i>Psylliodes spp.</i>) Cabbage stem flea beetle (<i>Psylliodes chrysocephala</i>) Peach–potato aphid (<i>Myzus persicae</i>)
Modesto	beta-cyfluthrin + clothianidin Bayer CropScience MAPP 14029 Crops: <u>WOSR</u> , poppies for morphine (EAMU)	Cabbage stem flea beetle (<i>Psylliodes chrysocephala</i>) Turnip sawfly (<i>Athalia rosea</i>) Peach–potato aphid (<i>Myzus persicae</i>)
Cereals		
Deter	Clothianidin Bayer CropScience MAPP 12411 Crops: Winter wheat, winter barley, winter oats, durum wheat, rye, triticale	Aphids/BYDV Slugs Leafhoppers
Redigo deter	Prothioconazole + clothianidin Bayer CropScience MAPP 12423 Crops: Winter wheat, winter barley, winter oats, durum wheat, rye, triticale	Aphids/BYDV Wireworms and slugs Leafhoppers
Tripod Plus	Imidacloprid + triadimenol + fuberidazole Makhteshim-Agan MAPP 13168 Crops: Winter wheat, winter barley, winter oats	Aphids/BYDV Wireworms
Maize		
Poncho	Clothianidin Bayer CropScience MAPP 13910 Crops: Forage maize, grain maize, sweetcorn	Frit fly Wireworm

(BCPC, 2013)

APPENDIX 2 – Photo gallery



Cabbage stem flea beetle (CSFB) in oilseed rape: (a) adult beetle, (b) larva, (c) 'shot-holing' damage



Turnip yellows virus (TuYV) in oilseed rape



Barley yellow dwarf virus (BYDV) in wheat