Evaluation of data concerning the necessity of flumioxazin as a herbicide to control a serious danger to plant health which cannot be contained by other available means, including non-chemical methods

European Food Safety Authority (EFSA)

Abstract
EFSA was requested by the European Commission to provide scientific assistance under Article 31 of Regulation (EC) No 178/2002 regarding the evaluation of data concerning the necessity of flumioxazin as a herbicide to control a serious danger to plant health which cannot be contained by other available means including non-chemical methods, in accordance with Article 4(7) of Regulation (EC) No. 1107/2009. In this context, EFSA organised a commenting phase with the Member States in order to collect and validate the data submitted by the applicant. The current scientific report summarises the outcome of the evaluation of 21 different uses (crop and non-agricultural) in nine Member States. The evaluation demonstrated that in general a wide range of alternative herbicide active substances are available for chemical weed control but that there are uses for which no sufficient chemical alternatives to flumioxazin are available. The evaluation included the assessment of non-chemical methods for the different uses. A wide range of non-chemical methods are available, however, often these methods do not have the same efficacy as chemical methods or have economic limitations. A combination of both chemical and non-chemical methods seems often possible. First practical experiences gained during the evaluation of flumioxazin have been expressed.

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Keywords: flumioxazin, pesticide, herbicide, Article 4(7) of Regulation (EC) No 1107/2009

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Correspondence: pesticides.peerreview@efsaeuropa.eu
Amendment: This Scientific Report has been republished following revision of the EFSA “Protocol for the evaluation of data concerning the necessity of the application of herbicide active substances to control a serious danger to plant health which cannot be contained by other available means, including non-chemical methods” (EFSA supporting publication 2016:EN-1060. 18 pp), published on 3 April 2017. The revised protocol was applied to this Scientific Report and related assessment of the active substance flumioxazin in the context of Article 4(7) of Regulation (EC) No 1107/2009. As a consequence, conclusions for the uses in pome fruits, stone fruits and grapes in Hungary changed. Corrections have been made on page 3, Section 3.1 (page 9), Section 3.2 (page 10), Section 3.5 (page 12), Section 3.6 (page 12), Section 3.8 (page 14), Section 3.9 (page 14), page 22–23 and in Appendix A. To avoid confusion, the older version of this scientific output has been removed from the EFSA Journal, but versions showing all the changes made are available on request.

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Summary

Flumioxazin was included in Annex I to Directive 91/414/EEC on 1 January 2003 by Commission Directive 2002/81/EC and has been deemed to be approved under Regulation (EC) No 1107/2009. The applicant, Sumitomo Chemical Agro Europe S.A.S., applied for renewal of approval in line with the provisions of Commission Regulation (EU) No 1141/2010.

Flumioxazin is a herbicide active substance (a.s.) which has soil surface residual properties, and is used for pre-emergence or early post-emergence control of both broadleaf and grass weeds.

Flumioxazin has a current harmonised classification in accordance with Regulation (EC) No 1272/2008, as toxic for reproduction category 1B, leading to a critical area of concern with regard to the approval criteria of Annex II, Point 3.6.4 of Regulation (EC) No 1107/2009.

The applicant requested derogation under Article 4(7) of Regulation (EC) No 1107/2009 when applying for renewal of approval. On 29 May 2015, the European Commission (EC) requested the European Food Safety Authority (EFSA) to provide its scientific assessment of the new information submitted to demonstrate that flumioxazin is necessary to control a serious danger to plant health, which cannot be contained by any other available means including non-chemical methods. In order to address this request, EFSA established a working group (WG) on flumioxazin to develop a specific methodology for the assessment of Article 4(7) submissions, as this was the first time to address such an application and no guidance is available to the Member States (MS) and EFSA. A protocol to enable consistent and transparent evaluations of submissions made by applicants in accordance with Article 4(7) of Regulation (EC) No 1107/2009 was developed after consultation with the Member States and published on 2 August 2016.

Subsequently, the applicant was requested by the European Commission to resubmit the data following the methodology developed by EFSA. In September 2016, the European Commission forwarded the information provided by the applicant to EFSA.

The applicant included claims that the use of flumioxazin is considered essential in accordance with Article 4(7) of Regulation (EC) No 1107/2009 in relation to the uses authorised in 15 MS.

As following step, EFSA launched a commenting phase in September-October 2016 asking all the MS to confirm that the uses for which the applicant requested Article 4(7) derogation are authorised, and if the use of flumioxazin is considered essential to control a serious danger to plant health, giving clear justification for each use that is considered as essential. In addition, all the MS were invited to submit information related to respective national authorisations for different crops or non-agricultural uses, evidence on resistance risk and uses that were not covered by applicant submission (e.g. minor uses).

On 25 November 2016, EFSA requested the involvement of the respective EFSA WG on flumioxazin for the evaluation of the data on flumioxazin and to discuss requirements related to the applied methodology.

Overall, 21 different uses (crop and non-agricultural) in nine Member States (Austria, Belgium, the Czech Republic, Greece, Hungary, the Netherlands, Slovakia, Spain and the United Kingdom) were evaluated to assess the applicant’s claims on the necessity of flumioxazin to control a serious danger to plant health. It can be concluded that generally a wide range of chemical alternative herbicide a.s. are available at the MS level for weed control in winter wheat (the Czech Republic and the United Kingdom), maize (Slovakia), tree nursery (Belgium) and amenities (Belgium). However, there are insufficient chemical alternatives to flumioxazin for particular cases such as minor uses (e.g. in vining peas, bulb onions, carrots and parsnips, winter oats (the United Kingdom)), or for weed control in apples and pears (the Netherlands), citrus (Spain), sorghum (Hungary), sunflower (Hungary and Slovakia), soybeans (the Czech Republic and Hungary), ways and places with woody plant growth (Austria), woody ornamental plants (Austria) and silviculture (Hungary). Due to the national authorisation for some uses, such as for olives, grapes, maize, winter wheat and railways, insufficient or sufficient chemical alternatives to flumioxazin are available. For potatoes (Hungary), an intermediate situation was concluded.

Non-chemical alternatives were also evaluated for these different uses and a wide range of methods are available, however, often these methods do not have the same efficacy as chemical methods or have economic limitations. A combination of both chemical and non-chemical methods seems often possible.

When evaluating individually the herbicide chemical alternatives, no serious alternatives may seem to be present, while the system as a whole may be able to function without the substance under evaluation (e.g. amenities in Belgium and non-agricultural terrain in the Netherlands). Thus, there is
the need to assess the whole system of weed control and further considerations from the MS on this subject might be needed.

First, practical experiences gained during the evaluation of flumioxazin have been expressed and should be taken into account when drafting a single guidance document for the assessment of applications for derogation under the Article 4(7) for the different types of pesticides.
# Table of contents

| Section                                                                 | Page |
|------------------------------------------------------------------------|------|
| Abstract                                                               | 1    |
| Summary                                                                | 3    |
| 1. Introduction                                                       | 6    |
| 1.1. Background and Terms of Reference as provided by the requestor   | 6    |
| 2. Data and methodologies                                              | 7    |
| 2.1. Methodologies                                                    | 7    |
| 2.2. Data and information                                             | 7    |
| 3. Evaluation and assessment                                          | 9    |
| 3.1. Railways                                                         | 9    |
| 3.2. Amenities                                                        | 10   |
| 3.3. Ways and places with woody plant growth                          | 11   |
| 3.4. Woody ornamental plants                                          | 11   |
| 3.5. Tree nursery including tree and shrub                            | 12   |
| 3.6. Pome fruits, stone fruits, and apple and pear                    | 12   |
| 3.7. Silviculture                                                     | 13   |
| 3.8. Grapes (wine and table grapes)                                   | 14   |
| 3.9. Olives (table-oil)                                               | 14   |
| 3.10. Citrus                                                          | 15   |
| 3.11. Maize                                                           | 16   |
| 3.12. Sunflower                                                       | 16   |
| 3.13. Soybean                                                        | 17   |
| 3.14. Potatoes                                                        | 17   |
| 3.15. Sorghum                                                         | 18   |
| 3.16. Winter wheat                                                    | 18   |
| 3.17. Winter oats                                                     | 19   |
| 3.18. Winter cereals (wheat, barley and triticale)                    | 20   |
| 3.19. Bulb onions                                                     | 20   |
| 3.20. Vining peas                                                     | 21   |
| 3.21. Carrots and parsnips                                            | 21   |
| 4. Conclusions                                                        | 22   |
| 5. Recommendation                                                    | 23   |
| References                                                            | 24   |
| Abbreviations                                                         | 24   |
| Appendix A                                                            | 26   |
| Appendix B                                                            | 27   |
1. Introduction

1.1. Background and Terms of Reference as provided by the requestor

Flumioxazin is an active substance included in Annex I to Directive 91/414/EEC\(^1\) on 1 January 2003 by Commission Directive 2002/81/EC\(^2\) and deemed to be approved under Regulation (EC) No 1107/2009\(^3\) for which the applicant Sumitomo Chemical Agro Europe S.A.S. applied for renewal in line with the provisions of Commission Regulation (EU) No 1141/2010\(^2\). Flumioxazin was evaluated by the Czech Republic as rapporteur Member State (RMS). The RMS delivered its initial evaluation of the dossier in the Renewal Assessment Report (RAR) on 4 March 2013 (Czech Republic, 2013). In accordance with Article 16 of Regulation (EU) No 1141/2010, EFSA finalised the conclusion on the peer review for flumioxazin on 4 June 2014 (EFSA, 2014).

On 6 June 2014, the European Chemicals Agency (ECHA) Risk Assessment Committee (RAC) adopted the opinion for flumioxazin with the following harmonised classifications: toxic for reproduction category 1B (H360D) and M = 1000 for Aquatic Chronic 1.

As a result of this classification, the approval criteria of Annex II, Point 3.6.4 of Regulation (EC) No 1107/2009 are not met. Consequently, the European Commission proposed a non-approval to the Standing Committee on Plants, Animals, Food and Feed on 3 December 2014 in accordance with Article 17 of Regulation (EU) No 1141/2010.

The applicant, when applying for renewal, informed the European Commission of certain serious plant health dangers which cannot be controlled by means other than by flumioxazin, in accordance with Article 4(7) of Regulation (EC) No 1107/2009. This information was made available by the RAR on 9 March 2015 in the form of an addendum to the RAR (Czech Republic, 2015).

On 29 May 2015, the European Commission requested EFSA to provide scientific assistance as regards the consideration of evidence that the application of flumioxazin is necessary to control a serious danger to plant health which cannot be contained by other available means including non-chemical methods. In order to address this request, EFSA set up a working group (WG) on flumioxazin to develop a specific methodology for the assessment of herbicide active substances (a.s.). On 10 March 2016, a dedicated meeting of the Pesticide Steering Network (PSN) with participation of the Member States (MS), the European Commission, EFSA and the WG on flumioxazin was organised to further discuss and refine the methodology. EFSA launched a consultation phase in May 2016 on the draft herbicide protocol. The protocol was published on 2 August 2016 (EFSA, 2016a).

Subsequently, the applicant was requested by European Commission to resubmit the data following the methodology developed by EFSA. In September 2016, the European Commission forwarded to EFSA the new submission provided by the applicant, consisting in a data collection set and a report (Sumitomo, 2016).

The applicant included claims that the use of flumioxazin is considered essential in accordance with Article 4(7) of Regulation (EC) No 1107/2009 in the following MS: Austria, Belgium, Bulgaria, Croatia, the Czech Republic, France, Germany, Greece, Hungary, Ireland, Romania, Slovakia, Spain, the Netherlands and the United Kingdom.

On 30 September 2016, EFSA launched a 4-week commenting phase asking all the MS to confirm that the uses for which the applicant requests Article 4(7) derogation are authorised and if the use of flumioxazin is considered essential to control the serious danger to plant health, giving clear justification for each use that is considered as critical. In addition, all the MS were invited to supplement the information provided by the applicant with information from their own MS uses also considering other uses not presented by the applicant (e.g. minor uses).

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1. Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market. OJ L 230, 19.8.1991, p. 1–32.
2. Commission Regulation (EU) No 1141/2010 of 7 December 2010 laying down the procedure for the renewal of the inclusion of a second group of active substances in Annex I to Council Directive 91/414/EEC and establishing the list of those substances. OJ L 322, 8.12.2010, p. 10–19.
3. Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC. OJ L 309, 24.9.2009, p. 1–50.
4. Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 OJ L 353, 31.12.2008, p. 1–1355.

www.efsa.europa.eu/efsajournal 6 EFSA Journal 2017;15(1):4688
As a follow up, EFSA ensured that the methodology was consistently applied by the MS and summarised the evaluation of flumioxazin (See Appendix A and B) in the current scientific report. A final consultation process on the draft scientific report with the MS was launched in December 2016. The legal deadline to finalise the current scientific report is 16 December 2016.

2. Data and methodologies

2.1. Methodologies

The assessment was conducted in line with the methodology for the evaluation of data concerning the necessity of the application of herbicide a.s. to control a serious danger to plant health which cannot be contained by other available means, including non-chemical methods published on 2 August 2016 (EFSA, 2016a). The submission provided by the applicant in the form of a collection data set and a report, was also in line with the EFSA methodology (EFSA, 2016a).

The role of EFSA is to act as the co-ordinator of the process, ensuring that the methodology is applied consistently and providing a scientific report on the evaluation of flumioxazin. EFSA considered the information provided by the MS such as the full list of authorised herbicide a.s., the shortlisted a.s. and the non-chemical methods as reliable and no further research was conducted to validate these data. Thus, the MS had the full responsibility for the accuracy and correctness of the data provided to EFSA to perform the assessment.

2.2. Data and information

This report presents the information contained in the applicant report on the addendum to the RAR of flumioxazin (Sumitomo, 2016), and additional information and data provided by the MS after the commenting phase launched by EFSA in September–October 2016 (Table 1).

EFSA provides the collection data set as validated by the MS (i.e. complete list/s of authorised a.s. in the relevant MS) as an Appendix to this scientific report (Appendix A). Also, a summary of the shortlisted herbicide a.s. for each use (crop or non-agricultural use) and the MS is provided as an Appendix to this report (Appendix B).

Table 1: Flumioxazin registrations in Europe

| Country          | Use/stage of application(a)                                                                 |
|------------------|-------------------------------------------------------------------------------------------|
| Austria          | Railways/Up to BBCH 12 of weeds                                                           |
|                  | Ways and places with woody plant growth/post-emergence weeds (BBCH 00-31) beginning of spring to the end of summer |
|                  | Woody ornamental plants/post-emergence weeds (BBCH 00-31) beginning of spring to the end of summer |
| Belgium          | Amenities (excluding railways)/pre-emergence of the weeds                                 |
|                  | Fruit tree nurseries/pre-emergence of the weeds (BBCH 00 of trees)                        |
| Bulgaria         | Maize/crop and weeds pre-emergence                                                        |
|                  | Sunflower/crop and weeds pre-emergence or BBCH 12-14 of crop                              |
| Croatia          | Wine and Table grapes/prebud burst, pre- and early post-emergence of weeds                 |
|                  | Maize/crop and weeds pre-emergence                                                        |
|                  | Sunflower/crop and weeds pre-emergence or BBCH 12-14 of crop                              |
| Czech Republic   | Winter wheat/pre-emergence or early post-emergence BBCH 10-14 of the crop (autumn)       |
|                  | Soybean/pre-emergence of weeds                                                            |
| France           | Wine and table grapes/spring application in pre-emergence or early post-emergence of weeds |
|                  | Pome fruits, quince, nashi/spring application in pre-emergence or early post-emergence of weeds |
| Country      | Use/stage of application<sup>(a)</sup>                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------|
| Germany     | Asparagus/BBCH 7 after harvest                                                                           |
|             | Pome fruit/BBCH 54-75, beginning of spring until end of summer                                             |
|             | Hop/crop BBCH 33-61                                                                                    |
|             | Blackcurrant/before flowering (crop) and after harvest (weeds) Raspberry/after harvest (crop); BBCH 00-12 (weeds) |
|             | Stone fruits/from beginning of spring to end of summer; weeds BBCH 00-12                                 |
|             | Wine and Table grapes/from beginning of spring to end of summer: crop BBCH 01-75; weeds BBCH 00-12       |
|             | Winter wheat/Autumn, pre-emergence BBCH 00-09 of crop and post-emergence BBCH 10-14 of crop               |
|             | Railways/pre- or early post-emergence of weeds (BBCH 00-12)                                             |
|             | Pathways and places (YMBAM)/From spring to the end of summer pre- or early post-emergence of weeds (BBCH 00-12) |
|             | Woody ornamental plants (NNNBA)/From spring to the end of summer pre- or early post-emergence of weeds (BBCH 00-12) |
| Greece      | Wine and Table grapes/prebud burst, pre-emergence of weeds until BBCH 12-14                              |
|             | Olives/Autumn (before harvest) pre-emergence and until BBCH 12-14                                       |
|             | Citrus (oranges, lemon, mandarin, grapefruit, pomelo)/pre-emergence of the weeds until BBCH 12-14       |
| Hungary     | Wine and table grapes/prebud burst, pre- and early post-emergence                                        |
|             | Pome fruit and Stone fruit/pre- or early post-emergence 2–6 leaves of weeds                              |
|             | Sunflower/pre- or early post-emergence 2–4 leaves of crop                                              |
|             | Maize/crop and weeds pre-emergence                                                                      |
|             | Silviculture/pre-emergence of weeds and post-emergence of weeds and up to 2–6 leaves                    |
|             | Winter wheat/post-emergence up to BBCH 21                                                              |
|             | Sorghum/crop and weeds pre-emergence                                                                   |
|             | Soybean/crop and weeds pre-emergence                                                                    |
|             | Potato/crop and weeds pre-emergence                                                                     |
| Ireland     | Winter wheat/Before 5th true leaf stage of crop (up to BBCH 15)                                         |
| Netherlands | Apple and pear/pre-emergence or early post-emergence of weeds (crop BBCH 00-60) March–May               |
|             | Non-agricultural terrain (unpaved and permeable, including railways)/March–July                          |
| Romania     | Maize/crop and weeds pre-emergence                                                                      |
|             | Sunflower/crop and weeds pre-emergence + early post-BBCH 12-14 of crop                                 |
|             | Potato/crop and weeds pre-emergence                                                                     |
|             | Soybean/crop and weeds pre-emergence                                                                    |
|             | Onion/crop and weeds pre-emergence and post-emergence BBCH 12-14                                       |
| Slovakia    | Maize/crop and weeds pre-emergence                                                                      |
|             | Winter cereals (winter wheat, winter barley, triticale, rye)/Crop pre- or post-emergence (BBCH 11-14)   |
|             | Sunflower/crop and weeds pre-emergence or BBCH 12-14 of crop                                            |
| Spain       | Wine and Table grapes/weeds pre-emergence or early post-emergence, prebud burst or early post-bud burst |
|             | Olives/Autumn (before harvest) pre-emergence and until BBCH 12-14 of crop                              |
|             | Railways/post-emergence of weeds (BBCH 00-12)                                                          |
| United       | Winter wheat/before 5th true leaf stage (up to BBCH 15)                                                |
| Kingdom     | Winter oats/Before crop emergence                                                                      |
|             | Vining Peas/Post-crop emergence                                                                        |
|             | Carrots and parsnips/Post-crop emergence at 2–3 leaf stage                                              |
|             | Bulb Onions/Post-crop emergence                                                                        |

BBCH: growth stages of mono- and dicotyledonous plants

<sup>(a)</sup>: The uses proposed in the following table correspond to the list provided by the applicant (Sumitomo, 2016) as validated by the MS.
In addition, key supporting documents to this scientific report are:

- the applicant submission in the form of a Report (Sumitomo, 2016) and collection data set;
- the comments received on the Applicant Report (EFSA, 2016b);
- the comments received on the draft scientific report (EFSA, 2016c).

The applicant submitted the information in relation to 15 MS; nine MS (Austria, Belgium, the Czech Republic, Greece, Hungary, the Netherlands, Slovakia, Spain and the United Kingdom) verified the information submitted by the applicant. Germany was not able to validate the information provided by the applicant as it was not possible to adjust the received information with the one available in the national database and therefore an accurate mapping was not possible. Furthermore, five MS (Bulgaria, Croatia, France, Ireland, and Romania) did not verify the information. As a consequence, for the following crops: quince and nashi, asparagus, hop, blackcurrant and raspberry, no evaluation of the applicants claims could be carried out.

### 3. Evaluation and assessment

#### 3.1. Railways

Non-agricultural uses fall under Regulation (EC) No 1107/2009. Table 2 summarises the number of authorised herbicide a.s. and the potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in railways in Austria and Spain.

**Table 2:** Number of authorised and shortlisted herbicide a.s. to control weeds in railways in Austria and Spain

| Use      | Country | Authorised a.s. | Shortlisted a.s. |
|----------|---------|----------------|-----------------|
| Railways | AT      | 4              | 3               |
| Railways | ES      | 7              | 6               |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in railways to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in herbicide resistance (HR) management strategy score of 5.5\(^5\) for Austria. This means that in Austria it is assumed that considering the herbicide a.s. flazasulfuron (B\(^5\)), glyphosate\(^7\) (G), 2,4-D\(^*\) (O) and three different mode of actions (MOA), there are insufficient chemical alternatives available. In Spain, the evaluation resulted in the following herbicide a.s. are shortlisted: fluroxypyr-meptyl\(^*\) (O), triclopyr-butoxy-ethyl-ester\(^*\) (O), carfentrazone-\(E\) (E), diflufenican\(^*\) (F1), glyphosate\(^*\) (G), 2-methyl-4-chlorophenoxyacetic acid\(^*\) (MCPA) (O), one of the shortlisted herbicide a.s., (carfentrazone-\(E\)) has the same MoA as the a.s. under consideration (flumioxazin). The protocol (EFSA, 2016a) states: “if one of the shortlisted a.s. has the same MoA [and site of action] as the a.s. under consideration, withdrawal of the a.s. under consideration has no implications for herbicide resistance management. Consequently, justifying derogation based on a reduced number of MoAs no longer holds”. This leads to the conclusion that there are sufficient chemical alternatives available for railways in Spain and there is no need to calculate a herbicide resistance (HR) score.

Spain noted that there are time restrictions to apply products containing diflufenican, glyphosate and MCPA and also for products containing fluroxypyr-meptyl, and triclopyr-butoxy-ethyl-ester.

In Austria, two non-chemical methods, mechanical weeding and thermal weed control, are available; however, these methods have economic limitations. In Spain, non-chemical alternatives are not an option for railways.

For details of the evaluation, see Appendix A and B.

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\(^5\) HR scores: lower or equal 6: insufficient chemical alternatives; higher than 8: sufficient chemical alternatives; between 6 and 8: intermediate situation (EFSA, 2016).

\(^6\) The alphabetical coding corresponds to the Mode of Action group according to the Herbicide Resistance Action Committee (HRAC) (Table 1, EFSA, 2016).

\(^7\) *: Active substance is available in a mixture of an authorised plant protection product.
3.2. Amenities

Under this chapter, the following uses are summarised: (i) amenities (excluding railways and used as pre-emergence) for Belgium and (ii) non-agricultural terrain (unpaved and permeable, including railways) for the Netherlands (applied in March-July).

In Belgium, amenities are defined areas of land that are removed from production and not intended to be sown or planted for the next 6-12 months. The soil should be natural without any man made surface, may be covered only by natural vegetation and may be further cropped. This exclude ‘permeable surface overlying soil’, ‘hard surface’ as they cannot be used further for cropping as it and ‘amenity grassland’, ‘amenity vegetation’ and ‘managed amenity turf’ as they are not covered by natural spontaneous vegetation. Railways are a specific subpart of the use ‘Hard surface’ in Belgium. It should be noted that flumioxazin is not authorised in amenity managed land in Belgium. In addition, flumioxazin is not authorised for use in paths or path woods in Belgium. Paths are not intended to be further used for cropping (sowing or planting) so excluded by the Belgium definition of the use. Table 3 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in amenities/non-agricultural terrain in Belgium and the Netherlands, respectively.

Table 3: Number of authorised and shortlisted herbicide a.s. to control weeds in amenities/ non-agricultural terrain in Belgium and the Netherlands

| Use                                           | Country | Authorised a.s. | Shortlisted a.s. |
|-----------------------------------------------|---------|----------------|------------------|
| Amenities (excluding railways and paths or path woods) | BE      | 18             | 16               |
| Non-agricultural terrain (unpaved and permeable, including railways) | NL      | 9              | 0                |

a.s.: active substance.

In Belgium the evaluation resulted in the following shortlisted a.s.: glyphosate (G), pyraflufen-E* (B2), 2,4-D* (O), amitrole* (F3), ammonium-thiocyanate* (Z), diflufenican (F1), fatty acid (E), glyphosate-ammonium (H) and triclopyr* (O), acetic acid (O), aminopyralid (O), fluroxypyr, iodosulfuron-M* (B), flazasulfuron (B), pelargonic acid (O), maleic hydrazide (O). One of the shortlisted a.s. (fatty acid) has the same MoA as the a.s. under consideration (flumioxazin (E)). The protocol (EFSA, 2016a) states: “If one of the shortlisted a.s. has the same MoA [and site of action] as the a.s. under consideration, withdrawal of the a.s. under consideration has no implications for herbicide resistance management. Consequently, justifying derogation based on a reduced number of MoAs no longer holds”. This leads to the conclusion that there are sufficient chemical alternatives available for amenities in Belgium and there is no need to calculate a HR score.

The evaluation of applicant’s claims on the necessity of flumioxazin in amenities/non-agricultural terrain to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in HR strategy score of 0° for the Netherlands. This means that, in the Netherlands, there are no other alternative chemical substances available. In the Netherlands, eight a.s. (diflufenican*, iodosulfuron-M*,2,4-D*, triclopyr*, acetic acid*, glycine*, glyphosate and MCPA) were not considered on shortlisted a.s. due to different weed spectrum (e.g. path-grass and broadleaf weeds) and time of application for weed (e.g. post-emergence, spot application; pre-emergence of weeds not covered). However, the Netherlands flagged that when comparing flumioxazin one by one to the chemical alternatives no serious alternatives seem to be present. Thus, it would be useful to look at the whole system of weed control on non-agricultural terrain (unpaved or permeable). Flumioxazin is not essential; the system is based mainly on glyphosate. Without flumioxazin, products based on 2,4-D, triclopyr; MCPA, glyphosate and glycine would be available, leading to a revised HR score of 7 (sufficient chemical alternatives).

Belgium also flagged this issue during the validation process that it is not correct to select only active substances which have similarities in term of spectrum of activity, time of application and activity on weeds. This approach was also supported by the EFSA WG on flumioxazin, particularly for the assessment of alternative chemical substances for non-agricultural uses and perennial crops. However, this approach has not been applied for all other MS where the evaluation was done in a stricter sense, meaning strictly applying the criteria ‘time of application’ and ‘weed spectrum’ to conclude on shortlisted herbicide a.s.
In Belgium, three non-chemical methods, mechanical weeding, hand-weeding and thermal weed control, are available but have technical (not effective) and economic limitations. Integrated Pest Management (IPM) including actually authorised products combined with non-chemical methods are available in Belgium. In the Netherlands, three non-chemical methods (thermal weed control, hand-weeding and possibly one other method preventing introduction of weed seeds from outside the terrain) are available. Thermal weed control is practised (10–50% acreage), available, highly effective, and feasible with restrictions (e.g. unsafe at factory terrains because of risk of fire) but expensive. Hand-weeding has economic limitations. It was also highlighted that preventing introduction of weed seeds from outside the terrain may be of additional value. The Netherlands concluded that considering the whole system of weed control on non-agricultural terrain (unpaved or permeable) there are enough alternatives.

For details of the evaluation, see Appendix A and B.

### 3.3. Ways and places with woody plant growth

Table 4 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in ways and places with woody plant growth in Austria.

Table 4: Number of authorised and shortlisted herbicide a.s. to control weeds in ways and places with woody plant growth in Austria

| Use                          | Country | Authorised a.s. | Shortlisted a.s. |
|------------------------------|---------|-----------------|-----------------|
| Ways and places with woody plant growth | AT      | 14              | 0               |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in ways and places with woody plant growth to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in a HR strategy score of 0.5 for Austria. This means that in Austria there are no other alternative chemical substances compared to flumioxazin available.

Nine possible alternative herbicide a.s. (diflufenican, glyphosate, glufosinate, flufenacet*, metosulam*, pelargonic acid, maleic hydrazide, caprylic-capric acid and acetic acid) are available, but these active substances are not authorised for use in Austria for the same weed spectrum (annual-grass-weeds, annual-broad-leaves weeds and moss) and time of application for weeds (pre-emergence) compared to flumioxazin.

In Austria, three non-chemical methods are available. One method (mechanical weeding) is practised (10–50% acreage), available, effective (moderate) and feasible. Two other methods (hand-weeding and thermal weed control) have economic limitations.

For details of the evaluation, see Appendix A and B.

### 3.4. Woody ornamental plants

Table 5 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in woody ornamental plants in Austria.

Table 5: Number of authorised and shortlisted herbicide a.s. to control weeds in woody ornamental plants in Austria

| Use                              | Country | Authorised a.s. | Shortlisted a.s. |
|----------------------------------|---------|-----------------|-----------------|
| Woody ornamental plants          | AT      | 5               | 1               |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in woody ornamental plants to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in a HR strategy score of 3.5 This means that in Austria is assumed that with one herbicide a.s. dimethenamid-P (K3) and one MOA insufficient chemical alternatives for sustainable HR management are available.

Austria excluded from the shortlisted a.s. flazasulfuron due to a different application time (only authorised as post-emergence of weeds), and a different weed spectrum (moss species not covered).
propyzamide due to different weed spectrum (moss not covered), and pendimethalin due to different weed spectrum (annual dicotyledonous weeds as well as moss are not covered).

In Austria, two non-chemical methods, mechanical weeding and hand-weeding are available. These methods are practised (10–50% acreage), available, moderate effective and feasible.

For details of the evaluation, see Appendix A and B.

3.5. Tree nursery including tree and shrub

Table 6 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in tree nursery including tree and shrub in Belgium.

| Use | Country | Authorised a.s. | Shortlisted a.s. |
|-----|---------|----------------|-----------------|
| Tree nursery including tree and shrub | BE | 26 | 22 |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in tree nursery to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in the following herbicide a.s. shortlisted: 2,4-D*7 (O), chlorpropham (K2), chlorotolurom (C2), cycloxydim (A), diflufenican* (F1), iodosulfuron-M* (B), diquat (D), fatty acid (E), fluazifop-P-B (A), glyphosate (G), isoxaben (L), lenacil (C1), metazachlor (K3), propyzamide (K1), and quinoclamine (H), triclopyr*, acetic acid (O), linuron (C2), MCPA (O), metamitron (C2), napropamide (K3), pendimethalin (K3). One of the shortlisted a.s. (fatty acid) has the same MoA as the a.s. under consideration (flumioxazin (E)). The protocol (EFSA, 2016a) states: “if one of the shortlisted a.s. has the same MoA [and site of action] as the a.s. under consideration, withdrawal of the a.s. under consideration has no implications for herbicide resistance management. Consequently, justifying derogation based on a reduced number of MoAs no longer holds”. This leads to the conclusion that there are sufficient chemical alternatives available for tree nurseries in Belgium and there is no need to calculate a HR score.

Belgium indicated that it is not correct to select only active substances which have similarities in term of spectrum of activity, time of application and activity on weeds. This approach was also supported by the EFSA WG on flumioxazin, particularly for the assessment of alternative chemical substances for non-agricultural uses and perennial crops. However, this approach has not been applied for all other MS where the evaluation was done in a stricter sense, meaning strictly applying the criteria ‘time of application’ and ‘weed spectrum’ to conclude on shortlisted a.s.

In Belgium, four non-chemical methods (crop cover/mulching, mechanical weeding, hand-weeding and thermal weed control) are available. Three methods (crop cover/mulching, mechanical weeding, hand-weeding) are practised (up to 15% of acreage), available, effective (moderate) and feasible with restrictions, two methods have economic limitations, and one method (thermal) has some technical limitations as it can be used in some cases in tree nursery. IPM including actually authorised products combined with non-chemical methods are available in BE.

For details of the evaluation, see Appendix A and B.

3.6. Pome fruits, stone fruits and apple and pear

Table 7 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in pome and stone fruits, and apples and pear in Hungary and the Netherlands, respectively.

| Use | Country | Authorised a.s. | Shortlisted a.s. |
|-----|---------|----------------|-----------------|
| Pome fruit, stone fruits | HU | 23 | 2 |
| Apple and pear | NL | 10 | 0 |

a.s.: active substance.
The evaluation of applicant’s claims on the necessity of flumioxazin in pome and stone fruits to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in the following herbicide a.s. shortlisted in Hungary: oxfluorfen (E), linuron (C2). One of the shortlisted a.s. (oxfluorfen) has the same MoA as the a.s. under consideration (flumioxazin (E)). The protocol (EFSA, 2016a) states: “If one of the shortlisted a.s. has the same MoA [and site of action] as the a.s. under consideration, withdrawal of the a.s. under consideration has no implications for herbicide resistance management. Consequently, justifying derogation based on a reduced number of MoAs no longer holds”. This leads to the conclusion that there are sufficient chemical alternatives available for pome and stone fruit in Hungary and there is no need to calculate a HR score. In the Netherlands, the evaluation resulted with no herbicide a.s. being shortlisted, meaning there are no other alternative chemical substances available for sustainable HR management.

For the Netherlands, linuron was not on the shortlisted a.s. as linuron is a selective systemic contact herbicide and can only be applied under trees that have been planted minimum 1 year before application. Propyzamide was not put on the shortlist as this active substance is a selective systemic herbicide, absorbed by the roots has a different time of application and cannot be applied in apple and pear crops less than 1-year old (i.e. label). Without flumioxazin, especially in young orchards, problems for weed control will arise. Seven a.s. (linuron, propyzamide, MCPA, 2,4-D, fluaazifop-p-b, glufosinate-ammonium, glyphosate) were not considered on shortlisted a.s. due to different weed spectrum (e.g. broadleaf weeds, not covering emerged weeds) and time of application for weeds. Two a.s. (metamitron and triclopyr) were excluded from herbicides authorised as these active substances are not authorised as a herbicide in the Netherlands, but as a growth regulator (fruit thinning).

In Hungary, non-chemical methods (mechanical weeding and the hand-weeding) are available. A full assessment was not provided, but it is stated in the applicant report that mechanical weeding is only for a short period effective and cannot be used in the rows due to risk of damage to plants. Hand-weeding has economic limitations.

In the Netherlands, two non-chemical methods (mechanical weed control and others) are available. One method (mechanical weed control) is practised (10–50% acreage), available, moderately effective and feasible, but during the growing season crop damage has more impact on production and it is not possible in young orchards. The other methods, preventing introduction of weed seeds from outside the orchard may be of additional value.

For details of the evaluation, see Appendix A and B.

### 3.7. Silviculture

Table 8 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in silviculture in Hungary.

| Use           | Country | Authorised a.s. | Shortlisted a.s. |
|---------------|---------|----------------|-----------------|
| Silviculture  | HU      | 15             | 0               |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in silviculture to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in a HR strategy score of 0.5 for Hungary. This means that in Hungary there are no alternative chemical substances for sustainable HR management available. Pendimethalin was deleted from the shortlisted a.s. by the MS as the spectrum of weed is different from active substances under consideration.

In Hungary, non-chemical methods (mechanical weeding and hand-weeding) are available. A full assessment was not provided. As stated in applicants report, mechanical weeding is possible but insufficient. Hand-weeding has economic limitations, and thermal methods are unsuitable due to fire risk.

For details of the evaluation, see Appendix A and B.
3.8. Grapes (wine and table grapes)

Table 9 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in grapes in Greece, Hungary and Spain, respectively.

**Table 9:** Number of authorised and shortlisted herbicide a.s. to control weeds in grapes in Greece, Hungary and Spain

| Use   | Authorised a.s. | Shortlisted a.s. |
|-------|----------------|-----------------|
| Grapes EL | 6              | 1               |
| Grapes ES | 8              | 4               |
| Grapes HU | 7              | 3               |

The evaluation of applicant’s claims on the necessity of flumioxazin in grapes to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in a score of 1.5 in Greece. This means that in Greece is assumed that with one herbicide a.s. and one MOA flazasulfuron (B) there are insufficient chemical alternatives for sustainable HR management available. In Hungary the evaluation resulted in the following herbicide a.s. shortlisted: (flazasulfuron (B), oxyfluorfen (E), linuron (C2)). One of the shortlisted a.s. (oxyfluorfen) has the same MoA as the a.s. under consideration (flumioxazin (E)). The protocol (EFSA, 2016a) states: “if one of the shortlisted a.s. has the same MoA [and site of action] as the a.s. under consideration, withdrawal of the a.s. under consideration has no implications for herbicide resistance management. Consequently, justifying derogation based on a reduced number of MoAs no longer holds”. This leads to the conclusion that there are sufficient chemical alternatives available for grapes in Hungary and there is no need to calculate a HR score. In Spain, the following have been shortlisted: pendimethalin (K1), oxyfluorfen (E), diflufenican (F1), isoxaben (L). One of the shortlisted a.s. (oxyfluorfen) has the same MoA as the a.s. under consideration (flumioxazin (E)). This leads to the conclusion that there are sufficient chemical alternatives available for grapes in Spain and there is no need to calculate a HR score.

Hungary clarified that pendimethalin, S-metolachlor and Napropamide (control of monocotyledonous weeds and only some dicotyledonous weeds) should be deleted from the shortlisted a.s. as the spectrum of weed control is different from flumioxazin.

In Greece four non-chemical methods (weed seed removal, crop cover/mulching, mechanical weeding and hand-weeding) are available. An assessment for mechanical weeding was provided. The method is practised on 10–50% acreage, moderate effective and feasible. In Hungary, one non-chemical method (hand-weeding) is available.

In Spain, two non-chemical methods (crop cover/mulching and hand-weeding) are available and highly effective. Non-chemical alternatives for weed management are a method used as a part of IPM programmes of weeds on grape (wine and table) crops such as we can found in Guidelines of Integrated Pest Management Ministry of Agriculture, Food and Environmental, Spain.

For details of the evaluation, see Appendix A and B.

3.9. Olives (table-oil)

Table 10 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in olives in Greece and Spain, respectively.

The evaluation of applicant’s claims on the necessity of flumioxazin in olives to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in HR strategy

**Table 10:** Number of authorised and shortlisted herbicide a.s. to control weeds in olives in Greece and Spain

| Use  | Authorised a.s. | Shortlisted a.s. |
|------|----------------|-----------------|
| Olives EL | 8              | 1               |
| Olives ES | 12             | 5               |
score of 1.5 in Greece. This means that in Greece is assumed that with one herbicide a.s. and one MOA flazasulfuron (B) insufficient chemical alternatives for sustainable HR management are available. In Spain, the evaluation resulted with the following herbicide a.s. shortlisted: chlorotoluron (C2), diflufenican (F1), iodosulfuron-M (B), oxyfluorfen (E), penoxsusam*7 (B). One of the shortlisted a.s. (oxyfluorfen) has the same MoA as the a.s. under consideration (flumioxazin (E)). The protocol (EFSA, 2016a) states: "if one of the shortlisted a.s. has the same MoA [and site of action] as the a.s. under consideration, withdrawal of the a.s. under consideration has no implications for herbicide resistance management. Consequently, justifying derogation based on a reduced number of MoAs no longer holds". This leads to the conclusion that there are sufficient chemical alternatives available for olives in Spain and there is no need to calculate a HR score.

In Greece, diflufenican and iodosulfuron were not considered on the shortlisted a.s. due to a different application time. In Spain, florasulam and fluroxypyr-mephtyl* were not considered in the shortlisted a.s. as the application time is different (post-harvest) compared to flumioxazin.

In Greece, four non-chemical methods (weed seed removal, crop cover/mulching, mechanical weeding and hand-weeding) are available. An assessment for mechanical weeding was available (practised on 10–50% acreage, moderate effective and feasible.

In Spain, five non-chemical methods (primary tillage, i.e. ploughing, false seed beds, crop cover/mulching, mechanical weeding and hand-weeding) are available. Three methods (except false seed beds) are practised, medium-highly effective and feasible. Non-chemical alternatives for weed management are part of IPM programmes of weeds in grape (wine and table) as available in Guidelines of Integrated Pest Management Ministry of Agriculture, Food and Environmental, Spain. However, non-chemical alternatives for weed management do not mean an alternative to the chemical methods. The management strategy is the combination of both methods: the application of the vegetal cover (mulches) obstructs the species emergency of Conyza spp. L., one of the most common weed in olive crops.

For details of the evaluation, see Appendix A and B.

### 3.10. Citrus

Table 11 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in citrus in Greece.

The evaluation of applicant’s claims on the necessity of flumioxazin in citrus to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in a HR strategy score of 1.55 for Greece. This means that is assumed that with one herbicide a.s. and one MOA flazasulfuron (B) there are insufficient chemical alternatives for sustainable herbicide resistance management available in Greece.

Pendimethalin (K1) was not considered on the shortlisted a.s. due to different weeds spectrum (grass) and different application time (pre-emergence) and propyzamide (K1) was not considered due to different application time (pre-emergence) compared to the a.s. under consideration. In case these a.s. would be considered, the revised score is 7.5 and would result in an intermediate situation.

In Greece, five non-chemical methods (weed seed removal, crop cover/mulching, tillage between rows, mechanical weeding and hand-weeding) are available. An assessment for mechanical weeding was available indicating that this method is practised on 10–50% acreage, moderate effective and feasible.

For details of the evaluation, see Appendix A and B.
3.11. Maize

Table 12 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in maize in Hungary and Slovakia.

Table 12: Number of authorised and shortlisted herbicide a.s. to control weeds in maize in Hungary and Slovakia

| Use    | Country | Authorised a.s. | Shortlisted a.s. |
|--------|---------|----------------|------------------|
| Maize  | HU      | 37             | 4                |
| Maize  | SL      | 42             | 5                |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in maize to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in HR scores of 5 and 7.5 for Hungary and Slovakia, respectively. This means that in Hungary it is assumed that considering the herbicide a.s. isoxaflutole (F2), mesotrione (F2), sulcotrione (F2), linuron (C2)) and two MOA insufficient chemical alternatives for sustainable HR management are available, whereas for Slovakia, it is assumed that considering the herbicide a.s. mesotrione (F2), S-metolachlor (K3), isoxaflutole (F2), dimethenamid-P (K3), terbuthylazine (C1) and three MOA sufficient chemical alternatives for sustainable HR management are available.

Hungary proposed not to shortlist terbuthylazine although the weed spectrum is not different from flumioxazin but higher application rates, currently not authorised in Hungary, are needed to have comparable results to flumioxazin and pendimethalin due to different weed spectrum (control of monocotyledonous weeds and only some dicotyledonous weeds). For consistency reasons, pendimethalin was also deleted from the shortlisted a.s. in Slovakia.

In Hungary, one non-chemical method (mechanical weeding) is available. A full assessment was not provided. In the applicants report, it is stated that these methods are ineffective and have economic limitations. In Slovakia, five non-chemical methods (primary tillage, false seed beds, late sowing, crop rotation, and mechanical weeding) are available. Late sowing, crop rotation, and mechanical weeding are practiced on 10%, 10–50%, and 10–50% of acreage respectively, are available and feasible but do not provide an effective weed control.

For details of the evaluation, see Appendix A and B.

3.12. Sunflower

Table 13 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in sunflower in Hungary and Slovakia.

Table 13: Number of authorised and shortlisted herbicide a.s. to control weeds in sunflower in Hungary and Slovakia

| Use     | Country | Authorised a.s. | Shortlisted a.s. |
|---------|---------|----------------|------------------|
| Sunflower | HU      | 28             | 0                |
| Sunflower | SL      | 20             | 0                |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in sunflower to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in HR strategy scores of 0 and 0 for Hungary and Slovakia. This means that in Hungary and Slovakia no alternative chemical substances are available, meaning insufficient chemical alternatives for sustainable HR management are available.

Slovakia proposed to delete S-metolachlor from the shortlisted a.s. due to different weed spectrum compared to the a.s. under consideration. Glyphosate was not considered due to different weed spectrum and application time (only post-emergence) as well as product authorisation will be cancelled. dimethenamid-P was not proposed to be on the shortlisted a.s. due to different application time (pre-emergence) However, EFSA would proposes to consider this a.s. which would lead to a
revised HR score of 3, meaning still insufficient chemical alternative substances for suitable HR management are available.

In Hungary, one non-chemical method (mechanical weeding) is available. A full assessment was not provided. The applicant stated that these methods are ineffective and have economic limitations. In Slovakia five non-chemical methods (primary tillage, false seed beds, late sowing, crop rotation and mechanical weeding) are available. Late sowing, crop rotation, and mechanical weeding are practiced on 10%, 10–50%, and 10–50% of acreage respectively, are available and feasible but do not provide an effective weed control.

For details of the evaluation, see Appendix A and B.

### 3.13. Soybean

Table 14 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in soybean in the Czech Republic and Hungary.

| Use    | Country | Authorised a.s. | Shortlisted a.s. |
|--------|---------|----------------|-----------------|
| Soybean| CZ      | 5              | 3               |
| Soybean| HU      | 22             | 2               |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in soybean to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in HR scores of 6 and 3.5 for Czech Republic and Hungary. This means that in the Czech Republic is assumed that considering the herbicide a.s. dimethenamid-P (K3), pethoxamid (K3), pendimethalin (K1) and one MOA insufficient chemical alternatives for sustainable HR management are available, as well in Hungary with two herbicide a.s. linuron (C2) and metribuzin (C1) and two MOA insufficient chemical alternatives substances for suitable HR management are available.

Hungary proposed to delete clomazone, dimethenamid-P, pendimethalin and S-metolachlor from the shortlisted a.s. due to different weed spectrum. In addition, EFSA noted that bentazone (C2) and thifensulfuron-M (B) have the same weed spectrum as flumioxazin, however, with a different application time (post-emergence). If these two a.s. are considered, sufficient chemical alternatives would be available.

In the Czech Republic, three non-chemical methods (primary tillage, late sowing, crop rotation) are available. These methods are practised (above 50%, up to 10%, 10–50% of acreage, respectively) available, feasible but do not provide an effective weed control.

In Hungary, no non-chemical methods are indicated. However, EFSA noted that the applicant stated mechanical weeding is frequently applied even if insufficient for a unique weed control, but complementary to pre- and post-emergence chemical control. Hand-weeding has economic limitations.

For details of the evaluation, see Appendix A and B.

### 3.14. Potatoes

Table 15 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in potatoes in Hungary.

| Use    | Country | Authorised a.s. | Shortlisted a.s. |
|--------|---------|----------------|-----------------|
| Potatoes| HU      | 21             | 4               |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in potatoes to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in HR strategy score of 6.5 for Hungary. This means that in Hungary it is assumed that considering the herbicide a.s.
flurochloridone (F1), linuron (C2), metobromuron (C2), metribuzin (C1) and three MOA this leads to an intermediate situation in relation to chemical alternatives for sustainable HR management.

EFSA noted that pendimethalin, S-metolachlor and prosulfocarb were deleted from shortlisted a.s. due to different weed spectrum compared to a.s. under consideration.

In Hungary, one method (mechanical weeding) is available. A full assessment was not provided. The applicant stated that mechanical weeding is frequently applied but is insufficient for a unique weed control, but complementary to pre- and post-emergence chemical control. Hand-weeding has economic limitations.

For details of the evaluation, see Appendix A and B.

3.15. Sorghum

Table 16 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in sorghum in Hungary.

| Use          | Country | Authorised a.s. | Shortlisted a.s. |
|--------------|---------|----------------|-----------------|
| Sorghum      | HU      | 8              | 0               |

The evaluation of applicant’s claims on the necessity of flumioxazin in sorghum to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in a HR strategy score of 0.5. This means that no alternative chemical substances are available, meaning insufficient chemical alternatives are available for sustainable HR management.

Hungary proposed to delete S-metolachlor from shortlisted a.s. due to different weed spectrum compared to flumioxazin. In addition, Hungary proposed not to shortlist terbuthylazine although the weed spectrum is not different from flumioxazin, since higher application rates (currently not authorised in Hungary) are needed to have comparable results to flumioxazin. EFSA noted that prosulfuron (B), bentazone (C3) and dicamba (O) have the same weed spectrum as the a.s. under consideration but are applied as post-emergence only.

In Hungary, one method (mechanical weeding) was indicated in the excel file. A full assessment was not provided. In the applicants report, it is stated that mechanical weeding is not practised and hand-weeding has economic limitations.

For details of the evaluation, see Appendix A and B.

3.16. Winter wheat

Table 17 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in winter wheat in the Czech Republic, Hungary and the United Kingdom.

| Use          | Country | Authorised a.s. | Shortlisted a.s. |
|--------------|---------|----------------|-----------------|
| Winter wheat | CZ      | 15             | 6               |
| Winter wheat | HU      | 16             | 3               |
| Winter wheat | UK      | 19             | 7               |

The evaluation of applicant’s claims on the necessity of flumioxazin in winter wheat to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in (HR) strategy scores of 15.5, 4.5 and 10.5 for the Czech Republic, Hungary and the United Kingdom, respectively. This means that in the Czech Republic it is assumed that considering the herbicide a.s. prosulfocarb (N), pendimethalin (K1), chlorotoluron (C2), diflufenican (F1), flufenacet (K3), chlorosulfuron (B) and six MOA sufficient chemical alternatives for sustainable HR management are available, whereas in Hungary it is assumed that considering the herbicide a.s. Iodosulfuron (B),
sulfosulfuron (B), prosulfocarb (N) and two MoA insufficient chemical alternatives for sustainable HR management are available.

In the United Kingdom, it is assumed that considering the herbicide a.s. flufenacet* (K3), flupyrdsulfuron-M *7 (B), pendimethalin* (K1), prosulfocarb (N), chlorotoluron (C2), tri-allate (N), and isoproturon* (C2) and five MOA sufficient chemical alternatives for sustainable HR management are available.

The Czech Republic added the following substances chlorotoluron, chlorsulfuron and pendimethalin, diflufenican and flufenacet to the shortlisted a.s. (due to same application time (pre- and post-emergence) and weed spectrum, respectively. Iodosulfuron-M-sodium was deleted from shortlisted a.s. by the Czech Republic due to different application time and weed spectrum. In the Czech Republic, flupyrdsulfuron-M is not shortlisted a.s. due to different weed spectrum and application time compared to a.s. under consideration. The Czech Republic highlighted that flumioxazin is not authorised against grass weeds in winter wheat.

Chlorsulfuron and triasulfuron were deleted from shortlisted a.s. by Hungary as they are not authorised. Hungary also proposed to delete diflufenican due to a different weed spectrum (no control of monocotyledonous weeds) compared to flumioxazin. EFSA noted that in Hungary beflubutamid (F1), chlorotoluron (C2), flufenacet (K3), pendimethalin (K1) were not considered due to different weed spectrum and application time (post-emergence). Metribuzin (C1), pyraflufen-E (E) pyroxsulam (B), sulfosulfuron (B) were not considered due to different application time (post-emergence) but same weed spectrum.

The United Kingdom proposed to delete diflufenican* (F1) from the shortlisted a.s. as this is not authorised in the United Kingdom for the control of grass weeds in winter wheat, picolinafen, amidosulfuron, due to a different weed spectrum, flurtamone as black-grass is not included as a susceptible species, iodosulfuron-M-NA*, mesosulfuron-M* and pyroxsulam due to different application time (post- and not pre-emergence). EFSA did not agree to delete chlorotoluron and isoproturon from the shortlisted a.s. as the application rate is not a selection criteria for shortlisting a.s. (EFSA, 2016a).

For the Czech Republic, three non-chemical methods (primary tillage, late sowing and crop rotation) are available. These methods are practised (above 50%, up to 10% and above 50% of acreage, respectively) available, feasible but do not provide an effective weed control. For Hungary, no non-chemical method seems to be available as there was no information provided. In the applicant's submission, it is stated that some preventive methods are applied but do not provide a sufficient weed control. Mechanical weeding is damaging the crop. Hand-weeding has economic limitations. In the United Kingdom, five non-chemical methods (primary tillage, false seed beds, late sowing, increased crop competitiveness and crop rotation) are available. These methods (except increased crop competitiveness) are practised (up to 10% and 10–50% of acreage, respectively) available, feasible but do not always provide an effective weed control for black-grass (except increased crop competitiveness) (up to 69% control, moderate, up to 31%, and 88% control of black-grass (spring crops), respectively).

For details of the evaluation, see Appendix A and B.

### 3.17. Winter oats

Table 18 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in winter oats in the United Kingdom.

| Use          | Country | Authorised a.s. | Shortlisted a.s. |
|--------------|---------|----------------|-----------------|
| Winter oats  | UK      | 19             | 0               |

a.s.: active substance.

The evaluation of applicant's claims on the necessity of flumioxazin in winter oats to control both black-grass and ryegrass based on the remaining chemical alternatives to flumioxazin resulted in a HR strategy score of 0 for the United Kingdom; this indicates insufficient chemical alternatives for sustainable HR management are available.
Flumioxazin is authorised for the control of blackgrass and ryegrass as pre-emergence. No other a.s. are authorised to cover these two weeds. However, for the control of black-grass, only two a.s. are available: flufenacet (K3), flupyrsulfuron-M (B), leading to a score of: 4.55 (insufficient chemical alternative substances).

In the United Kingdom, five non-chemical methods (primary tillage, false seed beds, late sowing, increased crop competitiveness and crop rotation). These methods (except increased crop competitiveness) are practised (up to 10%, and 10–50% of acreage, respectively) available, feasible but do not always provide an effective weed control for black-grass (except increased crop competitiveness) (up to 69% control, moderate, up to 31% and 88% control of black-grass (spring crops), respectively.

For details of the evaluation, see Appendix A and B.

### 3.18. Winter cereals (wheat, barley and triticale)

Table 19 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control and time of application as flumioxazin for use in winter cereals (wheat, barley and triticale) in Slovakia.

**Table 19:** Number of authorised and shortlisted herbicide a.s. to control weeds in winter cereals in Slovakia

| Use               | Country | Authorised a.s. | Shortlisted a.s. |
|-------------------|---------|----------------|-----------------|
| Winter cereals    | SL      | 38             | 1               |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in winter cereals (wheat, barley and triticale) to control a serious danger to plant health based on remaining chemical alternatives to flumioxazin resulted in a HR strategy score of 35. This means that in Slovakia is assumed that with one herbicide a.s. pendimethalin (K1) and one MOA (insufficient chemical alternatives for sustainable HR management are available.

Amidosulfuron*7 (B), iodosulfuron-M-sodium*, mefenpyr-diethyl*, diflufenican were not considered due to different application time (post-emergence) and weed spectrum compared to flumioxazin. Metsulfuron-M* was not considered due to different application time (post-emergence).

In Slovakia, four non-chemical methods (primary tillage, false seed beds, late sowing, and crop rotation) are available. These methods (except false seed beds) are practised (except primary tillage, 10% and 10–50% of acreage, respectively) available, feasible but do not provide an effective weed control.

For details of the evaluation, see Appendix A and B.

### 3.19. Bulb onions

Table 20 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control volunteer potatoes, volunteer-oilseed-rape, camomile mayweed, nightshade-black, groundsel and time of application as flumioxazin for use in bulb onions in the United Kingdom.

**Table 20:** Number of authorised and shortlisted herbicide a.s. to control selective weeds (see above) in bulb onions in the United Kingdom

| Use            | Country | Authorised a.s. | Shortlisted a.s. |
|----------------|---------|----------------|-----------------|
| Bulb onions    | UK      | 9              | 0               |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in bulb onions to control special weeds (volunteer potatoes, volunteer-oilseed-rape, camomile mayweed, nightshade-black, groundsel) based on the remaining chemical alternatives to flumioxazin resulted in HR strategy score of 05 in the United Kingdom. This indicates insufficient chemical alternatives for sustainable HR management are available.

In the United Kingdom, four non-chemical methods (primary tillage, crop rotation, mechanical weeding and hand-weeding) are available. These methods are practised, available, and feasible but do not always provide an effective weed control (e.g. mechanical weeding: mechanical weed control is
unreliable – further flushes of weeds appear after each cultivation – and in wet conditions, weeds re-establish). Although mechanical weed control is possible in crops grown in wide rows, weeds within the row are not controlled and it is not an option for crops grown at high populations on a close-row bed system (e.g. baby onions grown for sets or pickling/processing), or have economic limitations (hand-weeding).

For details of the evaluation, see Appendix A and B.

3.20. Vining peas

Table 21 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control for volunteer potatoes, volunteer-oilseed-rape, camomile mayweed, nightshade-black, groundsel, and time of application as flumioxazin for use in vining peas in the United Kingdom.

Table 21: Number of authorised and shortlisted herbicide a.s. to control special weeds (see above) in vining peas in the United Kingdom

| Use                  | Country | Authorised a.s. | Shortlisted a.s. |
|----------------------|---------|----------------|-----------------|
| Vining peas          | UK      | 16             | 0               |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in bulb onions to control both special weeds (volunteer potatoes, volunteer-oilseed-rape, camomile mayweed, nightshade-black, groundsel) based on the remaining chemical alternatives to flumioxazin resulted in HR score of 0.5 in the United Kingdom. This indicates insufficient chemical alternatives for sustainable HR management are available.

In the UK, four non-chemical methods (primary tillage, crop rotation, mechanical weeding and hand-weeding) are available. These methods are practised, are available and feasible but do not always provide an effective weed control (e.g. mechanical weeding: mechanical weed control is unreliable – further flushes of weeds appear after each cultivation – and in wet conditions, weeds re-establish). Although mechanical weed control is possible in crops grown in wide rows, weeds within the row are not controlled and it is not an option for crops grown at high density on a close-row bed system (e.g. baby onions grown for sets or pickling/processing), or have economic limitations (hand-weeding).

For details of the evaluation, see Appendix A and B.

3.21. Carrots and parsnips

In the assessment, the application of flumioxazin in the carrots and parsnips to control of volunteer potatoes, volunteer-oilseed-rape, camomile mayweed, nightshade-black, groundsel, as post-emergence is evaluated.

Table 22 summarises the number of authorised herbicide a.s. and potential chemical alternatives (shortlisted herbicide a.s.) that have the same spectrum of weed control (volunteer potatoes, volunteer-oilseed-rape, camomile mayweed, nightshade-black, groundsel) and time of application as flumioxazin for use in carrots and parsnips in the United Kingdom.

Table 22: Number of authorised and shortlisted herbicide a.s. to control special weeds (see above) in carrots and parsnips in the United Kingdom

| Use                 | Country | Authorised a.s. | Shortlisted a.s. |
|---------------------|---------|----------------|-----------------|
| Carrots and parsnips| UK      | 15             | 0               |

a.s.: active substance.

The evaluation of applicant’s claims on the necessity of flumioxazin in bulb onions to control both special weeds (volunteer potatoes, volunteer-oilseed-rape, camomile mayweed, nightshade-black, groundsel) based on the remaining chemical alternatives to flumioxazin resulted in HR management strategy score of 0.5 in the United Kingdom. This indicates insufficient chemical alternatives for sustainable HR management are available.

In the UK, four non-chemical methods (primary tillage, crop rotation, mechanical weeding and hand-weeding) are available. These methods are practised, are available and feasible but do not
always provide an effective weed control (e.g. mechanical weeding: mechanical weed control is unreliable – further flushes of weeds appear after each cultivation – and in wet conditions, weeds re-establish). Mechanical weed control is possible in carrots grown in wide rows, weeds within the row are not controlled, and it is not an option for baby carrots grown at high populations on a close-row bed system), or have economic limitations (hand-weeding).

4. Conclusions

The evaluation of applicant’s claims that the use of flumioxazin is considered essential in accordance with Article 4(7) of Regulation (EC) No 1107/2009 for each authorised use in the 15 MS was evaluated following the EFSA methodology (EFSA, 2016a).

Overall, 21 different uses (crop and non-agricultural) for nine Member States (Austria, 2016; Belgium, 2016; the Czech Republic, 2016; Greece, 2016; Hungary, 2016; the Netherlands, 2016; Slovakia, 2016; Spain, 2016 and the United Kingdom, 2016) were evaluated to assess the applicant’s claims on the necessity of flumioxazin to control a serious danger to plant health. It can be concluded that in general a wide range of chemical alternative herbicide a.s. are available at the MS level for weed control in winter wheat (the Czech Republic and the United Kingdom), maize (Slovakia), tree nursery (Belgium), and amenities (Belgium), but for particular cases such as minor uses (e.g. in vining peas, bulb onions, carrots and parsnips, winter oats (the United Kingdom)), or for weed control in apples and pears (the Netherlands), citrus (Spain), sorghum (Hungary), sunflower (Hungary and Slovakia), soybeans (the Czech Republic and Hungary), ways and places with woody plant growth (Austria), woody ornamental plants (Austria), and Silviculture (Hungary) there are insufficient chemical alternatives to flumioxazin. Due to national authorisation for some uses, such as for olives, grapes, maize and winter wheat and railways, insufficient or sufficient chemical alternatives to flumioxazin are available. For potatoes (Hungary), an intermediate situation was concluded.

Non-chemical alternatives were also evaluated for these different uses and generally a wide range of methods are available. However, often these methods do not have the same efficacy as chemical methods or have economic limitations. A combination of both chemical and non-chemical methods seems often possible.

When evaluating individually the herbicide chemical alternatives, no serious alternatives may seem to be present, while the system as a whole may be able to function without the substance under evaluation (e.g. amenities in Belgium and non-agricultural terrain in the Netherlands). Thus, there is the need to assess the whole system of weed control and further considerations from the MS might be needed.

Table 23: Outcome of the evaluation of applicant’s claims on the necessity of flumioxazin to control a serious danger to plant health according to Article 4(7) of Regulation (EC) No 1107/2009 for 21 different uses (crop and non-agricultural) in nine Member States

| Crop                | Country | Authorised a.s. | Shortlisted a.s. | Score | Results   |
|---------------------|---------|-----------------|------------------|-------|-----------|
| Pome and stone fruits | HU      | 23              | 2                | n.a.  | Sufficient|
| Apple and pear      | NL      | 10              | 0                | 0     | Insufficient|
| Grapes              | EL      | 6               | 1                | 1,5   | Insufficient|
| Grapes              | ES      | 8               | 4                | n.a.  | Sufficient|
| Grapes              | HU      | 7               | 3                | n.a.  | Sufficient|
| Olives              | EL      | 8               | 1                | 1,5   | Insufficient|
| Olives              | ES      | 12              | 5                | n.a.  | Sufficient|
| Citrus              | EL      | 3               | 1                | 1,5   | Insufficient|
| Maize               | HU      | 37              | 4                | 5     | Insufficient|
| Maize               | SL      | 42              | 5                | 7,5   | Sufficient|
| Sunflower           | HU      | 28              | 0                | 0     | Insufficient|
| Sunflower           | SL      | 20              | 0                | 0     | Insufficient|
| Soybean             | CZ      | 5               | 3                | 6     | Insufficient|
| Soybean             | HU      | 22              | 2                | 3,5   | Insufficient|
5. Recommendation

Flumioxazin was the first application evaluated in accordance with the herbicide protocol (EFSA, 2016a) and the following findings and recommendations should be taken into account when providing a single guidance document for the assessment of applications for derogation under the Article 4(7) of Regulation (EC) No 1107/2009 for the different types of pesticides.

- EFSA acknowledges that the methodology for this derogation is complex; particularly the vast amount of data was not easy to work with. A different structure for the data collection form should be further investigated.
- Clarifications on whether the full herbicide list must include each active substance (for which there may be many products authorised) or each individual product authorised should be provided. In the context of this evaluation, the applicant provided a product based authorisation list, leading to a wealth of repetitive data which were challenging to analyse and summarise.
- In situations where it seems that there is no or few alternative substances available, it would be useful to analyse a subset of data such as a.s. controlling ‘broad leaf’, and a.s. controlling ‘grass weeds’ to explore if a combination of different a.s. would be lead to the same characteristics of the a.s. under consideration. The same rationale applies to ‘time of application’. Such an evaluation would reflect better the situation (including non-chemical methods). Further discussions on this point with the MS should be needed. A critical step in the evaluation is the development of the shortlisted alternative herbicide a.s. based on the selection criteria ‘spectrum of weed control’ and ‘time of application’. A drop-down list for these two selection criteria should be provided in the data collection form to facilitate a consistent assessment.

Although non-agricultural uses of pesticides are covered under Regulation (EC) No 1107/2009, the possible derogation where there is a serious danger to plant health for these uses could be discussed by risk managers.
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Abbreviations

a.s. active substance  
BBCH growth stages of mono- and dicotyledonous plants  
DAR draft assessment report  
ECHA European Chemicals Agency  
HR herbicide resistance  
HRAC Herbicide Resistance Action Committee  
IPM Integrated Pest Management  
MCPA 2-methyl-4-chlorophenoxyacetic acid  
MOA mode of actions  
MS Member State  
PSN Pesticide Steering Network
Evaluation of data on flumioxazin to control a serious danger to plant health

RAC  Risk Assessment Committee
RAR  renewal assessment report
RMS  Rapporteur Member State
WG  working group
Appendix A

Validated Excel files submitted by the MS (Austria, 2016; Belgium, 2016; the Czech Republic, 2016; Greece, 2016; Hungary, 2016; the Netherland, 2016; Slovakia, 2016; Spain, 2016 and the United Kingdom, 2016) and evaluated by EFSA.
Appendix B

Shortlisted herbicide active substances gather according to each use (crop or non-agricultural use) and by the MS.

Table B.1: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for railways in Austria

| Number | Active substance     | HRAC group | Application time (crop)          | Weed spectrum                                      |
|--------|----------------------|------------|----------------------------------|----------------------------------------------------|
| 1      | Flazasulfuron        | B          | Not applicable                   | Weeds                                              |
| 2      | Glyphosate*          | G          | Not applicable                   | Weeds                                              |
| 3      | 2,4-D*               | O          | Not applicable                   | Weeds                                              |
|        | Flumioxazin          | E          | Not applicable                   | Annual-grass- and broadleaf-weeds                  |

Table B.2: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for railways in Spain

| Number | Active substance                        | HRAC group | Application time (crop)          | Weed spectrum                                      |
|--------|----------------------------------------|------------|----------------------------------|----------------------------------------------------|
| 1      | Fluroxypyr-meptyl                       | O          | Excl.-10/09–31/12                | Dicotyledoneae                                      |
| 2      | Carfentrazone                           | E          | Not applicable                   | Weeds                                              |
| 3      | Diflufenican*                           | F1         | Post-emergence                   | Weeds                                              |
| 4      | Glyphosate*                             | G          | Post-emergence                   | Weeds                                              |
| 5      | MCPA*                                  | O          | Post-emergence                   | Weeds                                              |
|        |                                        |            |                                  | Not to apply outside the period between March 1 and September 30 period |
| 6      | Triclopyr-butoxy-ethyl-ester*           | O          | Excl.-10/09–31/12                | Dicotyledoneae                                      |
|        |                                        | E          | Not applicable                   | Weeds                                              |

Table B.3: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for amenities in Belgium

| Number | Active substance                        | HRAC group | Application time (crop)          | Weed spectrum                                      |
|--------|----------------------------------------|------------|----------------------------------|----------------------------------------------------|
| 1      | Glyphosate                             | G          | No crops (total weed control)    | Weeds                                              |
| 2      | Pyraflufen-E                            | B2         | No crops (total weed control)    | Weeds                                              |
| 3      | 2,4-D                                 | O          | No crops (total weed control)    | Weeds                                              |
|        |                                        |            | or spring-treatment              |                                                    |
| 4      | Amitrole                               | F3         | No crops (total weed control)    | Weeds                                              |
| 5      | Ammonium-thiocyanate                   | Z          | No crops (total weed control)    | Weeds                                              |
| 6      | Diflufenican                            | F1         | No crops (total weed control)    | Weeds                                              |
|        |                                        |            | or spring-treatment              |                                                    |
| 7      | Fatty acid                             | E          | Spring-treatment                 | Weeds spot application                             |
| 8      | Glufosinate-ammonium (H)               | H          | No crops (total weed control)    | Weeds                                              |
| 9      | Triclopyr*                             | O          | Spring-treatment                 | BROADLEAVED SPOT APPLICATION                        |
| 10     | Acetic acid                            | O          | Spring-treatment                 | Weeds spot application                             |
| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum                        |
|--------|------------------|------------|-------------------------|--------------------------------------|
| 11     | Aminopyralid     | O          | Spring-treatment        | BROADLEAVED SPOT APPLICATION         |
| 12     | Fluroxypyr       | O          | Spring-treatment        | broadleaved weeds                    |
| 13     | Iodosulfuron-M*  | B          | No crops (total weed control) | grasses and BLD weeds               |
| 14     | Flazasulfuron    | B          | No crops (total weed control) | Weeds                               |
| 15     | Pelargonic acid  | O          | Spring-treatment        | Weeds spot application               |
| 16     | Maleique hydrazide | O          | Spring-treatment        | Weeds spot application               |
|        | Flumioxazin      | E          | No crops (total weed control) | Weeds                               |

Table B.4: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for **woody ornamental plants** in Austria.

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum                                         |
|--------|------------------|------------|-------------------------|-------------------------------------------------------|
| 1      | Dimethenamid-P   | K3         | > BBCH 10               | Annual-broadleaf-weeds, pathgrass, volunteer-millet   |
|        | Flumioxazin      | E          | During main vegetation  | Annual-broadleaf-weeds, annual-grass-weeds, moss (Bryophyta) |

Table B.5: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for **tree and shrub** in Belgium.

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum                                         |
|--------|------------------|------------|-------------------------|-------------------------------------------------------|
| 1      | Cycloxydim       | A          | Not applicable           | Annual-grass-weeds, couch-grass                       |
| 2      | Fluazifop-P-B    | A          | Not applicable           | Weeds                                                |
| 3      | Iodosulfuron-M*  | B          | Spring up to mid-May, BBCH 00 | Annual-grass-weeds, couch-grass                       |
| 4      | Lenacil          | C1         | Not applicable           | Weeds, moss                                          |
| 5      | Chlorotoluron    | C2         | March, end of winter     | Annual-broadleaf-weeds, annual-grass-weeds           |
| 6      | Linuron          | C2         | Spring-treatment         | Annual-broadleaf-weeds, groundsel, willowherb        |
| 7      | Metamitron       | C2         | BBCH 00                  | Annual-broadleaf-weeds                               |
| 8      | Diquat           | D          | Spring-treatment         | Weeds spot application                               |
| 9      | Fatty acid       | E          | Spring-treatment         | Annual weeds                                         |
| 10     | Diflufenican*    | F1         | Spring up to mid-May, BBCH 00 | Annual-grass-weeds, couch-grass                       |
| 11     | Glyphosate       | G          | During vegetation, not applicable in some cases | Weeds                                                |
| 12     | Quinoclamine     | H          | Post-transplant          | Moss (Bryophyta), liverwort                          |
| 13     | Propyzamide      | K1         | Autumn/winter, spring-treatment | Weeds                                                |
| 14     | Chlorpropham     | K2         | During vegetative rest, BBCH 00 | Annual-broadleaf-weeds, annual-grass-weeds           |
| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum |
|--------|-----------------|------------|-------------------------|---------------|
| 15     | Metazachlor     | K3         | BBCH 00                 | Annual-broadleaf-weeds, annual-grass-weeds |
| 16     | Napropamide     | K3         | BBCH 00                 | Annual-Broadleaf-Weeds, path-grass |
| 17     | Pendimethalin   | K3         | Spring-treatment, BBCH 00-03 | Annual-broadleaf-weeds |
| 18     | Isoxaben        | L          | December/march          | Annual-broadleaf-weeds |
| 19     | 2,4-D*          | O          | Spring-treatment        | Broadleaf weeds and trunk |
| 20     | Acetic acid     | O          | Spring-treatment        | Weed spot application |
| 21     | MCPA            | O          | During vegetation, not applicable in some cases | Broadleaf weeds |
| 22     | Triclopyr*      | O          | Spring-treatment        | Spot application |

**Table B.6:** Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazine and authorised in plant protection products for **pome and stone fruits** in **Hungary**

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum |
|--------|-----------------|------------|-------------------------|---------------|
| 1      | Oxyfluorfen     | E          | PRE (POST)-emergence    | Annual-broadleaf- and grass-weeds |
| 2      | Linuron         | C2         | Pre-emergence           | Annual-broadleaf-weeds |
|        | Flumioxazine    | E          | >3 years, PRE (POST)    | Annual-broadleaf- and grass-weeds |

**Table B.7:** Shortlisted herbicide active substance with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazine and authorised in plant protection products for **wine** and **table grapes** in **Greece**

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum |
|--------|-----------------|------------|-------------------------|---------------|
| 1      | Flazasulfuron   | B          | Pre-emergence/early post-emergence | Weeds |
|        | Flumioxazine    | E          | Not applicable           | Annual weeds |

**Table B.8:** Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazine and authorised in plant protection products for **wine** and **table grape** in **Hungary**

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum |
|--------|-----------------|------------|-------------------------|---------------|
| 1      | Flazasulfuron   | B          | PRE (POST)              | Annual-broadleaf- and grass-weeds |
| 2      | Oxyfluorfen     | E          | PRE (POST)              | Annual-broadleaf- and grass-weeds |
| 3      | Linuron         | C2         | PRE                     | Annual-broadleaf-weeds |
|        | Flumioxazine    | E          | PRE (POST)              | Annual-broadleaf- and grass-weeds |
### Table B.9: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for **wine** and **table grape** in Spain

| Number | Active substance | HRAC group | Application time (crop)                                      | Weed spectrum                |
|--------|------------------|------------|-------------------------------------------------------------|------------------------------|
| 1      | Oxyfluorfen      | E          | Autumn/early spring                                         | Annual weeds                 |
| 2      | Diflufenican*2    | F1         | Autumn/early spring                                         | Annual weeds                 |
| 3      | Isoxaben         | L          | Not applicable                                              | Dicotyledoneae, annual weeds |
| 4      | Pendimethalin    | K1         | Not applicable during vegetative rest, pre/post-transplant, winter treatment, dormancy | Annual weeds                 |
|        |                   |            |                                                             |                              |
|        | Flumioxazin      | E          | Prebud burst/early post-bud burst                            | Weeds                        |

### Table B.10: Shortlisted herbicide active substance with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for **olives (table-oil)** in Greece

| Number | Active substance | HRAC group | Application time (crop)                                      | Weed spectrum                |
|--------|------------------|------------|-------------------------------------------------------------|------------------------------|
| 1      | Flazasulfuron    | B          | Pre-emergence/early post-emergence                          | Weeds                        |
| 2      | Flumioxazin      | E          | Not applicable                                              | Annual weeds                 |

### Table B.11: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for **olives (table-oil)** in Spain

| Number | Active substance | HRAC group | Application time (crop)                                      | Weed spectrum                |
|--------|------------------|------------|-------------------------------------------------------------|------------------------------|
| 1      | Chlorotoluron    | C2         | No with olives on the ground                                | Annual weeds                 |
| 2      | Diflufenican     | F1         | Pre-emergence/early post-emergence, autumn/early spring     | Annual weeds                 |
| 3      | Iodosulfuron-M   | B          | No with olives on the ground                                | Weeds                        |
| 4      | Oxyfluorfen      | E          | Autumn/early spring                                         | Annual weeds                 |
| 5      | Penoxsulam*      | B          | FRUIT-COLOURING/PRE-HARVEST                                  | Annual weeds                 |
|        | Flumioxazin      | E          | Autumn (before harvest) pre-emergence and until BBCH 12-14  | Annual weeds                 |

### Table B.12: Shortlisted herbicide active substance with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for **citrus** in Greece

| Number | Active substance | HRAC group | Application time (crop)                                      | Weed spectrum                |
|--------|------------------|------------|-------------------------------------------------------------|------------------------------|
| 1      | Flazasulfuron    | B          | Pre-emergence/early post-emergence                          | Weeds                        |
| 2      | Flumioxazin      | E          | Not applicable                                              | Annual weeds                 |
Table B.13: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for maize in Hungary

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum |
|--------|------------------|------------|-------------------------|---------------|
| 1      | Isoxaflutole     | F2         | PRE, POST-BBCH 00-12    | Annual-broadleaf-weeds and some grasses |
| 2      | Linuron          | C2         | Pre-emergence           | Annual-broadleaf-weeds |
| 3      | Mesotrione       | F2         | PRE, POST-BBCH 12-18    | Annual-broadleaf-weeds |
| 4      | Sulcotrione      | F2         | PRE, POST-BBCH 00-16    | Annual-broadleaf- and grass-weeds |
| 5      | Flumioxazin      | E          | Pre-emergence           | Annual-broadleaf-weeds |

Table B.14: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for maize in Slovakia

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum |
|--------|------------------|------------|-------------------------|---------------|
| 1      | Mesotrione       | F2         | Pre-emergence and early post-emergence | Annual-broadleaf-weeds and grass weeds |
| 2      | S-Metolachlor    | K3         | Preplant, pre-emergence and early post-emergence | Broadleaf weeds and grass weeds |
| 3      | Terbuthylazine   | C1         | BBCH 10-15, pre-emergence, early post-emergence | Annual-broadleaf-weeds and grass weeds, harrif |
| 4      | Isoxaflutole     | F2         | Pre-emergence and early post-emergence | Annual-broadleaf-weeds and grass weeds |
| 5      | Dimethenamid-P   | K3         | Pre-emergence and early post-emergence | Annual-broadleaf-weeds and grass weeds |
|        | Flumioxazin      | E          | Pre-emergence           | Broadleaf-grass-weeds |

Table B.15: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for soybean in the Czech Republic

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum |
|--------|------------------|------------|-------------------------|---------------|
| 1      | Dimethenamid-P   | K3         | BBCH 00-03              | Dicotyledoneae, Annual-grass-weeds |
| 2      | Pendimethalin    | K1         | Preplant, pre-emergence | Dicotyledoneae, Annual-grass-weeds |
| 3      | Pethoxamid       | K3         | Pre-emergence/post-plant | Dicotyledoneae/ANNUAL, Poaceae (Gramineae) |
|        | Flumioxazin      | E          | Pre-emergence           | Dicotyledoneae, grass weeds |

Table B.16: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for soybean in Hungary

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum |
|--------|------------------|------------|-------------------------|---------------|
| 1      | Linuron          | C2         | Pre-emergence           | Annual-broadleaf-weeds |
| 2      | Metribuzin       | C1         | Pre-emergence           | Annual-broadleaf-weeds |
|        | Flumioxazin      | E          | Pre-emergence           | Annual-broadleaf-weeds |
### Table B.17: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for potato in Hungary

| Number | Active substance  | HRAC group | Application time (crop) | Weed spectrum                  |
|--------|------------------|------------|-------------------------|--------------------------------|
| 1      | Flurochloridone  | F1         | Pre-emergence           | Annual-broadleaf-weeds         |
| 2      | Linuron          | C2         | Pre-emergence           | Annual-broadleaf-weeds         |
| 3      | Metribuzin       | C1         | Pre-emergence           | Annual-broadleaf-weeds         |
| 4      | Metobromuron     | C2         | Pre-emergence           | Annual-broadleaf-weeds         |
|        | Flumioxazin      | E          | Pre-emergence           | Annual-broadleaf-weeds         |

### Table B.18: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for winter wheat in the Czech Republic

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum                  |
|--------|-----------------|------------|-------------------------|--------------------------------|
| 1      | Prosulfocarb    | N          | Pre-emergence, Post-emergence | Dicotyledoneae, Annual-grass-weeds |
| 2      | Pendimethalin   | K1         | Pre-emergence, Post-emergence | Dicotyledoneae, Annual-grass-weeds |
| 3      | Chlorotoluron   | C2         | Pre-emergence, Post-emergence, BBCH 10-29 | Dicotyledoneae, Annual-grass-weeds |
| 4      | Diflufenican    | F1         | Autumn-treatment, Pre-emergence, Post-emergence, BBCH 00-32 | Dicotyledoneae, Annual-grass-weeds |
| 5      | Flufenacet      | K3         | Pre/early post-emergence, BBCH 00-19 | Dicotyledoneae, Annual-grass-weeds |
| 6      | Chlorsulfuron   | B          | AUTUMN-TREATMENT PRE/POST-emergence BBCH 11-30 | Dicotyledoneae, grass-weeds |
|        | Flumioxazin     | E          | Pre-emergence + BBCH 10-14 | Dicotyledoneae, grass weeds |

### Table B.19: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for winter wheat in Hungary

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum                  |
|--------|-----------------|------------|-------------------------|--------------------------------|
| 1      | Diflufenican    | F1         | BBCH 13-29              | Annual-broadleaf- and grass-weeds |
| 2      | Iodosulfuron    | B          | 3 leaves-BBCH 30        | Annual-broadleaf and grass weeds |
| 3      | Prosulfocarb    | N          | PRE, EARLY POST-BBCH 00-13 | Annual-broadleaf-weeds + grasses |
|        | Flumioxazin     | E          | BBCH 00-21              | ANNUAL-BROADLEAF-WEEDS and APESV |

### Table B.20: Shortlisted herbicide active substances with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for winter wheat in the United Kingdom

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum                  |
|--------|-----------------|------------|-------------------------|--------------------------------|
| 1      | Flufenacet      | K3         | Pre-emergence           | Broadleaf and grass weeds, black grass |
| 2      | Flupyrsulfuron-M | B          | Pre-emergence           | Broadleaf and grass weeds, black grass deadnettle-red, groundsel, chickweed |
### Table B.21: Shortlisted herbicide active substance with information on MOA according to HRAC, herbicide application time and targeted weed spectrum having similar characteristics to flumioxazin and authorised in plant protection products for *winter cereals* (*wheat, barley and triticale*) in *Slovakia*

| Number | Active substance | HRAC group | Application time (crop) | Weed spectrum |
|--------|------------------|------------|-------------------------|---------------|
| 1      | Pendiethalin*    | K1         | Pre-emergence           | Annual-broadleaf-weeds, loose-silky-bentgrass, twitch-black, path-grass |
|        | Flumioxazin      | E          | Before 5th true leaf stage of crop (up to BBCH 15) | broadleaf and grass weeds |

**Evaluation of data on flumioxazin to control a serious danger to plant health**