Modification of the existing maximum residue levels for benzovindiflupyr in fresh herbs and edible flowers

EFSA (European Food Safety Authority),
Giulia Bellisai, Giovanni Bernasconi, Alba Brancato, Luis Carrasco Cabrera, Lucien Ferreira,
German Giner, Luna Greco, Samira Jarrah, Aija Kazocina, Renata Leuschner,
Jose Oriol Magrans, Ileana Miron, Stefanie Nave, Ragnor Pedersen, Hermine Reich,
Silvia Ruocco, Miguel Santos, Alessia Pia Scarlato, Anne Theobald, Benedicte Vagenende and
Alessia Verani

Abstract
In accordance with Article 6 of Regulation (EC) No 396/2005, the applicant Syngenta Agro GmbH submitted a request to the competent national authority in Germany to modify the existing maximum residue levels (MRLs) for the active substance benzovindiflupyr in fresh herbs and edible flowers. The data submitted in support of the request were found to be sufficient to derive MRL proposals for the crops under assessment. Adequate analytical methods for enforcement are available to control the residues of benzovindiflupyr on the commodities under consideration at the validated limit of quantification (LOQ) of 0.01 mg/kg. Based on the risk assessment results, EFSA concluded that the short-term and long-term intake of residues resulting from the use of benzovindiflupyr according to the reported agricultural practices is unlikely to present a risk to consumer health.

© 2021 European Food Safety Authority. EFSA Journal published by John Wiley and Sons Ltd on behalf of European Food Safety Authority.

Keywords: benzovindiflupyr, fresh herbs, edible flowers, fungicide, MRL, consumer risk assessment

Requestor: European Commission
Question number: EFSA-Q-2021-00388
Correspondence: pesticides.mrl@efs Europa.eu
Declarations of interest: The declarations of interest of all scientific experts active in EFSA’s work are available at https://ess.efsa.europa.eu/doi/doiweb/doisearch.

Acknowledgements: EFSA wishes to thank Stathis Anagnos, Laszlo Bura, Andrea Mioc, Marta Szot, Aikaterini Vlachou for the support provided to this scientific output.

Suggested citation: EFSA (European Food Safety Authority), Bellisai G, Bernasconi G, Brancato A, Carrasco Cabrera L, Ferreira L, Giner G, Greco L, Jarrah S, Kazocina A, Leuschner R, Magrans JO, Miron I, Nave S, Pedersen R, Reich H, Ruocco S, Santos M, Scarlato AP, Theobald A, Vagenende B and Verani A, 2021. Reasoned Opinion on the modification of the existing maximum residue levels for benzovindiflupyr in fresh herbs and edible flowers. EFSA Journal 2021;19(9):6839, 29 pp. https://doi.org/10.2903/j.efsa.2021.6839

ISSN: 1831-4732

© 2021 European Food Safety Authority. EFSA Journal published by John Wiley and Sons Ltd on behalf of European Food Safety Authority.

This is an open access article under the terms of the Creative Commons Attribution-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited and no modifications or adaptations are made.

The EFSA Journal is a publication of the European Food Safety Authority, a European agency funded by the European Union.
Summary

In accordance with Article 6 of Regulation (EC) No 396/2005, Syngenta Agro GmbH submitted an application to the competent national authority in Germany (evaluating Member State, EMS) to modify the existing maximum residue levels (MRLs) for the active substance benzovindiflupyr in fresh herbs and edible flowers. The EMS drafted an evaluation report in accordance with Article 8 of Regulation (EC) No 396/2005, which was submitted to the European Commission and forwarded to the European Food Safety Authority (EFSA) on 29 June 2021. To accommodate for the intended uses in northern Europe (NEU) of benzovindiflupyr, the EMS proposed to raise the existing MRLs in fresh herbs and edible flowers from the limit of quantification (LOQ) of 0.02 to 1.0 mg/kg.

EFSA assessed the application and the evaluation report as required by Article 10 of the MRL regulation. EFSA identified points which needed further clarification, which were requested from the EMS. On 3 August 2021, the EMS submitted a revised evaluation report (Germany, 2021), which replaced the previously submitted evaluation report.

Based on the conclusions derived by EFSA in the framework of Regulation (EC) No 1107/2009, the data evaluated under previous MRL assessments and the additional data provided by the EMS in the framework of this application, the following conclusions are derived.

The metabolism of benzovindiflupyr following foliar application was investigated in primary crops belonging to the groups of fruit crops, cereals/grass and pulses/oilseeds. The metabolism in these three crop groups was similar, with the parent compound as the major component of residues, except in soyabees where pyrazole-derived metabolites were also observed. Studies investigating the effect of processing on the nature of benzovindiflupyr (hydrolysis studies) demonstrated that the active substance is stable under standard processing conditions. In rotational crops, the major residues identified were the parent compound and certain pyrazole-derived metabolites.

Based on the metabolic pathway identified in metabolism studies, hydrolysis studies and the toxicological significance of metabolites, the residue definitions for plant products were proposed as ‘benzovindiflupyr’ for both enforcement and risk assessment. These residue definitions are applicable to primary crops, rotational crops and processed products. EFSA concluded that for the crops assessed in this application, the metabolism of benzovindiflupyr in primary and in rotational crops and the possible degradation in processed products have been sufficiently addressed and that the previously derived residue definitions are applicable.

Sufficiently validated analytical methods based on high-performance liquid chromatography with tandem mass spectrometry (HPLC-MS/MS) are available to quantify residues in the crops assessed in this application according to the enforcement residue definition. The methods enable quantification of residues at or above 0.01 mg/kg in the crops assessed (LOQ).

The available residue trials on chervil and parsley are sufficient to derive an MRL proposal of 1.0 mg/kg for the whole subgroup of fresh herbs and edible flowers.

Specific studies investigating the magnitude of benzovindiflupyr residues in processed commodities are not required, as the total theoretical maximum daily intake (TMDI) is below the trigger value of 10% of the acceptable daily intake (ADI).

The occurrence of benzovindiflupyr residues in rotational crops was investigated in the framework of the EU pesticides peer review. Based on the available information on the nature and magnitude of residues, it was concluded that significant benzovindiflupyr residue levels are unlikely to occur in rotational crops, provided that the active substance is used according to the proposed Good Agricultural Practice (GAP). However, since the potential generation of pyrazole-derived metabolites above the LOQ cannot be excluded, in particular in pulses/oilseeds, Member States are recommended to consider the need to implement appropriate risk mitigation measures in order to avoid the presence of benzovindiflupyr pyrazole-derived metabolites in succeeding crops belonging to this group.

Residues of benzovindiflupyr in commodities of animal origin were not assessed since the crops under consideration in this MRL application are normally not fed to livestock.

The toxicological profile of benzovindiflupyr was assessed in the framework of the EU pesticides peer review under Regulation (EC) No 1107/2009 and the data were sufficient to derive an acceptable daily intake (ADI) of 0.05 mg/kg body weight (bw) per day and an acute reference dose (ARFD) of 0.1 mg/kg bw.

The consumer risk assessment was performed with revision 3.1 of the EFSA Pesticide Residues Intake Model (PRIMO). Benzovindiflupyr is a racemic mixture of two enantiomers. Since the information on the possible preferential degradation of each isomer in treated commodities and their individual toxicity is not available, the consumer risk assessment was performed by applying a factor of 2,
assuming a worst-case scenario where the toxicity is attributed to a single enantiomer and a complete
switch of the composition of residues into this enantiomer occurs.

The short-term exposure assessment was performed only for the commodities assessed in this
application. The calculations were based on the highest residues (HR) derived from supervised field
trials and the short-term exposure did not exceed the acute reference dose (ARfD) for any of the crops
assessed.

The long-term exposure assessment was performed taking into account the median residue values
(STMR) for the commodities assessed in this application derived from supervised field trials. For the
remaining commodities covered by the MRL regulation, the STMR values derived in the EU pesticides
peer review, in previous MRL applications and by the Joint FAO/WHO Meetings on Pesticide Residues
(JMPR) for the Codex MRLs adopted in the MRL regulation were selected as input values. Additionally,
the existing MRLs set at the LOQ were used. After applying the factor of 2, the estimated long-term
dietary intake accounted for 10% of the ADI (NL toddler diet). The contributions of residues expected
in the commodities assessed in the present MRL application to the overall long-term exposure is
< 0.02% of the ADI.

EFSA concluded that the proposed use of benzovindiflupyr on fresh herbs and edible flowers will
not result in a consumer exposure exceeding the toxicological reference values and therefore is
unlikely to pose a risk to consumers’ health.

EFSA proposes to amend the existing MRLs as reported in the summary table below.

Full details of all end points and the consumer risk assessment can be found in Appendices B–D.

| Code(a) | Commodity                      | Existing EU MRL (mg/kg) | Proposed EU MRL (mg/kg) | Comment/justification                                |
|---------|--------------------------------|-------------------------|-------------------------|------------------------------------------------------|
| 0256000 | Fresh herbs and edible flowers | 0.02*                   | 1.0                     | The submitted data on chervil and parsley were combined to derive an MRL proposal for the NEU use for the whole subgroup of herbs and edible flowers. Risk for consumers unlikely. |

MRL: maximum residue level; NEU: northern Europe; SEU: southern Europe; GAP: Good Agricultural Practice.

*: Indicates that the MRL is set at the limit of analytical quantification (LOQ).

(a): Commodity code number according to Annex I of Regulation (EC) No 396/2005.
## Table of contents

Abstract ................................................................................................................................................... 1

Summary ................................................................................................................................................. 3

Assessment .............................................................................................................................................. 6

1. Residues in plants .......................................................................................................................... 7

1.1. Nature of residues and methods of analysis in plants ................................................................. 7

1.1.1. Nature of residues in primary crops ................................................................................................. 7

1.1.2. Nature of residues in rotational crops .............................................................................................. 7

1.1.3. Nature of residues in processed commodities ................................................................................... 8

1.1.4. Methods of analysis in plants ........................................................................................................... 8

1.1.5. Storage stability of residues in plants ............................................................................................... 8

1.1.6. Proposed residue definitions ........................................................................................................ 8

1.2. Magnitude of residues in plants ....................................................................................................... 8

1.2.1. Magnitude of residues in primary crops ............................................................................................ 8

1.2.2. Magnitude of residues in rotational crops ......................................................................................... 9

1.2.3. Magnitude of residues in processed commodities .............................................................................. 10

1.2.4. Proposed MRLs ................................................................................................................................ 10

2. Residues in livestock ....................................................................................................................... 10

3. Consumer risk assessment .............................................................................................................. 10

4. Conclusion and Recommendations ................................................................................................... 11

References ............................................................................................................................................... 11

Abbreviations ........................................................................................................................................... 12

Appendix A – Summary of intended GAP triggering the amendment of existing EU MRLs .............................. 14

Appendix B – List of end points .............................................................................................................. 17

Appendix C – Pesticide Residue Intake Model (PRIMo) ........................................................................... 23

Appendix D – Input values for the exposure calculations ........................................................................... 25

Appendix E – Used compound codes ................................................................................................... 28
Assessment

The European Food Safety Authority (EFSA) received an application to modify the existing maximum residue levels (MRLs) for benzovindiflupyr in fresh herbs and edible flowers. The detailed description of the intended uses of benzovindiflupyr, which are the basis for the current MRL application, is reported in Appendix A.

Benzovindiflupyr is the ISO common name for N-[(1RS,4SR)-9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methylpyrazole-4-carboxamide (IUPAC). The chemical structures of the active substance and its main metabolites are reported in Appendix E.

Benzovindiflupyr was evaluated in the framework of Regulation (EC) No 1107/20094 with France designated as rapporteur Member State (RMS) for the representative uses as foliar spray applications on wheat, rye, barley and oats. The draft assessment report (DAR) prepared by the RMS has been peer reviewed by EFSA (EFSA, 2015). Benzovindiflupyr was approved2 for the use as fungicide on 2 March 2016.

The EU MRLs for benzovindiflupyr are established in Annex II of Regulation (EC) No 396/2005.3 Proposals for setting MRLs covering the representative uses according to good agricultural practices (GAP) in the EU were assessed during the approval of benzovindiflupyr under Regulation (EC) No 1107/2009 and implemented in Regulation. EFSA has also issued two reasoned opinions on the modification of MRLs for benzovindiflupyr. The proposals from one of the two opinions have been considered in recent MRL regulation.4 In addition, certain codex maximum residue limits (CXLs) have been taken over in the EU MRL legislation.5

In accordance with Article 6 of Regulation (EC) No 396/2005, Syngenta Agro GmbH submitted an application to the competent national authority in Germany (evaluating Member State, EMS) to modify the existing maximum residue level(s) (MRLs) for the active substance benzovindiflupyr in herbs and edible flowers. The EMS drafted an evaluation report in accordance with Article 8 of Regulation (EC) No 396/2005, which was submitted to the European Commission and forwarded to the European Food Safety Authority (EFSA) on 29 June 2021. To accommodate for the intended NEU uses of benzovindiflupyr, the EMS proposed to raise the existing MRLs for fresh herbs and edible flowers from the limit of quantification (LOQ) of 0.02 to 1 mg/kg.

EFSA assessed the application and the evaluation report as required by Article 10 of the MRL regulation. EFSA identified points which needed further clarification, which were requested from the EMS. On 3 August 2021, the EMS submitted the requested information and a revised evaluation report (Germany, 2021), which replaced the previously submitted evaluation report.

EFSA based its assessment on the evaluation report submitted by the EMS (Germany, 2021), the draft assessment report (DAR) and its addendum (France, 2014, 2015) prepared under Regulation (EC) 1107/2009, the Commission review report on benzovindiflupyr (European Commission, 2020b), the conclusion on the peer review of the pesticide risk assessment of the active substance benzovindiflupyr (EFSA, 2015), as well as the conclusions from previous EFSA opinions on benzovindiflupyr (EFSA, 2016, 2021a) and from the assessment of the Codex MRLs (EFSA, 2017, 2021b).

For this application, the data requirements established in Regulation (EU) No 544/20116 and the guidance documents applicable at the date of submission of the application to the EMS are applicable (European Commission, 1997a–g, 2000, 2010a,b, 2017; OECD, 2011). The assessment is performed in

---

1 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, 24.11.2009, p. 1–50.
2 Commission Implementing Regulation (EU) 2016/177 of 10 February 2016 approving the active substance benzovindiflupyr, as a candidate for substitution, in accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council concerning the placing of plant protection products on the market, and amending the Annex to Implementing Regulation (EU) No 540/2011. OJ L 35, 11.2.2016, p. 1–5.
3 Regulation (EC) No 396/2005 of the European Parliament and of the Council of 23 February 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC. OJ L 70, 16.3.2005, p. 1–16.
4 For an overview of all MRL Regulations on this active substance, please consult: https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/active-substances/?event=Search
5 Commission Regulation (EU) 2018/687 of 4 May 2018 amending Annexes II and III to Regulation (EC) No 396/2005 of the European Parliament and of the Council as regards maximum residue levels for acibenzolar-S-methyl, benzovindiflupyr, bifenthrin, bixafen, chlorantraniliprole, deltamethrin, flonicamid, fluazifop-P-ethyl, isofetamid, metrafenone, pendimethalin and tebufluthrin in or on certain products. OJ L 121, 16.5.2018, p. 63–104.
6 Commission Regulation (EU) No 544/2011 of 10 June 2011 implementing Regulation (EC) No 1107/2009 of the European Parliament and of the Council as regards the data requirements for active substances. OJ L 155, 11.6.2011, p. 1–66.
in accordance with the legal provisions of the Uniform Principles for the Evaluation and the Authorisation of Plant Protection Products adopted by Commission Regulation (EU) No 546/2011. A selected list of end points of the studies assessed by EFSA in the framework of this MRL application including the end points of relevant studies assessed previously is presented in Appendix B. 

The evaluation report submitted by the EMS (Germany, 2021) and the exposure calculations using the EFSA Pesticide Residues Intake Model (PRIMo) are considered as supporting documents to this reasoned opinion and, thus, are made publicly available as background documents to this reasoned opinion.

1. **Residues in plants**

1.1. **Nature of residues and methods of analysis in plants**

1.1.1. **Nature of residues in primary crops**

The metabolism of benzovindiflupyr in primary crops belonging to the groups of fruit crops (tomatoes), cereals/grass (wheat) and pulses/oilseeds (soyabeans) has been investigated in the framework of the EU pesticides peer review (EFSA, 2015).

Benzovindiflupyr was the main residue in tomato fruits (≥ 91% of the total radioactive residue, TRR), in wheat commodities (≥ 81% of the TRR) and in soya foliage (67–85% of the TRR). Only in soyabeans benzovindiflupyr represented up to 31% of the TRR and the major residue was the desmethyl pyrazole carboxylic acid (metabolite SYN545720) (47% TRR), present in both free and conjugated forms. In wheat and tomatoes, this metabolite was found only at low proportions and levels (< 1% TRR, up to 0.04 mg eq./kg in wheat straw). The EU pesticides peer review concluded that the metabolic pathway resulting from the three primary crop studies is similar and a global residue definition in commodities of plant origin for risk assessment and for monitoring purposes was proposed as parent benzovindiflupyr only.

In the framework of the EU pesticides peer review, it was highlighted that the above-mentioned studies did not investigate the possible impact of plant metabolism on the isomer ratio of benzovindiflupyr (EFSA, 2015) and further investigation on this matter would in principle be required. It is in fact noted that the EFSA guidance on the risk assessment of compounds that may have stereoisomers has been finalised (EFSA, 2019b). Therefore, EFSA would recommend reconsidering this point in the framework of the renewal of approval of the active substance.

For the intended use, the metabolic behaviour in primary crops is sufficiently addressed and the residue definition for enforcement and risk assessment agreed during the EU pesticides peer review is applicable.

1.1.2. **Nature of residues in rotational crops**

Benzovindiflupyr is proposed to be used on crops that can be grown in rotation with other crops, and therefore, residues in rotational crops need to be investigated. According to the soil degradation studies evaluated in the framework of the peer review, benzovindiflupyr exhibits very high persistence in soil (DT50 = 1,216 days), and therefore, further studies investigating the nature and magnitude of residues in rotational crops were assessed during the EU pesticides peer review (EFSA, 2015).

Metabolism of benzovindiflupyr was examined in crops belonging to the groups of leafy crops (lettuce), root and tuber crops (turnip) and cereals (wheat) after soil treatment with phenyl-14C and pyrazole-14C-labelled benzovindiflupyr at ca. 530 g/ha. The pattern of metabolites found in the studies using [pyrazole-14C]-labelled benzovindiflupyr was different to that found in the studies using the [phenyl-14C]-labelled benzovindiflupyr because of the presence of metabolites originating from a cleaved parent molecule, retaining only the pyrazole ring.

Pyrazole acid (NOA449410) was the major metabolite found in leafy, root/tuber crops and in cereal forage and hay and it was mostly present in the conjugated form. Metabolite SYN545720 (major metabolite in soyabeans according to primary crop metabolism) was also a significant metabolite found in leafy, root/tuber crops and in cereals (forage and hay), in both free and conjugated forms. However, the residue levels of the individual metabolites were mostly below the limit of quantification of

---

7 Commission Regulation (EU) No 546/2011 of 10 June 2011 implementing Regulation (EC) No 1107/2009 of the European Parliament and of the Council as regards uniform principles for evaluation and authorisation of plant protection products. OJ L 155, 11.6.2011, p. 127–175.
0.01 mg/kg at all plant back intervals at an exaggerated application rate compared to the representative uses in cereals.

The EU pesticides peer review concluded that metabolism in primary and rotational crops is similar. For the proposed uses assessed in this application, no further information is required.

1.1.3. Nature of residues in processed commodities

The effect of processing on the nature of benzovindiflupyr was investigated in the framework of the EU pesticides peer review (EFSA, 2015). These studies showed that benzovindiflupyr is hydrolytically stable under standard processing conditions representative of pasteurisation, baking/brewing/boiling and sterilisation.

1.1.4. Methods of analysis in plants

Analytical methods for the determination of benzovindiflupyr residues were assessed during the EU pesticides peer review (EFSA, 2015).

The analytical methods based on high-performance liquid chromatography with tandem mass spectrometry (HPLC-MS/MS), including a multiresidue QuEChERS method, are sufficiently validated to monitor residues of benzovindiflupyr at or above the LOQ of 0.01 mg/kg for matrices with high water content, high oil content, high acid content and in dry matrices. The method was also validated for the determination of residues of benzovindiflupyr in coffee beans at the same LOQ.

Therefore, EFSA concludes that sufficiently validated analytical methods are available to monitor residues of benzovindiflupyr in the plant commodities under consideration (high water content matrix) at or above the LOQ of 0.01 mg/kg.

1.1.5. Storage stability of residues in plants

The storage stability of benzovindiflupyr in plants stored under frozen conditions was investigated in the framework of the EU pesticides peer review (EFSA, 2015). The storage stability of benzovindiflupyr was demonstrated for a period of 24 months at −18°C in plant commodities with high water content, high oil content, high protein content, high acid content and in dry matrices supporting storage stability for the crops assessed in the framework of this application.

1.1.6. Proposed residue definitions

Based on the metabolic pattern identified in metabolism studies, the results of hydrolysis studies, the toxicological significance of metabolites and the capabilities of enforcement analytical methods, the following residue definitions were proposed by the EU pesticides peer review (EFSA, 2015):

- residue definition for risk assessment: benzovindiflupyr
- residue definition for enforcement: benzovindiflupyr

The same residue definitions are applicable to rotational crops and processed products. The residue definition for enforcement set in Regulation (EC) No 396/2005 is identical with the above-mentioned residue definition.

Taking into account the proposed use assessed in this application, EFSA concluded that these residue definitions are appropriate also for fresh herbs and edible flowers and no further information is required.

1.2. Magnitude of residues in plants

1.2.1. Magnitude of residues in primary crops

In support of the MRL application, the applicant submitted residue trials performed on chervil and parsley. The residue trial samples were analysed for the parent compound according to the residue definitions for enforcement and risk assessment.

According to the assessment of the EMS, the methods used were sufficiently validated and fit for purpose (Germany, 2021). The samples of these residue trials were stored under conditions for which integrity of the samples has been demonstrated.
**Fresh herbs and edible flowers**

*NEU outdoor GAP: 1 × 75 g a.s./ha; PHI: 14 days*

The applicant provided 11 residue trials performed in Germany over the period of 2017–2019 to determine the residues of benzovindiflupyr in chervil and parsley after the application of benzovindiflupyr according to the intended GAP as reported in Appendix A. All residue trials were considered independent as they were performed either in different geographical locations or over different growing seasons.

The applicant proposed to merge chervil and parsley residue trials and to extrapolate the residue data set to the whole subgroup of fresh herbs and edible flowers. EFSA agrees with the proposed approach as it is in line with the applicable EU guidance document SANCO 7525/VII/95 on setting MRLs, comparability of residue trials and extrapolation (European Commission, 2020a).

In fact, in line with the principle of combining residue trials performed on different crops, merging of trials in chervil and parsley is possible since (i) the same GAP applies to these crops and to the whole subgroup of fresh herbs and edible flowers, (ii) these trials are representative for the intended GAP and (iii) the number of trials provided is in line with the data requirements and the extrapolation rules for this subgroup composed only of minor crops. Moreover, according to SANCO 7525/VII/95, residues on any representative of the subgroup herbs and edible flowers except sage, rosemary, thyme and laurel/bay leaves may be extrapolated to the whole subgroup herbs and edible flowers.

An MRL of 1.0 mg/kg is therefore derived for the whole subgroup of fresh herbs and edible flowers in support of the intended NEU use of benzovindiflupyr.

### 1.2.2. Magnitude of residues in rotational crops

Fresh herbs and edible flowers can be grown in a crop rotation. The possible transfer of benzovindiflupyr residues to crops that are grown in a crop rotation has been assessed in the EU pesticides peer review (EFSA, 2015). The available studies demonstrated that significant residues of benzovindiflupyr (above 0.01 mg/kg) are not expected in succeeding crops belonging to the groups of leafy crops, root/tuber crops and cereals planted in soil previously treated at 200 g a.s./ha. The only exception was wheat straw planted 30 days after the soil treatment, where benzovindiflupyr was found at 0.02 mg/kg.

Benzovindiflupyr exhibits very high persistence in soil (DT$_{50} = 1,216$ days) and the concept of the maximum plateau concentration of benzovindiflupyr should be considered. The portion of the total application rate reaching the soil (effective application rate, $A_{\text{eff}}$) deriving from the uses of the present application amounts to 45 g a.s./ha,$^8$ corresponding to PEC$_{\text{soil}}$ of 0.02 mg/kg soil, 20 cm soil of a density of 1.5 g/cm$^3$. The total soil concentration of benzovindiflupyr (PEC$_{\text{soil}}$) is calculated at 0.0679 mg/kg soil after 19 years of consecutive uses. Four rotational crop field trials were considered in the framework of the peer review (EFSA, 2015). In all trials, benzovindiflupyr was applied on bare soil at a dose rate of 200 g a.s./ha (equivalent to a PEC$_{\text{soil}}$ of 0.067 g a.s./kg soil; 20 cm soil of a density of 1.5 g/cm$^3$; no crop-soil interception). Therefore, the dose rate of the rotational field studies is equivalent (1N) to the dose of the uses under assessment. It can, thus, be concluded that no significant benzovindiflupyr residues are anticipated in succeeding crops following multiannual applications, provided that the active substance is applied to the crops under assessment according to the intended good agricultural practices (GAPs).

However, during the EU pesticides peer review of benzovindiflupyr (EFSA, 2015), it was reported that the presence of pyrazole-derived metabolites above the LOQ levels in pulses/oilseed crop group could not be excluded. Since confined rotational crop metabolism data were not available with pulses and oilseeds, a data gap was set for rotational crop field trials to determine the magnitude of these metabolites in pulses and in oilseeds (EFSA, 2015). It was additionally noticed that the exposure to pyrazole ring-structured metabolites will have to be looked at cumulatively taking into account the multiple sources (i.e. other fungicides belonging to the pyrazole carboxamide group, such as bixafen, fluxapyroxad, isopyrazam, sedaxane) from which these compounds may originate, including their presence as groundwater metabolites. Therefore, pending the submission of these studies, Member

---

8 The amount of benzovindiflupyr reaching the soil (effective soil application ($A_{\text{eff}}$)) when the compound is applied on fresh herbs and edible flowers according to the intended GAP is calculated at 45 g/ha, applying the interception factor for leafy crops at intermediate crop cover of 40%. Information on the crop interception considered were taken from the EFSA guidance document to obtain DegT50 values (EFSA, 2014).

9 PEC$_{\text{soil initial (20 cm)}}$ + PEC$_{\text{plateau (20 cm)}}$ = 0.02 + 0.047 = 0.067 mg/kg; 20 cm soil of a density of 1.5 g/cm$^3$. 

www.efsa.europa.eu/efsajournal
States are recommended to consider the need to implement appropriate risk mitigation measures in order to avoid the presence of benzovindiflupyr pyrazole-derived metabolites in succeeding crops belonging to the crop group of pulses and oilseeds.

1.2.3. Magnitude of residues in processed commodities

Specific processing studies for the crops under assessment are not available and are not necessary because the total theoretical maximum daily intake (TMDI) for the individual crops under assessment is less than 10% of the ADI.

1.2.4. Proposed MRLs

The available data are considered sufficient to derive MRL proposals as well as risk assessment values for benzovindiflupyr for the whole subgroup of fresh herbs and edible flowers (see Appendix B.4). In Section 3, EFSA assessed whether residues on these crops resulting from the intended uses of benzovindiflupyr are likely to pose a consumer health risk.

2. Residues in livestock

Not relevant as fresh herbs and edible flowers are normally not used for feed purposes.

3. Consumer risk assessment

EFSA performed a dietary risk assessment using revision 3.1 of the EFSA PRIMo (EFSA, 2018, 2019a). This exposure assessment model contains food consumption data for different subgroups of the EU population and allows the acute and chronic exposure assessment to be performed in accordance with the internationally agreed methodology for pesticide residues (FAO, 2016a).

The toxicological reference values for benzovindiflupyr used in the risk assessment (i.e. ADI and ARfD values) were derived in the framework of the EU pesticides peer review (European Commission, 2020b).

EFSA notes that in the framework of the peer review of benzovindiflupyr, it was highlighted that metabolism studies did not investigate the possible impact of plant and animal metabolism on the isomer ratio of benzovindiflupyr (EFSA, 2015) and further investigation on this matter would in principle be required. It is further noted that the EFSA guidance on the risk assessment of compounds that may have stereoisomers has been finalised (EFSA, 2019b); hence, EFSA would recommend reconsidering this point in the framework of the renewal of approval of benzovindiflupyr. In the absence of specific information of the possible preferential degradation of each enantiomer of the benzovindiflupyr racemate mixture in plant and animal commodities, EFSA applied a conservative approach in the risk assessment by applying a correction factor of 2 assuming a complete switch in residue composition of the racemic mixture in the commodities and that all the toxic activities are due to one single isomer. The approach is in line with previous EFSA risk assessments on benzovindiflupyr (EFSA, 2015, 2016, 2021a).

**Short-term (acute) dietary risk assessment**

The short-term exposure assessment was performed only for fresh herbs and edible flowers. The calculations were based on the highest residue (HR) values derived from supervised field trials on chervil and parsley. The complete list of input values can be found in Appendix D.1.

The short-term exposure did not exceed the ARfD for any of the crops assessed in this application, even after applying the conservative correction factor of 2 to account for a worst-case assumption for isomeric switch in the residue composition (see Appendix B.3).

**Long-term (chronic) dietary risk assessment**

The long-term exposure assessment was performed using the median residue (STMR) values derived for herbs and edible flowers from the submitted residue trials. For the remaining commodities covered by the MRL regulation, the existing EU MRLs (at the LOQs) and the STMR values derived in the EU pesticide peer review (EFSA, 2015) and in previous MRL applications (EFSA, 2016, 2021a) were selected as input values. Moreover, also STMR values derived by the Joint FAO/WHO Meetings on Pesticide Residues (FAO, 2016b) were selected as input values for CXLs which were implemented by Regulation (EU) 2018/687.
Additionally, also STMR values for garlic, onions, shallots, other bulb vegetables and sugar cane derived by JMPR for the CXL proposals assessed by EFSA for the Codex Committee on Pesticide Residues (CCPR) preparation (EFSA, 2021b, FAO, 2020) were considered as input values even if not yet voted and implemented in the EU MRL legislation. For commodities of animal origin, conversion factors for risk assessment calculated in the previous MRL assessment (EFSA, 2016) were used to estimate the contribution of the metabolite mono-hydroxylated benzovindiflupyr (SYN546039) included in the EU residue definition for risk assessment for animal commodities. The complete list of input values is presented in Appendix D.1.

The estimated long-term dietary intake amounted to 10% of the ADI (NL toddler diet) after applying the conservative correction factor of 2 to account for a worst-case assumption for isomeric switch in the residue composition. The contribution of residues expected in the commodities assessed in this application to the overall long-term exposure is minimal (0.02% of the ADI for parsley and basil and edible flowers).

EFSA concluded that the long-term intake of residues of benzovindiflupyr resulting from the existing and the intended uses is unlikely to present a risk to consumer health.

For further details on the exposure calculations, a screenshot of the Report sheet of the PRIMo is presented in Appendix C.

4. Conclusion and Recommendations

The data submitted in support of this MRL application were found to be sufficient to derive an MRL proposal for the whole subgroup of fresh herbs and edible flowers.

EFSA concluded that the proposed use of benzovindiflupyr on fresh herbs and edible flowers will not result in a consumer exposure exceeding the toxicological reference values and therefore is unlikely to pose a risk to consumers’ health.

The MRL recommendations are summarised in Appendix B.4

References

EFSA (European Food Safety Authority), 2014. EFSA Guidance Document for evaluating laboratory and field dissipation studies to obtain DegT50 values of active substances of plant protection products and transformation products of these active substances in soil. EFSA Journal 2014;12(5):3662, 37 pp. https://doi.org/10.2903/j.efsa.2014.3662

EFSA (European Food Safety Authority), 2015. Conclusion on the peer review of the pesticide risk assessment of the active substance benzovindiflupyr. EFSA Journal 2015;13(3):4043, 88 pp. https://doi.org/10.2903/j.efsa.2015.4043

EFSA (European Food Safety Authority), 2016. Reasoned opinion on the setting of import tolerances for benzovindiflupyr in various plant and animal origin commodities. EFSA Journal 2016;14(12):4644, 30 pp. https://doi.org/10.2903/j.efsa.2016.4644

EFSA (European Food Safety Authority), 2017. Scientific Report of EFSA on scientific support for preparing an EU position in the 49th Session of the Codex Committee on Pesticide Residues (CCPR). EFSA Journal 2017;15(7):4929, 162 pp. https://doi.org/10.2903/j.efsa.2017.4929

EFSA (European Food Safety Authority), 2021a. Reasoned opinion on the modification of the existing maximum residue levels for benzovindiflupyr in leeks and spring onions/green onions/Welsh onions. EFSA Journal 2021;19(7):6774, 25 pp. https://doi.org/10.2903/j.efsa.2021.6774

EFSA (European Food Safety Authority), 2021b. Scientific support for preparing an EU position for the 52nd Session of the Codex Committee on Pesticide Residues (CCPR). EFSA Journal 2021;19(8):6766, 342 pp. https://doi.org/10.2903/j.efsa.2021.6766

EFSA (European Food Safety Authority), Brancato A, Brocca D, Ferreira L, Greco L, Jarrah S, Leuschner R, Medina P, Miron I, Nougadere A, Pedersen R, Reich H, Santos M, Stanek A, Tarazona J, Theobald A and Villamar-Bouza L, 2018. Guidance on use of EFSA Pesticide Residue Intake Model (EFSA PRIMo revision 3). EFSA Journal 2018;16(1):5147, 43 pp. https://doi.org/10.2903/j.efsa.2018.5147

EFSA (European Food Safety Authority), Anastassiadou M, Brancato A, Carrasco Cabrera L, Ferreira L, Greco L, Jarrah S, Kazocina A, Leuschner R, Magrans JO, Miron I, Pedersen R, Raczyk M, Reich H, Ruocco S, Sacchi A, Santos M, Stanek A, Tarazona J, Theobald A and Verani A, 2019a. Pesticide Residue Intake Model- EFSA PRIMo revision 3.1 (update of EFSA PRIMo revision 3). EFSA supporting publication 2019;EN-1605, 15 pp. https://doi.org/10.2903/sp.efsa.2019.en-1605

EFSA (European Food Safety Authority), Bura L, Friel A, Magrans JO, Parra-Moreira JM and Szentes C, 2019b. Guidance of EFSA on risk assessments for active substances of plant protection products that have stereoisomers as components or impurities and for transformation products of active substances that may have stereoisomers. EFSA Journal 2019;17(8):5804, 33 pp. https://doi.org/10.2903/j.efsa.2019.5804

European Commission, 1997a. Appendix A. Metabolism and distribution in plants. 7028/VI/95-rev.3, 22 July 1997.

www.efsa.europa.eu/efsajournal 11 EFSA Journal 2021;19(9):6839
European Commission, 1997b. Appendix B. General recommendations for the design, preparation and realization of residue trials. Annex 2. Classification of (minor) crops not listed in the Appendix of Council Directive 90/642/EEC. 7029/VI/95-rev. 6, 22 July 1997.

European Commission, 1997c. Appendix C. Testing of plant protection products in rotational crops. 7524/VI/95-rev. 2, 22 July 1997.

European Commission, 1997d. Appendix E. Processing studies. 7035/VI/95-rev. 5, 22 July 1997.

European Commission, 1997e. Appendix F. Metabolism and distribution in domestic animals. 7030/VI/95-rev. 3, 22 July 1997.

European Commission, 1997f. Appendix H. Storage stability of residue samples. 7032/VI/95-rev. 5, 22 July 1997.

European Commission, 1997g. Appendix I. Calculation of maximum residue level and safety intervals. 7039/VI/95-rev. 3, 22 July 1997. As amended by the document: classes to be used for the setting of EU pesticide maximum residue levels (MRLs). SANCO 10634/2010, finalised in the Standing Committee on the Food Chain and Animal Health at its meeting of 23–24 March 2010.

European Commission, 2000. Residue analytical methods. For pre-registration data requirements for Annex II (part A, section 4) and Annex III (part A, section 5) of Directive 91/414. SANCO/3029/99-rev. 4. 11 July 2000.

European Commission, 2010a. Classes to be used for the setting of EU pesticide Maximum Residue Levels (MRLs). SANCO 10634/2010-rev. 0, Finalised in the Standing Committee on the Food Chain and Animal Health at its meeting of 23–24 March 2010.

European Commission, 2010b. Residue analytical methods. For post-registration control. SANCO/825/00-rev. 8.1, 16 November 2010.

European Commission, 2017. Appendix D. Guidelines on comparability, extrapolation, group tolerances and data requirements for setting MRLs. 7525/VI/95-rev. 10.3, 13 June 2017.

European Commission, 2020a. Technical guidelines on data requirements for setting maximum residue levels, comparability of residue trials and extrapolation on residue data on products from plant and animal origin. SANTE/2019/12752, 23 November 2020.

European Commission, 2020b. Final Review report for the active substance benzovindiflupyr. Finalised in the Standing Committee on the Food Chain and Animal Health at its meeting on 11 December 2015 in view of the inclusion of benzovindiflupyr as a candidate for substitution in accordance with Regulation (EC) No 1107/2009. SANCO/11259/2015-Rev.2, 4 December 2020.

FAO (Food and Agriculture Organization of the United Nations), 2016a. Submission and evaluation of pesticide residues data for the estimation of Maximum Residue Levels in food and feed. Pesticide Residues. 3rd Edition. FAO Plant Production and Protection Paper 225, 298 pp.

FAO (Food and Agriculture Organization of the United Nations), 2016b. Benzovindiflupyr. In: Pesticide residues in food – 2016. Report of the Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group on Pesticide Residues. FAO Plant Production and Protection Paper 229.

FAO (Food and Agriculture Organization of the United Nations), 2020. Benzovindiflupyr. In: Pesticide residues in food – 2019. Report of the Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group on Pesticide Residues.

France, 2014. Draft assessment report (DAR) on the active substance benzovindiflupyr prepared by the rapporteur Member State France in the framework of Commission Regulation (EC) No 1107/2009, January 2014. Available online: www.efsa.europa.eu

France, 2015. Revised Draft Assessment Report (DAR) on benzovindiflupyr prepared by the rapporteur Member State France in the framework of Regulation (EC) No 1107/2009, January 2015. Available online: www.efsa.europa.eu

Germany, 2021. Evaluation report on the modification of MRLs for benzovindiflupyr in fresh herbs and edible flowers. June 2021, as revised in August 2021, 25 pp. Available online: www.efsa.europa.eu

OECD (Organisation for Economic Co-operation and Development), 2011. OECD MRL calculator: spreadsheet for single data set and spreadsheet for multiple data set, 2 March 2011. In: Pesticide Publications/Publications on Pesticide Residues. Available online: http://www.oecd.org

Abbreviations

a.s. active substance
ADI acceptable daily intake
ARfD acute reference dose
BBCH growth stages of mono- and dicotyledonous plants
bw body weight
CAS Chemical Abstract Service
CCPR Codex Committee on Pesticide Residues
CF conversion factor for enforcement to risk assessment residue definition
CIRCA (EU) Communication & Information Resource Centre Administrator
## Appendix A – Summary of intended GAP triggering the amendment of existing EU MRLs

| Crop and/or situation | NEU, SEU, MS or country | F or G or I(a) | Pests or group of pests controlled | Preparation | Application | Application rate per treatment | Remarks |
|-----------------------|-------------------------|----------------|-----------------------------------|-------------|----------------|-----------------------------|---------|
|                       |                         |                |                                   | Type(b)     | Conc. a.s. | Method kind | Range of growth stages and season(c) | Number | Interval between application (days) | g a.s./hL min-max | Water (L/ha) min-max | Rate min-max | Unit | PHI (days)(d) | |
| Chervil               | NEU F                   |                | Rust fungi *Uredinales*-fungal leaf spot diseases | EC          | 100 g/L | Foliar treatment – broadcast spraying | At beginning of infestation and/or when first symptoms become visible | 1 n.a. | 0.013–0.019 | 400–600 | 75 g a.i./ha | 14 |
| Chives                | NEU F                   |                | Rust fungi *Uredinales*-fungal leaf spot diseases | EC          | 100 g/L | Foliar treatment – broadcast spraying | At beginning of infestation and/or when first symptoms become visible | 1 n.a. | 0.013–0.019 | 400–600 | 75 g a.i./ha | 14 |
| Celery leaves         | NEU F                   |                | Rust fungi *Uredinales*-fungal leaf spot diseases | EC          | 100 g/L | Foliar treatment – broadcast spraying | At beginning of infestation and/or when first symptoms become visible | 1 n.a. | 0.013–0.019 | 400–600 | 75 g a.i./ha | 14 |
| Parsley               | NEU F                   |                | Rust fungi *Uredinales*-fungal leaf spot diseases | EC          | 100 g/L | Foliar treatment – broadcast spraying | At beginning of infestation and/or when first symptoms become visible | 1 n.a. | 0.013–0.019 | 400–600 | 75 g a.i./ha | 14 |
| Crop and/or situation | NEU, SEU, MS or country | F or G | Pests or group of pests controlled | Preparation Type(b) | Conc. a.s. | Method kind | Range of growth stages and season(c) | Application rate per treatment (d) | Water (L/ha) min-max | Rate min-max | Unit | PHI (days)(d) | Remarks |
|----------------------|------------------------|-------|----------------------------------|---------------------|----------|-----------|----------------------------------|-------------------------------|---------------------|-------------|------|------------|---------|
| Sage                 | NEU                    | F     | Rust fungi Uredinales-fungal leaf spot diseases | EC 100 g/L Foliar treatment – broadcast spraying | At beginning of infestation and/or when first symptoms become visible | 1 n.a. | 0.013–0.019 | 400–600 | 75 g a.i./ha | 14        |         |
| Rosemary             | NEU                    | F     | Rust fungi Uredinales-fungal leaf spot diseases | EC 100 g/L Foliar treatment – broadcast spraying | At beginning of infestation and/or when first symptoms become visible | 1 n.a. | 0.013–0.019 | 400–600 | 75 g a.i./ha | 14        |         |
| Thyme                | NEU                    | F     | Rust fungi Uredinales-fungal leaf spot diseases | EC 100 g/L Foliar treatment – broadcast spraying | At beginning of infestation and/or when first symptoms become visible | 1 n.a. | 0.013–0.019 | 400–600 | 75 g a.i./ha | 14        |         |
| Basil and edible flowers | NEU                | F     | Rust fungi Uredinales-fungal leaf spot diseases | EC 100 g/L Foliar treatment – broadcast spraying | At beginning of infestation and/or when first symptoms become visible | 1 n.a. | 0.013–0.019 | 400–600 | 75 g a.i./ha | 14        |         |
| Crop and/or situation | NEU, SEU, MS or country | F G or I (a) | Pests or group of pests controlled | Preparation | Application | Range of growth stages and season (c) | Number | Interval between application (days) | Application rate per treatment | Remarks |
|-----------------------|-------------------------|--------------|-----------------------------------|-------------|------------|--------------------------------------|-------|-------------------------------|-------------------------------|---------|
| Laurel/bay leaves     | NEU F                    | Rust fungi *Uredinales*-fungal leaf spot diseases | EC 100 g/L | Foliar treatment – broadcast spraying | At beginning of infestation and/or when first symptoms become visible | 1 | n.a. | 0.013–0.019 | 400–600 | 75 | g a.i./ha | 14 |
| Tarragon              | NEU F                    | Rust fungi *Uredinales*-fungal leaf spot diseases | EC 100 g/L | Foliar treatment – broadcast spraying | At beginning of infestation and/or when first symptoms become visible | 1 | n.a. | 0.013–0.019 | 400–600 | 75 | g a.i./ha | 14 |
| Others (0256990)      | NEU F                    | Rust fungi *Uredinales*-fungal leaf spot diseases | EC 100 g/L | Foliar treatment – broadcast spraying | At beginning of infestation and/or when first symptoms become visible | 1 | n.a. | 0.013–0.019 | 400–600 | 75 | g a.i./ha | 14 |

MRL: maximum residue level; GAP: Good Agricultural Practice; NEU: northern European Union; SEU: southern European Union; MS: Member State; a.s.: active substance; EC: emulsifiable concentrate.

(a): Outdoor or field use (F), greenhouse application (G) or indoor application (I).
(b): CropLife International Technical Monograph no 2, 7th Edition. Revised March 2017. Catalogue of pesticide formulation types and international coding system.
(c): Growth stage range from first to last treatment (BBCH Monograph, Growth Stages of Plants, 1997, Blackwell, ISBN 3-8263-3152-4), including, where relevant, information on season at time of application.
(d): PHI – minimum preharvest interval.
Appendix B – List of end points

B.1. Residues in plants

B.1.1. Nature of residues and methods of analysis in plants

B.1.1.1. Metabolism studies, methods of analysis and residue definitions in plants

| Primary crops (available studies) | Crop groups | Crop(s) | Application(s) | Sampling (DAT) | Comment/Source |
|----------------------------------|-------------|---------|----------------|----------------|----------------|
| Fruit crops                     | Tomatoes    |         | 4 × ca. 132 g/ha foliar spray, 7 days interval | 1, 14 DALA | Radiolabelled active substance: [phenyl-14C]-benzovindiflupyr and [pyrazole-14C]-benzovindiflupyr (EFSA, 2015) |
| Cereals/grass                   | Wheat       |         | 2 × ca. 135 g/ha foliar spray, 35-day interval, BBCH 31 and 69 | Forage: 9 DAT1 (BBCH 39); Hay: 10 DALA (BBCH 77); Straw, grain: 40–41 DALA | Radiolabelled active substance: [phenyl-14C]-benzovindiflupyr and [pyrazole-14C]-benzovindiflupyr (EFSA, 2015) |
| Pulses/oilseeds                | Soyabeans   |         | 2 × ca. 120 g/ha foliar spray, 21-day interval, BBCH 55–60 and 75 | Forage: 11 DAT1 (BBCH 70); Hay: 13 DALA (BBCH 85); Seed: 30 DALA (BBCH 89) | Radiolabelled active substance: [phenyl-14C]-benzovindiflupyr and [pyrazole-14C]-benzovindiflupyr (EFSA, 2015) |

| Rotational crops (available studies) | Crop groups | Crop(s) | Application(s) | PBI (DAT) | Comment/Source |
|-------------------------------------|-------------|---------|----------------|-----------|----------------|
| Root/tuber crops                   | Turnip      |         | 1 × ca. 530 g/ha, soil treatment | 30, 90 and 300 | Radiolabelled active substance: [phenyl-14C]-benzovindiflupyr and [pyrazole-14C]-benzovindiflupyr (EFSA, 2015) |
| Leafy crops                        | Lettuces    |         |                |           |                |
| Cereal (small grain)               | Wheat       |         |                |           |                |

| Processed commodities (hydrolysis study) | Conditions | Stable? | Comment/Source |
|------------------------------------------|------------|---------|----------------|
| Pasteurisation (20 min, 90°C, pH 4)     | Yes        |         | Radiolabelled active substance: [pyrazole-14C]-benzovindiflupyr (EFSA, 2015) |
| Baking, brewing and boiling (60 min, 100°C, pH 5) | Yes |         |                |
| Sterilisation (20 min, 120°C, pH 6)     | Yes        |         |                |
Can a general residue definition be proposed for primary crops?
Yes EFSA (2015)

Rotational crop and primary crop metabolism similar?
Yes Metabolism more extensive in rotational crops than in primary crops (EFSA, 2015)

Residue pattern in processed commodities similar to residue pattern in raw commodities?
Yes EFSA (2015)

Plant residue definition for monitoring (RD-Mo)
Benzovindiflupyr

Plant residue definition for risk assessment (RD-RA)
Benzovindiflupyr

Methods of analysis for monitoring of residues (analytical technique, crop groups, LOQs)
Matrices with high water content, high oil content, high acid content, dry matrices, and coffee beans: Single residue method (confirmed by multi residue method - QuEChERS). HPLC–MS/MS, LOQ 0.01 mg/kg. ILV available (EFSA, 2015)

DAT: days after treatment; PBI: plant-back interval; BBCH: growth stages of mono- and dicotyledonous plants; a.s.: active substance; MRL: maximum residue level; HPLC–MS/MS: high performance liquid chromatography with tandem mass spectrometry; LOQ: limit of quantification; QuEChERS: Quick, Easy, Cheap, Effective, Rugged, and Safe; ILV: independent laboratory validation.

### B.1.1.2. Stability of residues in plants

| Plant products (available studies) | Category | Commodity       | T (°C) | Stability period | Compounds covered | Comment/Source |
|-----------------------------------|----------|-----------------|--------|------------------|-------------------|----------------|
|                                    | High water content | Spinaches      | –18    | Month            | 24 Benzovindiflupyr | EFSA (2015) |
|                                    |          | Potatoes        | –18    | Month            | 24 Benzovindiflupyr | EFSA (2015) |
|                                    |          | Sugar cane      | –18    | Month            | 4 Benzovindiflupyr  | Investigated up to 4 months EFSA (2015) |
|                                    | High oil content  | Soyabeans       | –18    | Month            | 24 Benzovindiflupyr | EFSA (2015) |
|                                    |          | Coffee beans    | –18    | Month            | 4 Benzovindiflupyr  | Investigated up to 4 months EFSA (2015) |
|                                    | High protein content | Broad bean    | –18    | Month            | 24 Benzovindiflupyr | EFSA (2015) |
|                                    | Dry/High starch | Wheat (grain)   | –18    | Month            | 24 Benzovindiflupyr | EFSA (2015) |
|                                    | High acid content | Oranges        | –18    | Month            | 24 Benzovindiflupyr | EFSA (2015) |
|                                    | Others    | Wheat (straw)   | –18    | Month            | 24 Benzovindiflupyr | EFSA (2015) |
### B.1.2. Magnitude of residues in plants

#### B.1.2.1. Summary of residues data from the supervised residue trials

| Commodity            | Region/(a) | Residue levels observed in the supervised residue trials (mg/kg) | Comments/Source                                                                 | Calculated MRL (mg/kg) | HR(b) (mg/kg) | STMR(c) (mg/kg) | CF(d) |
|----------------------|------------|------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------|----------------|-----------------|-------|
| Chervil, parsley     | NEU        | 0.036; 0.047; 0.059; 0.084; 0.11; 0.11; 0.15; 0.23; 0.27; 0.42; 0.70 (residue data on ‘parsley’; ‘chervil’) | Residues data on chervil and parsley were merged and extrapolated to the whole group of herbs and edible flowers | 1.0                    | 0.70           | 0.13            | N/a   |

MRL: maximum residue level; GAP: Good Agricultural Practice; Mo: monitoring; RA: risk assessment.

(a): NEU: Outdoor trials conducted in northern Europe, SEU: Outdoor trials conducted in southern Europe, EU: indoor EU trials or Country code: if non-EU trials.

(b): Highest residue. The highest residue for risk assessment refers to the whole commodity and not to the edible portion.

(c): Supervised trials median residue. The median residue for risk assessment refers to the whole commodity and not to the edible portion.

(d): Conversion factor to recalculate residues according to the residue definition for monitoring to the residue definition for risk assessment.
B.1.2.2. Residues in rotational crops

Residues in rotational and succeeding crops expected based on confined rotational crop study?

| No | In a confined rotational crop study lettuce, turnip and wheat were sown in soil treated with benzovindiflupyr at 530 g/ha; residue levels of parent and individual metabolites were mostly below the LOQ of 0.01 mg/kg for all plant back intervals (EFSA, 2015) |

Residues in rotational and succeeding crops expected based on field rotational crop study?

| Inconclusive (pyrazole structured metabolites) | Four rotational crop field trials with leafy, root and tuber vegetables and cereals planted 30, 60 or 360 days after treatment of soil at the dose of 200 g a.s./ha. Benzovindiflupyr residue < LOQ of 0.01 mg/kg was found in spinach, carrot (top and root), wheat (grain, forage and straw), except for one trial on wheat straw sowed 30 days after treatment (benzovindiflupyr 0.02 mg/kg). EFSA requested additional crop field trials to determine the magnitude of the parent and its pyrazole structured metabolites in oilseeds and in pulses ((data gap), EFSA, 2015) |

LOQ: limit of quantification; a.s.: active substance.

B.1.2.3. Processing factors

No processing studies were submitted in the framework of the present MRL application.

B.2. Residues in livestock

Not relevant.
B.3. Consumer risk assessment

**ARfD**

0.1 mg/kg bw (European Commission, 2020)

Highest IESTI, according to EFSA PRIMo

| Crop          | Contribution | ARfD      |
|---------------|--------------|-----------|
| Chervil       | 0.9% of ARfD |           |
| Parsley       | 0.8% of ARfD |           |
| Chives        | 0.6% of ARfD |           |
| Sage          | 0.5% of ARfD |           |
| Basil and edible flowers | 0.5% of ARfD |     |
| Celery leaves | 0.3% of ARfD |           |
| Thyme         | 0.04% of ARfD|           |
| Rosemary      | 0.02% of ARfD|           |
| Laurel/bay leaves | 0.01% of ARfD | |
| Tarragon      | no consumption data |

Assumptions made for the calculations

The short-term exposure assessment was calculated for the whole sub-group of fresh herbs and edible flowers using the highest residue levels (HR) derived from the residue trials on chervil and parsley.

A factor of 2 was applied, assuming a complete switch in the residue isomeric composition.

An exceedance of the ARfD was observed for table grapes after applying the factor of 2 (118%). Further refinement of the exposure estimates for this commodity may be possible, such as investigating the impact of the possible preferential isomerisation of the racemic mixture in plants and animals or establishing an alternative variability factor.

Calculations performed with PRIMo revision 3.1.

**ADI**

0.05 mg/kg bw per day (European Commission, 2020)

Highest IEDI, according to EFSA PRIMo

| Crop          | Contribution | IEDI  |
|---------------|--------------|-------|
| Herbs and edible flowers | individually < 0.02% of the ADI |       |

Assumptions made for the calculations

The long-term exposure assessment was based on the median residue levels derived for raw agricultural commodities (STMRs) assessed in the present application.

For the remaining commodities covered by the MRL regulation, the STMR values derived in the EU pesticides peer review, in previous MRL applications and by the JMPR were selected as input values (EFSA, 2015, 2016, 2021a; FAO, 2016b, FAO, 2020). Additionally, the existing MRLs set at the LOQ were used. For animal commodities, conversion factors from enforcement to risk assessment were applied (EFSA, 2016).

Even when applying a factor of 2 in the dietary risk assessment assuming a complete switch in the residue isomeric composition and that the toxicity is attributed to this single enantiomer, a risk for consumer is not identified (max 10% of ADI).

Calculations performed with PRIMo revision 3.1.

ARfd: acute reference dose; bw: body weight; IESTI: international estimated short-term intake; PRIMo: (EFSA) Pesticide Residues Intake Model; ADI: acceptable daily intake; IEDI: international estimated daily intake; MRL: maximum residue level; STMR: supervised trials median residue; CXL: codex maximum residue limit.
## B.4. Recommended MRLs

| Code\(^{(a)}\) | Commodity                      | Existing EU MRL (mg/kg) | Proposed EU MRL (mg/kg) | Comment/justification                                                                                                                                                                                                 |
|----------------|--------------------------------|-------------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0256000        | Fresh herbs and edible flowers | 0.02*                   | 1.0                     | The submitted data on chervil and parsley were combined to derive an MRL proposal for the NEU use for the whole subgroup of herbs and edible flowers. Risk for consumers unlikely.                                             |

Enforcement residue definition: Benzovindiflupyr

MRL: maximum residue level; NEU: northern Europe; SEU: southern Europe; GAP: Good Agricultural Practice.

*: Indicates that the MRL is set at the limit of analytical quantification (LOQ).

\(^{(a)}\): Commodity code number according to Annex I of Regulation (EC) No 396/2005.
## Appendix C – Pesticide Residue Intake Model (PRIMo)

### Benzovindiflupyr

**European Food Safety Authority**

**EFSA PRIMo: Revision 3.1, 2021/01/06**

### Normal Mode

**Chronic risk assessment: JMPR methodology (IEDI/TMDI)**

| Commodity/Group of Commodities | MS Diet | 1% Total | 0.7% Total | 0.2% Total | 0.1% Total |
|--------------------------------|---------|----------|------------|------------|------------|
| Tomatoes                       | 0.8%    | 0.1%     | 0.0%       | 0.0%       | 0.0%       |
| Wine grapes                    | 0.7%    | 0.1%     | 0.0%       | 0.0%       | 0.0%       |
| Barley                         | 0.5%    | 0.1%     | 0.0%       | 0.0%       | 0.0%       |
| Wheat                          | 0.4%    | 0.1%     | 0.0%       | 0.0%       | 0.0%       |
| Sugar canes                    | 0.3%    | 0.1%     | 0.0%       | 0.0%       | 0.0%       |
| Oat                            | 0.2%    | 0.1%     | 0.0%       | 0.0%       | 0.0%       |
| Wheat                          | 0.2%    | 0.1%     | 0.0%       | 0.0%       | 0.0%       |
| Milk: Cattle                   | 0.2%    | 0.1%     | 0.0%       | 0.0%       | 0.0%       |
| Potatoes                       | 0.1%    | 0.1%     | 0.0%       | 0.0%       | 0.0%       |
| Apples                         | 0.1%    | 0.1%     | 0.0%       | 0.0%       | 0.0%       |
| Coffee beans                   | 0.1%    | 0.1%     | 0.0%       | 0.0%       | 0.0%       |

### Conclusion

The estimated long-term dietary intake (TMDI/NEDI/IEDI) was below the ADI.

The long-term intake of residues of Benzovindiflupyr is unlikely to present a public health concern.

**Disclaimer:** Dietary data from the UK were included in PRIMO when the UK was a member of the European Union.
The acute risk assessment is based on the ARD. DISCLAIMER: Dietary data from the UK were included in PRIMO when the UK was a member of the European Union. The calculation is based on the large portion of the most critical consumer group.

| Unprocessed commodities | Exposure (µg/kg bw) | MRL/input for RA (mg/kg) | Highest % of ARfD/ADI | Commodities |
|-------------------------|---------------------|--------------------------|-----------------------|-------------|
| 0.8% Chervil            | 0.77                | 1.07                     | 0.8% Parsley          |
| 0.6% Chives             | 0.57                | 1.07                     | 0.1% Sage             |
| 0.5% Sage               | 0.53                | 1.07                     | 0.1% Chives           |
| 0.5% Basil and edible flowers | 0.51 | 1.07                     | 0.09% Basil and edible flowers |
| 0.3% Celery leaves      | 0.34                | 1.07                     | 0.07% Rosemary        |
| 0.04% Thyme             | 0.04                | 1.07                     | 0.07% Rosemary        |
| 0.02% Rosemary          | 0.02                | 1.07                     | 0.07% Rosemary        |
| 0.01% Laurel/bay leaves | 0.01                | 1.07                     | 0.06% Chervil          |

Processed Commodities

| Exposure (µg/kg bw) | MRL/input for RA (mg/kg) | Highest % of ARfD/ADI | Commodities |
|---------------------|--------------------------|-----------------------|-------------|
|                    | 1.07                     | 0.1% Rosemary         |
|                    | 1.07                     | 0.07% Rosemary        |
|                    | 1.07                     | 0.07% Rosemary        |
|                    | 1.07                     | 0.06% Chervil          |

Conclusion:
No exceedance of the toxicological reference value was identified for any unprocessed commodity.
A short term intake of residues of Benzovindiflupyr is unlikely to present a public health risk.
For processed commodities, no exceedence of the ARfD/ADI was identified.
### Appendix D – Input values for the exposure calculations

#### D.1. Consumer risk assessment

| Commodity                      | Existing/Proposed MRL (mg/kg) | Source                     | Chronic risk assessment | Acute risk assessment |
|--------------------------------|-------------------------------|----------------------------|-------------------------|-----------------------|
|                                |                               |                            | Input value (mg/kg)     | Comment (mg/kg)       | Comment (a) |
| Apples                         | 0.2                           | CXL (FAO, 2016b)           | 0.058                   | STMR-RAC              | 0.17        | HR-RAC     |
| Pears                          | 0.2                           | CXL (FAO, 2016b)           | 0.058                   | STMR-RAC              | 0.17        | HR-RAC     |
| Quinces                        | 0.2                           | CXL (FAO, 2016b)           | 0.058                   | STMR-RAC              | 0.17        | HR-RAC     |
| Medlar                         | 0.2                           | CXL (FAO, 2016b)           | 0.058                   | STMR-RAC              | 0.17        | HR-RAC     |
| Loquats/Japanese medlars        | 0.2                           | CXL (FAO, 2016b)           | 0.058                   | STMR-RAC              | 0.17        | HR-RAC     |
| Other pome fruits              | 0.2                           | CXL (FAO, 2016b)           | 0.058                   | STMR-RAC              | 0.17        | HR-RAC     |
| Table grapes                   | 1                             | CXL (FAO, 2016b)           | 0.29                    | STMR-RAC              | 0.81        | HR-RAC     |
| Wine grapes                    | 1                             | CXL (FAO, 2016b)           | 0.29                    | STMR-RAC              | 0.81        | HR-RAC     |
| Azaroles/Medi. medlars         | 0.2                           | CXL (FAO, 2016b)           | 0.058                   | STMR-RAC              | 0.17        | HR-RAC     |
| Kaki/Japanese persimmons       | 0.2                           | EFSA (2017)                | 0.058                   | STMR-RAC              | 0.17        | HR-RAC     |
| Potatoes                       | 0.02                          | EFSA (2016)                | 0.01                    | STMR-RAC              | 0.02        | HR-RAC     |
| Cassava roots/manioc           | 0.02                          | EFSA (2016)                | 0.01                    | STMR-RAC              | 0.02        | HR-RAC     |
| Sweet potatoes                 | 0.02                          | EFSA (2016)                | 0.01                    | STMR-RAC              | 0.02        | HR-RAC     |
| Yams                           | 0.02                          | EFSA (2016)                | 0.01                    | STMR-RAC              | 0.02        | HR-RAC     |
| Arrowroots                     | 0.02                          | EFSA (2016)                | 0.01                    | STMR-RAC              | 0.02        | HR-RAC     |
| Jerusalem artichokes           | 0.02                          | EFSA (2016)                | 0.01                    | STMR-RAC              | 0.02        | HR-RAC     |
| Garlic                         | 0.02                          | FAO (2020)                 | 0.01                    | STMR-RAC              | 0.015       | HR-RAC     |
| Onions                         | 0.02                          | FAO (2020)                 | 0.01                    | STMR-RAC              | 0.015       | HR-RAC     |
| Shallots                       | 0.02                          | FAO (2020)                 | 0.01                    | STMR-RAC              | 0.015       | HR-RAC     |
| Spring onions/green onions and Welsh onions | 0.09                      | EFSA (2021a)              | 0.03                    | STMR-RAC              | 0.05        | HR-RAC     |
| Other bulb vegetables          | 0.02                          | FAO (2020)                 | 0.01                    | STMR-RAC              | 0.015       | HR-RAC     |
| Tomatoes                       | 0.9                           | CXL (FAO, 2016b)           | 0.089                   | STMR-RAC              | 0.62        | HR-RAC     |
| Sweet peppers/bell peppers    | 1                             | EFSA (2016)                | 0.09                    | STMR-RAC              | 0.62        | HR-RAC     |
| Aubergines/egg plants          | 0.9                           | CXL (FAO, 2016b)           | 0.089                   | STMR-RAC              | 0.62        | HR-RAC     |
| Okra/lady’s fingers            | 1                             | EFSA (2016)                | 0.09                    | STMR-RAC              | 0.62        | HR-RAC     |
| Other solanaceae               | 1                             | EFSA (2016)                | 0.09                    | STMR-RAC              | 0.62        | HR-RAC     |
| Cucumbers                      | 0.08                          | EFSA (2016)                | 0.02                    | STMR-RAC              | 0.05        | HR-RAC     |
| Gherkins                       | 0.08                          | EFSA (2016)                | 0.02                    | STMR-RAC              | 0.05        | HR-RAC     |
| Courgettes                     | 0.08                          | EFSA (2016)                | 0.02                    | STMR-RAC              | 0.05        | HR-RAC     |
| Other cucurbits – edible peel  | 0.08                          | EFSA (2016)                | 0.02                    | STMR-RAC              | 0.05        | HR-RAC     |

Risk assessment residue definition: Benzovindiflupyr
| Commodity                           | Existing/Proposed MRL (mg/kg) | Source                     | Chronic risk assessment | Acute risk assessment |
|------------------------------------|------------------------------|----------------------------|-------------------------|-----------------------|
|                                    |                              |                            | Input value (mg/kg)    | Comment               |
|                                    |                              |                            | Comment (a)            | Input value (mg/kg)   | Comment (a)            |
| Sweet corn                         | 0.01                         | EFSA (2016)                | 0.01                    | STMR-RAC             | 0.01                   | HR-RAC                |
| Other fruiting vegetables          | 0.9                          | CXL (FAO, 2016b)          | 0.089                   | STMR-RAC             | 0.62                   | HR-RAC                |
| Chervil                            | 1 Proposed                   |                             | 0.13                    | STMR-RAC             | 0.70                   | HR-RAC                |
| Chives                             | 1 Proposed                   |                             | 0.13                    | STMR-RAC             | 0.70                   | HR-RAC                |
| Celery leaves                      | 1 Proposed                   |                             | 0.13                    | STMR-RAC             | 0.70                   | HR-RAC                |
| Parsley                            | 1 Proposed                   |                             | 0.13                    | STMR-RAC             | 0.70                   | HR-RAC                |
| Sage                               | 1 Proposed                   |                             | 0.13                    | STMR-RAC             | 0.70                   | HR-RAC                |
| Rosemary                           | 1 Proposed                   |                             | 0.13                    | STMR-RAC             | 0.70                   | HR-RAC                |
| Thyme                              | 1 Proposed                   |                             | 0.13                    | STMR-RAC             | 0.70                   | HR-RAC                |
| Basil and edible flowers           | 1 Proposed                   |                             | 0.13                    | STMR-RAC             | 0.70                   | HR-RAC                |
| Laurel/bay leaves                  | 1 Proposed                   |                             | 0.13                    | STMR-RAC             | 0.70                   | HR-RAC                |
| Tarragon                           | 1 Proposed                   |                             | 0.13                    | STMR-RAC             | 0.70                   | HR-RAC                |
| Other herbs                        | 1 Proposed                   |                             | 0.13                    | STMR-RAC             | 0.70                   | HR-RAC                |
| Leeks                              | 0.09                         | EFSA (2021a)               | 0.03                    | STMR-RAC             | 0.05                   | HR-RAC                |
| Beans                              | 0.2                          | EFSA (2016)                | 0.01                    | STMR-RAC             | 0.01                   | STMR-RAC             |
| Lentils                            | 0.2                          | EFSA (2016)                | 0.01                    | STMR-RAC             | 0.01                   | STMR-RAC             |
| Peas                               | 0.2                          | CXL (FAO, 2016b)          | 0.011                   | STMR-RAC             | 0.011                  | STMR-RAC             |
| Lupins/lupini beans                | 0.2                          | EFSA (2016)                | 0.01                    | STMR-RAC             | 0.01                   | STMR-RAC             |
| Other pulses                       | 0.2                          | EFSA (2016)                | 0.01                    | STMR-RAC             | 0.01                   | STMR-RAC             |
| Linseeds                           | 0.15                         | EFSA (2016)                | 0.02                    | STMR-RAC             | 0.02                   | STMR-RAC             |
| Peanuts/groundnuts                 | 0.04                         | CXL (FAO, 2016b)          | 0.01                    | STMR-RAC             | 0.01                   | STMR-RAC             |
| Poppy seeds                        | 0.15                         | EFSA (2016)                | 0.02                    | STMR-RAC             | 0.02                   | STMR-RAC             |
| Rapeseeds/canola seeds             | 0.2                          | CXL (FAO, 2016b)          | 0.023                   | STMR-RAC             | 0.023                  | STMR-RAC             |
| Soybeans                           | 0.08                         | CXL (FAO, 2016b)          | 0.01                    | STMR-RAC             | 0.01                   | STMR-RAC             |
| Mustard seeds                      | 0.15                         | EFSA (2016)                | 0.02                    | STMR-RAC             | 0.02                   | STMR-RAC             |
| Cotton seeds                       | 0.15                         | EFSA (2016)                | 0.01                    | STMR-RAC             | 0.01                   | STMR-RAC             |
| Gold of pleasure seeds             | 0.15                         | EFSA (2016)                | 0.02                    | STMR-RAC             | 0.02                   | STMR-RAC             |
| Barley                             | 1.5                           | EFSA (2016)               | 0.19                    | STMR-RAC             | 0.19                   | STMR-RAC             |
| Maize/corn                         | 0.02                         | EFSA (2016)                | 0.01                    | STMR-RAC             | 0.01                   | STMR-RAC             |
| Oat                                | 1.5                           | EFSA (2016)                | 0.19                    | STMR-RAC             | 0.19                   | STMR-RAC             |
| Rye                                | 0.1                           | EFSA (2016)                | 0.02                    | STMR-RAC             | 0.02                   | STMR-RAC             |
| Wheat                              | 0.1                           | EFSA (2016)                | 0.02                    | STMR-RAC             | 0.02                   | STMR-RAC             |
| Coffee beans                       | 0.15                          | CXL (FAO, 2016b)          | 0.015                   | STMR-RAC             | 0.015                  | STMR-RAC             |
| Ginger                             | 0.15                          | EFSA (2016)                | 0.08                    | STMR-RAC             | 0.08                   | STMR-RAC             |
| Turmeric/curcuma                    | 0.15                          | EFSA (2016)                | 0.08                    | STMR-RAC             | 0.15                   | HR-RAC                |
| Sugar canes                        | 0.4                           | FAO (2020)                | 0.069                   | STMR-RAC             | 0.25                   | HR-RAC                |

| Other commodities of plant origin | LOQs as in Regulation (EU) 2018/687 |
| Commodity | Existing/Proposed MRL (mg/kg) | Source | Chronic risk assessment | Acute risk assessment |
|-----------|-----------------------------|--------|------------------------|-----------------------|
|           |                             |        | Input value (mg/kg)    | Comment (a)           |
|           |                             |        | Input value (mg/kg)    | Comment (a)           |
| Swine, bovine, sheep, goat, equine, other farmed animals: Fat tissue | 0.03 | CXL (FAO, 2016b) | 0.02 | STMR*CF (2) (EFSA, 2016) | 0.038 | HR*CF (2) (EFSA, 2016) |
| Swine, bovine, sheep, goat, equine, other farmed animals: Liver | 0.1 | CXL (FAO, 2016b) | 0.042 | STMR*CF (3) (EFSA, 2016) | 0.192 | HR*CF (3) (EFSA, 2016) |
| Swine, bovine, sheep, goat, equine, other farmed animals: Kidney | 0.1 | CXL (FAO, 2016b) | 0.035 | STMR*CF (2.5) (EFSA, 2016) | 0.16 | HR*CF (2.5) (EFSA, 2016) |
| Swine, bovine, sheep, goat, equine, other farmed animals: Edible offal (other than liver and kidney) | 0.1 | CXL (FAO, 2016b) | 0.028 | STMR*CF (2) (EFSA, 2016) | 0.128 | HR*CF (2) (EFSA, 2016) |
| Other commodities of animal origin | LOQs as in Regulation (EU) 2018/687 | | | |

Risk assessment residue definition: Benzovindiflupyr and mono-hydroxylated benzovindiflupyr, free and conjugated (SYN546039), expressed as benzovindiflupyr.

STMR-RAC: supervised trials median residue in raw agricultural commodity; HR-RAC: highest residue in raw agricultural commodity; PeF: Peeling factor.

(a): Input values for the commodities which are not under consideration for the acute risk assessment are reported in grey.

(b): STMR values for garlic, onions, shallots, other bulb vegetables and sugar cane derived by JMPR for the CXL proposals assessed by EFSA for the CCPR preparation (EFSA, 2021b, FAO, 2020) were considered as input values even if not yet voted and implemented in the EU MRL legislation.
## Appendix E – Used compound codes

| Code/trivial name | IUPAC name/SMILES notation/InChiKey | Structural formula |
|------------------|-------------------------------------|--------------------|
| **Benzovindiflupyr**  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  
(SYN545192)  | N-[[1R,5S,4SR]-9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methylpyrazole-4-carboxamide  
FC(F)c4nn(C)cc4C(=O)Nc3cccc2C1CCC(C1=C(Cl)Cl)c23  
CCCGEEKHTPTUHJ-UHFFFAOYSA-N  
N-[[1R,5S,4SR]-9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methylpyrazole-4-carboxamide  
FC(F)c4nn(C)cc4C(=O)Nc3cccc2C1CCC(C1=C(Cl)Cl)c23  
CCCGEEKHTPTUHJ-UHFFFAOYSA-N  
and  
N-[[1S,5SR,4RS]-9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methylpyrazole-4-carboxamide  
FC(F)c4nn(C)cc4C(=O)Nc3cccc2C1CCC(C1=C(Cl)Cl)c23  
CCCGEEKHTPTUHJ-UHFFFAOYSA-N  
and  
N-[[1S,5SR,4RS]-9-(dichloromethylene)-1,2,3,4-tetrahydro-1,4-methanonaphthalen-5-yl]-3-(difluoromethyl)-1-methylpyrazole-4-carboxamide  
FC(F)c4nn(C)cc4C(=O)Nc3cccc2C1CCC(C1=C(Cl)Cl)c23  
CCCGEEKHTPTUHJ-VHSXESVS-N | ![Structure](structure1.png)  
![Structure](structure2.png)  
![Structure](structure3.png)  
![Structure](structure4.png)  
![Structure](structure5.png)  
![Structure](structure6.png)  
![Structure](structure7.png)  
![Structure](structure8.png)  
![Structure](structure9.png)  
![Structure](structure10.png)  
![Structure](structure11.png)  
![Structure](structure12.png)  
![Structure](structure13.png)  
![Structure](structure14.png)  
![Structure](structure15.png)  
![Structure](structure16.png)  
![Structure](structure17.png)  
![Structure](structure18.png)  
![Structure](structure19.png)  
![Structure](structure20.png)  
![Structure](structure21.png)  
![Structure](structure22.png)  
![Structure](structure23.png)  
![Structure](structure24.png)  
![Structure](structure25.png)  
![Structure](structure26.png)  
![Structure](structure27.png)  
![Structure](structure28.png)  
![Structure](structure29.png)  
![Structure](structure30.png)  
![Structure](structure31.png)  |
| Code/trivial name\(^{(a)}\) | IUPAC name/SMILES notation/InChiKey\(^{(b)}\) | Structural formula\(^{(c)}\) |
|-----------------------------|------------------------------------------|-----------------------------|
| NOA449410 (pyrazole acid, CSAA798670) | 3-(difluoromethyl)-1-methyl-1\(^{H}\)-pyrazole-4-carboxylic acid $\text{FC(F)c1nn1(C)cc1C(=O)O}$ RLOHO8NEYHBZID-UHFFFAOYSA-N | ![Structural formula](https://example.com/structure.png) |

IUPAC: International Union of Pure and Applied Chemistry; SMILES: simplified molecular-input line-entry system; InChiKey: International Chemical Identifier Key.

(a): The metabolite name in bold is the name used in the conclusion.
(b): ACD/Name 2020.2.1 ACD/Labs 2020 Release (File version N15E41, Build 116563, 15 June 2020).
(c): ACD/ChemSketch 2020.2.1 ACD/Labs 2020 Release (File version C25H41, Build 121153, 22 March 2021).