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The 2019 European Union report on pesticide residues in food

European Food Safety Authority (EFSA),
Luis Carrasco Cabrera and Paula Medina Pastor

Abstract

Under European Union legislation (Article 32, Regulation (EC) No 396/2005), the EFSA provides an annual report which examines pesticide residue levels in foods on the European market. This report is based on data from the official national control activities carried out by EU Member States, Iceland and Norway and includes a subset of data from the EU-coordinated control programme which uses a randomised sampling strategy. For 2019, 96.1% of the overall 96,302 samples analysed fell below the maximum residue level (MRL), 3.9% exceeded this level, of which 2.3% were non-compliant, i.e. samples exceeding the MRL after taking the measurement uncertainty into account. For the subset of 12,579 samples analysed as part of the EU-coordinated control programme, 2.0% exceeded the MRL and 1.0% were non-compliant. To assess acute and chronic risk to consumer health, dietary exposure to pesticide residues was estimated and compared with health-based guidance values. The findings suggest that the residue levels for the food commodities analysed are unlikely to pose any concern for consumer health. However, a number of recommendations are proposed to increase the effectiveness of European control systems, thereby continuing to ensure a high level of consumer protection throughout the EU.

Keywords: pesticide residues, food safety, European Union, national monitoring programme, maximum residue levels, dietary exposure, risk assessment, acute, chronic

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Correspondence: DATA.Admin@efsa.europa.eu

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Summary

The 2019 EU report on pesticide residues in food provides an overview of the official control activities on pesticide residues carried out in the EU Member States,[1] Iceland and Norway. It summarises the results of both the EU-coordinated control programme (EUCP) and the national control programmes (NP). The report also includes the outcome of the risk assessment from both programmes.

The comprehensive analysis of the results from all reporting countries provides risk managers with a sound evidence base for designing future monitoring programmes and enabling appropriate decisions on which pesticides and food products should be targeted.

EU-coordinated control programme (EUCP)

The EUCP randomly samples the food products most consumed by EU citizens as indicated in the EUCP Regulation. A snapshot of the situation of pesticide residues present in those food products is provided. As it was the case last year, these results are presented in Annex I.[2] Conclusions and recommendations derived from the results remain within this report.

In the 2019 EUCP, 12 food products were selected: apples, head cabbages, lettuce, peaches, spinach, strawberries, tomatoes, oat grain, barley grain, wine (red or white), cow's milk and swine fat. The results were compared with those of 2016. A total of 12,579 samples were analysed for 182 pesticide residues: 158 in food of plant origin and 8 in food of animal origin (16 pesticide residues were to be analysed within food both of plant and animal origin). Of those samples analysed[3]:

- 6,674 or 53% were found to be without quantifiable levels of residues (residues < limit of quantification (LOQ)).
- 5,664 or 45% contained one or more pesticide residues in concentrations above the LOQ and below or equal to the Maximum Residue Levels (MRL).[4]
- 241 or 2% contained residue concentrations exceeding their respective MRL. Of these, 120 or 1.0% of the total samples were considered non-compliant, when the measurement uncertainty was taken into account.

As most of the 12 selected food commodities had also been included in the 2016 EUCP, a comparison between the individual MRL exceedance rate resulted in an increase in this parameter from 2016 to 2019 in strawberries (from 1.8% to 3.3%), head cabbages (from 1.1% to 1.9%), wine grapes[5] (from 0.4% to 0.9%) and swine fat (from 0.1% to 0.3%). However, the rate of exceedances fell in 2019 compared to 2016 for peaches (from 1.9% to 1.5%), lettuce (from 2.4% to 1.8%), apples (from 2.7% to 2.1%) and tomatoes (from 2.6% to 1.7%). Cattle milk remains steady with no MRL exceedances in both years. Spinach was not sampled since 2014 and oat grain since 2013; therefore, neither of these two commodities were compared with previous monitoring programmes. Also, for barley grain, which was new to the programme, no comparison was possible.

The following pesticides, not approved in the EU, were found on samples of crops grown in the EU and falling in the EUCP with levels above the limit of quantification taking the measurement uncertainty into account and therefore non-compliant with maximum residue levels: acephate (RD), carbofuran (RD), chlorfenapyr (RD), chlorothalonil (RD), chlorpropham (RD), clothianidin (RD), cyfluthrin (RD), dieldrin (RD), iprodione (RD), methomyl (RD), oxadixyl (RD), triadimefon (RD). Non-approved pesticide residues were found to be non-compliant on imported samples: acephate (RD), chlorfenapyr (RD), clothianidin (RD), dichlorvos (RD), fipronil (RD), permethrin (RD) and thiamethoxam (RD).

Amongst the commodities of animal origin (i.e. swine fat and cattle milk), fat soluble persistent organic pollutant pesticides (i.e. DDT(RD) and dieldrin (RD)) were the substances most frequently detected and quantified. These substances are no longer used as pesticides but are very persistent in

[1] As of 31 January 2020, the United Kingdom became a third country. The United Kingdom data have been included and evaluated in the present report because in 2019 the EU requirements on data sampling applied still to them.

[2] A dedicated website where EUCP results are presented: https://www.efsa.europa.eu/en/annual-pesticides-report-2019

[3] These samples comprised those provided by EU-MS, Norway and Iceland. It excludes those of baby food samples requested under the EUCP.

[4] The 'maximum residue level' (MRL) is defined as the upper legal level of concentration for a pesticide residue in or on food or feed set in accordance with Regulation (EC) No 396/2005, based on good agricultural practice and the lowest consumer exposure necessary to protect vulnerable consumers.

[5] Wine was listed as the commodity to be sampled in 2019 EUCP. However, when checking MRL compliance, Member States competent authorities do so on the MRLs set on grapes intended for wine production.

the environment and can therefore still be found in the food chain today. Regarding MRL exceedances, pirimiphos-methyl (RD) was identified in two swine fat samples.

EU-coordinated and national programmes (EUCP + NP)

The overall EU pesticide monitoring programmes for 2019 incorporate both the results of the EU-coordinated control programme (EUCP) and the individual national programmes, as implemented by the 28 Member States, Iceland and Norway. The data analysis of this section is not presented in Annex I but remains in the text of this report.

The reporting countries (EU Member States, Iceland and Norway) analysed 96,302 samples, an increase of 5.8% compared to 2018 and of 9.1% compared to 2017. In total, 799 pesticides were analysed and on average, 233 per sample (239 pesticides in 2018).

Overall, the number of samples that fell within the legal limit (i.e. the measured residue levels did not exceed the MRLs permitted in EU legislation) remains similar in comparison with the previous year (96.1% in 2019 vs. 95.5% in 2018). MRLs were exceeded in 3.9% of the samples analysed (whereas this figure was 4.5% in 2018). When considering the measurement uncertainty, 2.3% of all samples analysed (2,252 samples) triggered legal sanctions or administrative actions. This is lower than last year's value of 2.7%.

The proportion of samples from reporting countries compared to third countries also remains steady. However, the slight increase in the number of samples of unknown origin (11.3% in 2019 vs. 10.1% in 2018) raises concerns regarding the reason for the lack of reporting of this information.

Exceedances remain higher for unprocessed food than for processed food (4% vs. 2.8%, respectively).

Reporting countries analysed 1,513 samples of foods for infants and young children. The incidence of samples with no quantifiable residues was 97.8%, a figure greater than in the previous 2 years (90.3% in 2018 and 94.6% in 2017) whereas samples with quantified residues (those at or above the LOQ but below or at the MRL) were found at a lower incidence in 2019 (0.9%) compared to 2018 (9.7%). MRL exceedances remained constant over the 2 years (1.3%).

Of 6,048 samples of organic food analysed, 5,254 samples did not contain quantifiable residues (86.9% of the analysed samples vs. 84.8% in 2018); 718 samples contained quantified residues but below or at the MRL level (11.8% vs. 13.8% in 2018) and 76 samples were reported with residue levels above their corresponding MRLs (1.3% vs. 1.4% in 2018), of which 0.5% (31 samples) were non-compliant in 2019, the same rate as in 2018. Compared to conventionally produced food (or non-organic food), the levels of MRL exceedance and samples with quantified residues tend to be generally lower in organic food. However, with respect to animal products, in 2019, this trend has changed resulting in a higher incidence of samples with measurable residues (mainly due to hexachlorobenzene, DDT, thiacloprid and copper) in organic samples (15%) than in conventional production samples (6%).

The number of samples of animal origin reported in 2019 was 16,090. The results showed that 14,669 samples were free of quantifiable residues (91.2% vs. 87.8% in 2018) while 1,421 samples (8.8% vs. 12.2% in 2018) contained one or several pesticides in quantifiable concentrations. MRL exceedances were identified at a much lower rate (0.6% vs. 1.7% in 2018) than in the previous year. The most frequently quantified substances were persistent pesticides in the environment (e.g. DDT (RD), hexachlorobenzene (RD), beta-hexachlorocyclohexane (RD)), by-products of chlorine solutions or biocides (e.g. BAC (RD), DDAC (RD), chlorates (RD)), fipronil in eggs and in animal fat food products and chlorpyrifos in animal kidney.

Of 1,301 samples of honey and other apicultural products analysed, 1,024 samples (78.7%) were found without quantifiable residues. In 265 samples (20.4%), residues at or above the LOQ but below or at the MRL were identified. MRL exceedances were reported in 12 samples (0.9%) of which five samples (0.4%) were found to be non-compliant. Overall, these findings in honey and other apicultural products concerned neonicotinoids (e.g. thiacloprid, acetamiprid) and veterinary medicinal residue products (e.g. amitraz, coumaphos).

The frequency of samples with multiple residues (i.e. containing more than one pesticide residue in quantifiable concentration) in food samples was higher in unprocessed products (28%) compared to processed products (16.8%). Multiple residues were reported in 25,584 samples (27% vs. 29% in 2018).

Dietary exposure and risk assessment

Dietary exposure to pesticide residues is estimated by combining EU food consumption information from dietary surveys provided by EU Member States along with data for pesticide residues per food commodity.

Acute risk assessment

The acute risk assessment was carried out for the pesticide/food product combinations covered by the EUCP programme, using the conservative deterministic EFSA model, PRIMo revision 3.1. The deterministic approach used for this calculation is based on conservative model assumptions. Samples taken under the EUCP were pooled with those from national programmes matching the EUCP pesticide/crop combinations in order to have a more representative number of samples. Overall, 19,767 samples were assessed for acute exposure for the 182 pesticide residues covered in the EUCP. For six of those pesticides, no acute health-based guidance value was available, and therefore, consumer risk could not be assessed. For 38 pesticides, the setting of an acute reference dose (ARfD) was not relevant. For 24 pesticides, there were no quantified results in the samples. Assessment of 87 pesticides with quantified levels was below their corresponding acute health-based guidance values. The remaining 28 pesticides revealed residue levels that exceeded the acute health-based guidance value in 170 samples (0.9%). The food products with observed exceedances (in descending order) were apples (45 samples), lettuce (41 samples), peaches (40 samples), tomatoes (24 samples), spinach (13 samples), strawberries (6 samples) and head cabbage (1 sample). There were no results exceeding the available health-based guidance values for acute exposure observed in cereal grains (barley and oat), wine or animal commodities (swine fat and cow's milk). The pesticides which most frequently exceeded the ARfD were chlorpyrifos (RD) (29 samples), lambda-cyhalothrin (RD) (21), pyraclostrobin (RD) (20), deltamethrin (RD) (16), tebuconazole (RD) (16) and acetamiprid (RD) (13).

Based on the above deterministic method which uses several conservative assumptions to assess acute exposure and on the fact that under the European Rapid Alert System samples may be withdrawn from the market when there is a non-compliant result and/or an exceedance of the health-based guidance value (ARfD), EFSA considers that the limited number of exceedances of the ARfD would pose concerns for consumer health is unlikely. Nevertheless, in future reports on pesticide residues in food, the deterministic exposure assessments will be accompanied by probabilistic assessments to single substances allowing to quantify better the possible risk encountered, and the uncertainties associated.

Chronic risk assessment

EFSA also estimated the chronic exposure to pesticides for which residue concentrations were reported for all food products using the PRIMo revision 3.1 model. The assessment was based on results submitted for the 182 pesticide residues covered by the EUCP and analysed in 79,895 samples (comprised of those samples from both the EUCP and the national programmes). This covered all unprocessed products from Annex I (part A) of Regulation (EC) No 396/2005 for which consumption data were available in the PRIMo model.

Three scenarios were calculated. The lower bound scenario – which assumes that if the residue is not quantifiable, it is not present in the food product analysed. The adjusted upper bound scenario – which assumes that even if not quantified, residues are present at the level of LOQ (for all pesticide/commodity combinations for which residues above the LOQ were found in at least one sample) – and the adjusted middle bound scenario which assumes that even if not quantified, residues are present at the level of half the LOQ.

In general, the estimated exposure was notably lower in the lower bound scenario compared to the adjusted upper bound approach. EFSA noted that the high proportion of samples with pesticide residues below the limit of quantification (LOQ), may result in particularly high upper bound exposure values due to the assumption that even if not quantified, residues are present in all samples at the level of LOQ. This ensures a high level of conservatism within the exposure assessment methodology, basing it on the sensitivity of the analytical equipment used and the LOQ value derived. Furthermore, high LOQs explain the differences in the exposure estimates between the lower bound and the middle/upper bound scenarios.

Based on the analysis of different food commodities, EFSA concludes that according to current scientific knowledge, chronic dietary exposure to the 182 pesticide residues of the 2019 EUCP is unlikely to pose any concern for EU consumer health.

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1. Background

1.1. Legal Basis

Pesticide residues,[6] resulting from the use of plant protection products[7] on crops or food products that are used for food, can potentially pose a risk to public health. For this reason, a comprehensive legislative framework has been established in the European Union (EU), which defines rules for the approval of active substances used in plant protection products,[8] their use and their residues in food. In order to ensure a high level of consumer protection, legal limits, or so-called 'maximum residue levels'[4], are established in Regulation (EC) No 396/2005[9]. EU-harmonised MRLs are set for more than 1,300 pesticides covering 378 food products/food groups. A default MRL of 0.01 mg/kg is applicable to nearly 690 of these pesticides which are not explicitly mentioned in the MRL legislation. Regulation (EC) No 396/2005 imposes the obligation on Member States to carry out controls to ensure that food placed on the market is compliant with the legal limits. This regulation establishes both EU and national control programmes:

- EU-coordinated control programme: this programme defines the food products and pesticides that should be monitored by all Member States. The EU-coordinated programme (EUCP) relevant for the calendar year 2019 was set up in Commission Implementing Regulation (EU) No 2018/555[10] hereafter referred to as '2019 EUCP Regulation' or '2019 monitoring programme',
- National control programmes: Member States usually define the scope of national control programmes, focussing on certain products, which are expected to contain residues in concentrations exceeding the legal limits, or on products that are more likely to pose risks for consumer safety (Article 30 of Regulation (EC) No 396/2005).

According to Article 31 of Regulation (EC) No 396/2005, Member States are requested to share the results of the official controls and other relevant information with the European Commission, EFSA and other Member States by the 31 August each year. Regulation (EU) 2017/625[11] in its Article 113, sets the 31 August each year for the submission of a report containing aggregated data on the number of official controls carried out by each Member State. For them to comply with both Regulations and make best use of the data submitted, EFSA recommends anticipating the deadline for the submission of the pesticide residue data under EFSA ChemMon data collection, to the 30 June every year.

Under Article 32 of the above-mentioned Regulation, EFSA is responsible for preparing an Annual Report on pesticide residues, analysing the data in view of the MRL compliance of food available in the EU and the exposure of European consumers to pesticide residues. In addition, based on these findings, EFSA derives recommendations for future monitoring programmes.

[6] The term pesticide residue is used throughout this report and supplementary documents (the MRL exceedance supplement and the PRIMo exposure assessment) to refer to measurable amounts of an active substance and/or related metabolites and/or degradation products that can be found on harvested crops or in foods of animal origin.

[7] The term plant protection products (PPP) used throughout this report and supplementary documents pertains to a product containing an active substance and other substances added and/or their products to ensure, among others, plant protection against harmful organisms, influence their life processes (e.g. growth regulators), destroy or prevent growth of undesired plants or parts of them in the fields, etc.

[8] 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.

[9] 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.

[10] Commission Implementing Regulation (EU) 2018/555 of 9 April 2018 concerning a coordinated multiannual control programme of the Union for 2019, 2020 and 2021 to ensure compliance with maximum residue levels of pesticides and to assess the consumer exposure to pesticide residues in and on food of plant and animal origin. OJ L 92, 10.4.2018, p. 6–18.

[11] Regulation (EU) 2017/625 of the European Parliament and of the Council of 15 March 2017 on official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products, amending Regulations (EC) No 999/2001, (EC) No 396/2005, (EC) No 1069/2009, (EC) No 1107/2009, (EU) No 1151/2012, (EU) No 652/2014, (EU) 2016/429 and (EU) 2016/2031 of the European Parliament and of the Council, Council Regulations (EC) No 1/2005 and (EC) No 1099/2009 and Council Directives 98/58/EC, 1999/74/EC, 2007/43/EC, 2008/119/EC and 2008/120/EC, and repealing Regulations (EC) No 854/2004 and (EC) No 882/2004 of the European Parliament and of the Council, Council Directives 89/608/EEC, 89/662/EEC, 90/425/EEC, 91/496/EEC, 96/23/EC, 96/93/EC and 97/78/EC and Council Decision 92/438/EEC (Official Controls Regulation). OJ L 95, 7.4.2017, p. 1–142.

Specific MRLs are set in Directives 2006/125/EC[12] and 2006/141/EC[13] for food intended for infants and young children. Following the precautionary principle, the legal limit for these types of food products was set at a low level (limit of quantification); in general, a default MRL of 0.01 mg/kg is applicable unless lower legal limits for the residue levels are defined in these Directives. Regulation (EU) No 609/2013[14] repeals the aforementioned Directives; however, the pesticide MRLs of Directive 2006/125/EC and 2006/141/EC were still applicable in 2019.

It is noted that some of the active substances for which legal limits are set under Regulation (EC) No 396/2005 are also covered by Commission Regulation (EU) No 37/2010 on pharmacologically active substances.[15] For these so-called dual use substances, Member States perform controls in accordance with Council Directive 96/23/EC[16] for veterinary medicinal products (VMPR). Results of the controls for dual use substances[17] are reported within this report if the Competent Authority has flagged as so in the remit of the ChemMon data collection (EFSA, 2020a). Otherwise, results are reported in another EFSA output on VMPR residues (EFSA, 2021b).

It should be highlighted that for organic products no specific MRLs are established. Thus, the MRLs set in Regulation (EC) No 396/2005 apply equally to organic food and to conventional food. However, Article 5 of Regulation (EC) No 889/2008[18] on organic production of agricultural products defines the restrictions in place for the use of plant protection products.

Regulation (EC) No 669/2009[19] repealed in late 2019 by Regulation(EU) 2019/1793[20] lays down rules concerning the increased level of official controls to be carried out on a list of food of non-animal origin and feed which based on known or emerging risks, requires increased levels of controls prior to their introduction into the EU. The food products, the country of origin of the products, the frequency of checks to be performed at the point of entry into the EU territories and the hazards (e.g. pesticides residues, not approved food additives, mycotoxins) are specified in Annex I to this regulation which is regularly updated; for the calendar year 2019, four updated versions are relevant.[21,22,23,24]

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[12] Commission Directive 2006/125/EC of 5 December 2006 on processed cereal-based foods and baby foods for infants and young children. OJ L 339, 6.12.2006, p. 16–35.

[13] Commission Directive 2006/141/EC of 22 December 2006 on infant formulae and follow-on formulae and amending Directive 1999/21/EC. OJ L 401, 30.12.2006, p. 1–33.

[14] Regulation (EU) No 609/2013 of the European Parliament and of the Council of 12 June 2013 on food intended for infants and young children, food for special medical purposes, and total diet replacement for weight control and repealing Council Directive 92/52/EEC, Commission Directives 96/8/EC, 1999/21/EC, 2006/125/EC and 2006/141/EC, Directive 2009/39/EC of the European Parliament and of the Council and Commission Regulations (EC) No 41/2009 and (EC) No 953/2009. OJ L181, 29.6.2013, p. 35–56.

[15] Commission Regulation (EU) No 37/2010 of 22 December 2009 on pharmacologically active substances and their classification regarding maximum residue limits in foodstuffs of animal origin. OJ L 015 20.1.2010, p. 1.

[16] Council Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products and repealing Directives 85/358/EEC and 86/469/EEC and Decisions 89/187/EEC and 91/664/EEC. OJ L 125, 23.5.1996, p. 10.

[17] The comprehensive results from the monitoring of veterinary medicinal product residues and other substances in live animals and animal products are published in a separate report (EFSA, 2020a).

[18] Commission Regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control. OJ L 250, 18.9.2008, p. 1–84.

[19] Commission Regulation (EC) No 669/2009 of 24 July 2009 implementing Regulation (EC) No 882/2004 of the European Parliament and of the Council as regards the increased level of official controls on imports of certain feed and food of non-animal origin and amending Decision 2006/504/EC. OJ L 194, 25.7.2009, p. 11–21.

[20] Commission Implementing Regulation (EU) 2019/1793 of 22 October 2019 on the temporary increase of official controls and emergency measures governing the entry into the Union of certain goods from certain third countries implementing Regulations (EU) 2017/625 and (EC) No 178/2002 of the European Parliament and of the Council and repealing Commission Regulations (EC) No 669/2009, (EU) No 884/2014, (EU) 2015/175, (EU) 2017/186 and (EU) 2018/1660. OJ L 277, 29.10.2019, p. 89–129.

[21] Commission Implementing Regulation (EU) 2018/1660 of 7 November 2018 imposing special conditions governing the import of certain food of non-animal origin from certain third countries due to the risks of contamination with pesticides residues, amending Regulation (EC) No 669/2009 and repealing Implementing Regulation (EU) No 885/2014. OJ L 278, 8.11.2018, p. 7–15.

[22] Commission Implementing Regulation (EU) 2019/35 of 8 January 2019 amending Regulation (EC) No 669/2009 implementing Regulation (EC) No 882/2004 of the European Parliament and of the Council as regards the increased level of official controls on imports of certain feed and food of non-animal origin. OJ L 9, 11.1.2019, p. 77–84.

[23] Commission Implementing Regulation (EU) 2019/890 of 27 May 2019 imposing special conditions governing the import of groundnuts from Gambia and Sudan and amending Regulation (EC) No 669/2009 and Implementing Regulation (EU) No 884/2014. OJ L 142, 29.5.2019, p. 48–5.

[24] Commission Implementing Regulation (EU) 2019/1249 of 22 July 2019 amending Annex I to Regulation (EC) No 669/2009 implementing Regulation (EC) No 882/2004 of the European Parliament and of the Council as regards the increased level of official controls on imports of certain feed and food of non-animal origin OJ L 195, 23.7.2019, p. 5–12.

1.2. Terms of Reference

In accordance with Article 32 of Regulation (EC) No 396/2005, EFSA shall prepare an annual report on pesticide residues concerning the official control activities for food carried out in 2019.

The annual report shall include at a minimum the following information:

- an analysis of the results of the controls on pesticide residues provided by EU Member States,
- a statement of the possible reasons why the MRLs were exceeded, together with any appropriate observations regarding risk management options,
- an analysis of chronic and acute risks to the health of consumers from pesticide residues,
- an assessment of consumer exposure to pesticide residues based on the information provided by Member States and any other relevant information available, including reports submitted under Directive 96/23/EC[25].

In addition, the report may include an opinion on the pesticides that should be included in future monitoring programmes.

2. Introduction

This report provides a detailed insight into the control activities at European level and the results from the official control activities performed by the EU Member States,[1] including Iceland and Norway as members of the European Free Trade Association (EFTA) and of the European Economic Area (EEA). The main purpose of the data analysis presented in this report is to give risk managers the necessary information to decide on risk management issues. At the same time, the report aims to address questions such as:

- How frequently were pesticide residues found in food?
- Which food products frequently contained pesticide residues?
- Compared with previous years, are there any notable changes?
- In which products were violations of the legal limits identified by the Member States?
- What actions were taken by the national competent authorities responsible for food control to ensure that pesticide residues in food not complying with the European food standards are not placed on the EU market?
- Do the residues in food pose a risk to consumer health?

This report aims to answer these questions in a way that can be understood without deep knowledge on the subject. Furthermore, EFSA developed a data visualisation tool to help end-users gain insights from the vast amount of data underpinning this report. The 2019 EU-coordinated programme results, as defined by Commission Implementing Regulation (EU) No 2018/555[11] are presented in Annex I,[226] An overall evaluation can still be found in Section 3 of this report, but the figures and tables will be in the Annex I. The design and analysis of the national control programmes results are reported in Section 4 of this report. The results of the dietary exposure assessments for individual pesticides are described in Section 5. The raw data provided by reporting countries and anonymised by EFSA can also be downloaded from the Open Science platform Zenodo[27] by typing: 'Member-State-Name results from the monitoring of pesticide residues in food'.

Furthermore, separate annexes will be published in Zenodo under the same link.[28] These are: Annex II: full list of samples exceeding the MRLs, anonymised previously for the sample code, including information on the measured residue concentrations and the origin of the samples, Annex III: PRIMo file containing the results of the exposure assessment and Annex IV: 2019 analytical scope covered by the official laboratories reporting pesticide residues to EFSA.

The websites of the national competent authorities can be seen in Appendix A of this report. In addition, EFSA compiled a technical report (EFSA, 2021c) containing the descriptive information of the

[25] Council Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products and repealing Directives 85/358/EEC and 86/469/EEC and Decisions 89/187/EEC and 91/664/EEC. OJ L 125, 23.5.1996, p. 10–32.

[26] In Annex I, the EUCP findings are presented. However, baby food samples requested under this Regulation, are excluded from the analyses and are presented in Section 4.2.6 of this report.

[27] https://zenodo.org/search?page=1&size=20&q=results%20from%20the%20monitoring%20of%20pesticide%20residues%20in%20food

[28] https://doi.org/10.5281/zenodo.4545606

pesticide monitoring activity by year and submitted by the reporting countries. Here further details at national level are provided.

3. EU-coordinated control programme

In compliance with the 2019 EU monitoring programme satisfying Regulation (EU) No 2018/555[9], reporting countries sampled and analysed specific pesticide/food product combinations, as set out in its Annex I. These included apples, head cabbages, lettuce, peaches, spinach, strawberries, tomatoes, oat grain, barley grain, wine (red or white), swine fat and cow's milk. These were compared with similar food products from the 2016 EU monitoring programme. Exceptions included barley grain, introduced for the first time in the present programme, spinach that was last requested in 2014 and oat grain last included in the 2013 programme. Leek was removed in 2019 compared to the 2016 programme. Pesticides from Member States national programmes were also provided for the present report, i.e. 182 pesticide residues. Further details on the list of pesticides covered by the 2019 EUCP are presented in Appendix B. Compared with the 2016 EUCP list (n = 165), the 2019 EUCP pesticide list had 18 additional pesticide residues (n = 182) and the removal of one (tolylfluanid (RD)).

In accordance with Annex II of the EUCP Regulation, samples were taken for each of the 12 food products mentioned in Annex I, from organic production systems, with a minimum of one. In total, 829 organic samples[29] were analysed. In addition, Annex II also requested Member States to test 10 samples of foods destined for infants and young children other than infant formulae, follow-on formulae and processed cereal-based baby food. The total number of samples reported under baby food categories amounted to 156 samples. A comprehensive analysis of these results is reported in Section 4.2.6 where the data for all baby food samples are pooled. This category of samples has not been included in Annex I[2].

Annex II of the above-mentioned Regulation also sets the minimum number of samples to be monitored per food product to 683 samples in order to estimate a minimum of 1% MRL exceedances with a margin of error of 0.75%. These numbers were distributed among EU Member States depending on their population size. The limits ranged from 12 to 97 samples per food product. Bearing in mind that EUCP samples are not only used to check for MRL compliance but also for carrying out deterministic and probabilistic exposure assessments to individual and multiple pesticides (see Section 5), EFSA recommends revisiting the calculation on the minimum number of samples to be taken by commodity as well as the manner in which they are distributed among EU MSs (EFSA, 2020b).

In compliance with the EUCP Regulation, 12,579[30] samples were analysed. In Annex I[2], the total number of samples taken by each reporting country is plotted together with a mark on the minimum number of samples required as stated in Annex II of the EUCP Regulation[9]. Romania, Italy, Germany, the Netherlands, Greece, Spain, Denmark, Hungary, Portugal and the United Kingdom sampled more than required. On the contrary, some Member States failed in coding properly their EUCP samples under the Chemical Monitoring data collection (EFSA, 2020a–e) appearing with a lower number of samples taken that what they really took. EFSA recommends Member States allowing enough time to carefully check their validation reports before accepting their data in EFSA's scientific Data Warehouse (sDWH) (EFSA, 2015d) and advices starting earlier the reporting season. For most commodities, the number of samples taken was above 683 (except for grains of barley and oats). The 2019 EUCP Regulation outlined that if insufficient grain samples of one type were available, then samples from the other type of grain could be taken. It also allowed whole grain flour to be taken. Either way, the minimum number was not reached.

Overall, in 53% of samples (6,674 out of the 12,579 samples analysed), no quantifiable levels of residues[31] were reported (residues were below the LOQ). The number of samples with pesticide residues within the legally permitted levels[32] (at or above the LOQ but below or at the MRL) was 5,664

[29] No organic samples were reported by Bulgaria, Lithuania and Poland.

[30] This number does not include samples of infant formulae and follow-on formulae which are presented in Section 4.2.6 of the report.

[31] In the context of this report, samples without quantifiable residues refer to results where the analytes were not present in concentrations at or exceeding the limit of quantification (LOQ). The LOQ is the smallest concentration of an analyte that can be quantified with any reliability. It is defined as the minimum concentration of the analyte in the test sample that can be determined with acceptable precision and accuracy.

[32] Samples with quantified residues within the legal limits (below or at the MRL) in the context of this report refers to samples containing quantified residues of one or several pesticides in concentrations below or at the MRL but above the limit of quantification.

(45%). MRLs were exceeded in 2% of samples (241 samples), 1.0% of which (120 samples) were found to be non-compliant based on the measurement uncertainty.[33]

Due to different commodities being sampled, there is no direct MRL exceedance rate comparison between the 2019 and 2016 programmes. Results organised by food commodity showed that a comparison between the individual MRL exceedance rates resulted in an increase from 2016 to 2019 in strawberries (from 1.8% to 3.3%), head cabbages (from 1.1% to 1.9%), wine grapes (from 0.4% to 0.9%) and swine fat (from 0.1% to 0.3%). The rate of exceedances fell in 2019 compared to 2016 for peaches (from 1.9% to 1.5%), lettuce (from 2.4% to 1.8%), apples (from 2.7% to 2.1%) and tomatoes (from 2.6% to 1.7%). Cow milk remains steady with no MRL exceedances in either programme years.

Among the EUCP commodities grown in the EU territory, the following non-EU approved pesticide residues (i.e. active substances that are not allowed to be used in plant protection products applied on commodities grown in the EU), were reported to be non-compliant: acephate (RD), carbofuran (RD), chlorfenapyr (RD), chlorothalonil (RD), chlorpropham (RD), clothianidin (RD), cyfluthrin (RD), dieldrin (RD),, iprodione (RD), methomyl (RD), oxadixyl (RD), triadimefon (RD). Among the EUCP samples grown outside the internal market, the following non-EU approved pesticides were found to be non-compliant in acephate (RD), chlorfenapyr (RD), clothianidin (RD), dichlorvos (RD),, fipronil (RD), permethrin (RD), thiamethoxam (RD).

Among commodities of animal origin (i.e. swine fat and cattle milk), fat soluble persistent organic pollutant pesticides (i.e. DDT(RD) and dieldrin (RD)) were the substances most frequently quantified. These substances are no longer used as pesticides but are very persistent in the environment and can therefore still be found in the food chain. MRL exceedances were identified for pirimiphos-methyl (RD) in two swine fat samples.

Detailed analysis by commodity is presented in Annex I.[2]

4. Overall monitoring programmes (EUCP and national programmes)

This chapter incorporates both the results of the EU-coordinated control programme (EUCP) and the national programmes, as implemented by the 28 Member States, Iceland and Norway. The data analysis of this section is not presented in Annex I but is instead presented here, in the text of this report.

Compared with the EUCP, the national control programmes are risk-based in accordance with Article 30 of Regulation (EC) No 396/2005. The focus is set on products likely to contain pesticide residues or for which MRL infringements were identified in previous monitoring programmes. These programmes are not designed to provide statistically representative results for residues expected in food placed on the European market. The reporting countries define the priorities for their national control programmes taking into account several factors including: the importance of food products in trade or in the national diets, products with historically high residue prevalence or non-compliance rates in previous years, the use pattern of pesticides and national laboratory capacities. The number of samples and/or the number of pesticides analysed by any reporting country is determined by the capacities of their national control laboratories and available budget resources. The results of national control programmes are not always comparable because the specific needs in each country, its dietary habits and access to local produce along with the particular targeting of national control programmes may differ.

Within the framework of each national control programme, some reporting countries provide results of import controls performed under Regulation (EC) No 669/2009 and Regulation (EU) No 2019/1793. These specific import controls are *inter alia* based on previously observed high incidences of non-compliant products imported from certain countries from outside the European Union. Some of these controls may feed into the Rapid Alert System for Food and Feed of the European Commission. These Regulations defines the percentage of lots to be analysed. This means that if not sampled at the EU border the consignment can enter the EU market and be consumed.

[33] Non-compliant samples in the context of this report refers to samples containing residue concentrations clearly exceeding the legal limits, considering the measurement uncertainty. The concept of measurement uncertainties and the impact on the decision of non-compliance is described in Figure 1 of the 2018 guidance document on reporting data on pesticide residues (EFSA, 2018a). It is required in official controls that the uncertainty of the analytical measurement is considered before legal or administrative sanctions are imposed on food business operators for infringement of the MRL legislation (Codex, 2006; Ellison and Williams, 2012).

The first part of this chapter (Section 4.1) gives an overview of the national programmes, highlighting the sample origin (e.g. domestic samples), type (e.g. processed, unprocessed), number of samples and pesticides tested per reporting country. In the second part of the chapter (Section 4.2), the results of these national control activities are analysed and discussed. The findings, in particular the MRL exceedances, are considered by risk managers to take decisions on designing the risk based national monitoring programmes, e.g. which pesticides should be covered by the analytical methods used to analyse food products, or which types of products should be included in the national control programmes in order to make the programmes more efficient. The findings are also a valuable source of information for food business operators and can be used to enhance the efficiency and safety of self-control systems.

4.1. Overview of the EUCP and national monitoring programmes

In 2019, a total of 96,302 samples[34] of food products covered by Regulation (EC) No 396/2005 were analysed for pesticide residues by 30 reporting countries. The total number of samples analysed in 2019[35] (Figure 1) increased by 5.8% compared to 2018 (91,015 samples) and by 9.1% compared to 2017 (88,247 samples). The frequency of sampling per 100,000 inhabitants per reporting country is presented in Figure 2. Information on the origin of samples included in the 2019 programme is presented in Figure 3.

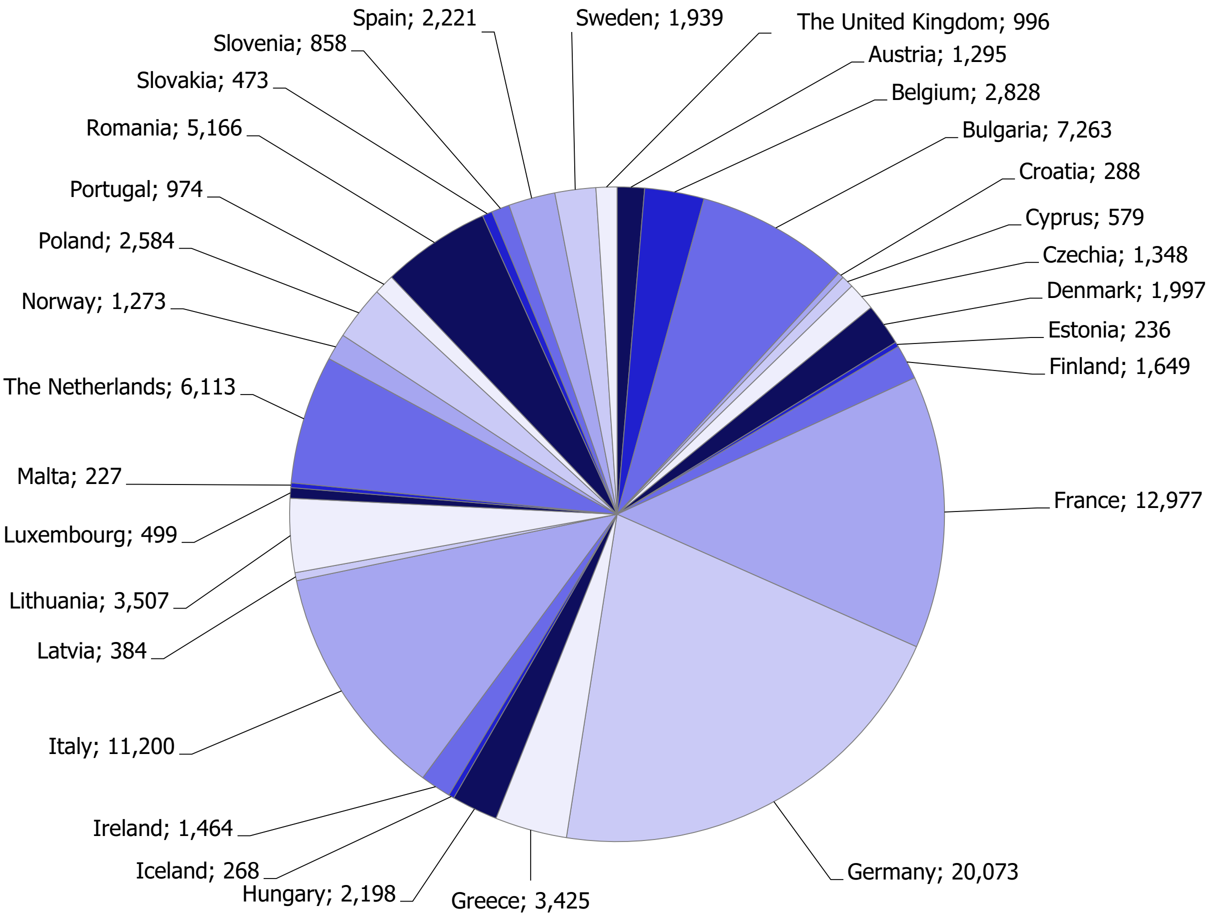

Figure 1: Number of samples analysed per reporting country[36]

[34] In addition to these 96,302 samples, 17 Member States reported 1,309 samples of feed and 1,332 samples of fish to EFSA. However, as no MRLs are applicable for feed or fish under Regulation (EC) No 396/2005, these samples were not considered in 2019's overall monitoring analysis of the results.
[35] In this section the national and EUCP samples are pooled and analysed together.
[36] Baby food samples are included in this chart along with all the others in this chapter unless otherwise stated.

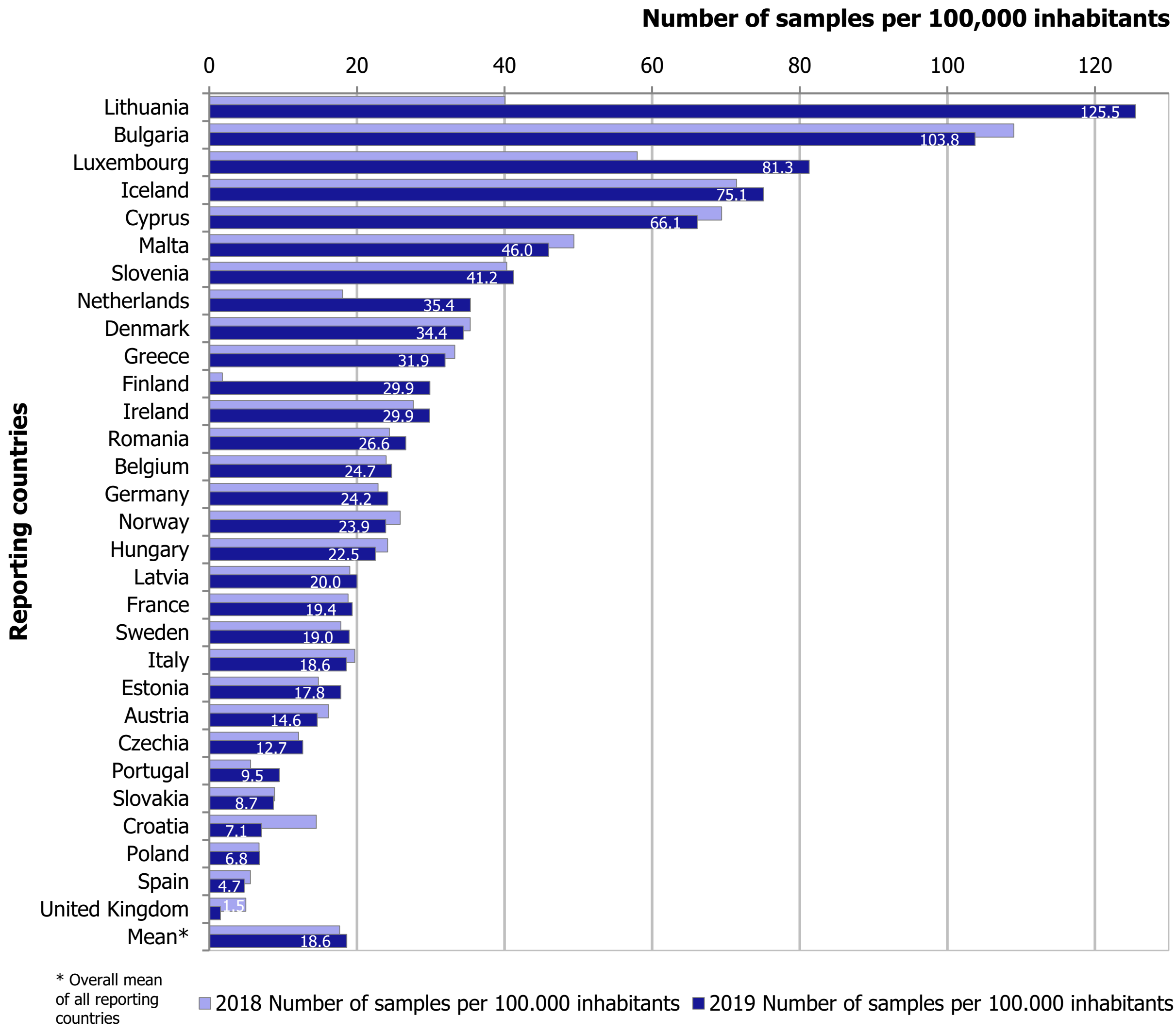

Figure 2: Number of samples normalised per number of inhabitants[37]

[37] Under the ChemMon data collection, Belgium reported all analytical results on animal products (with the exception of samples analysed in the framework of the EUCP), under VMPR report (EFSA, 2021b) consequently, are not reflected in this report.

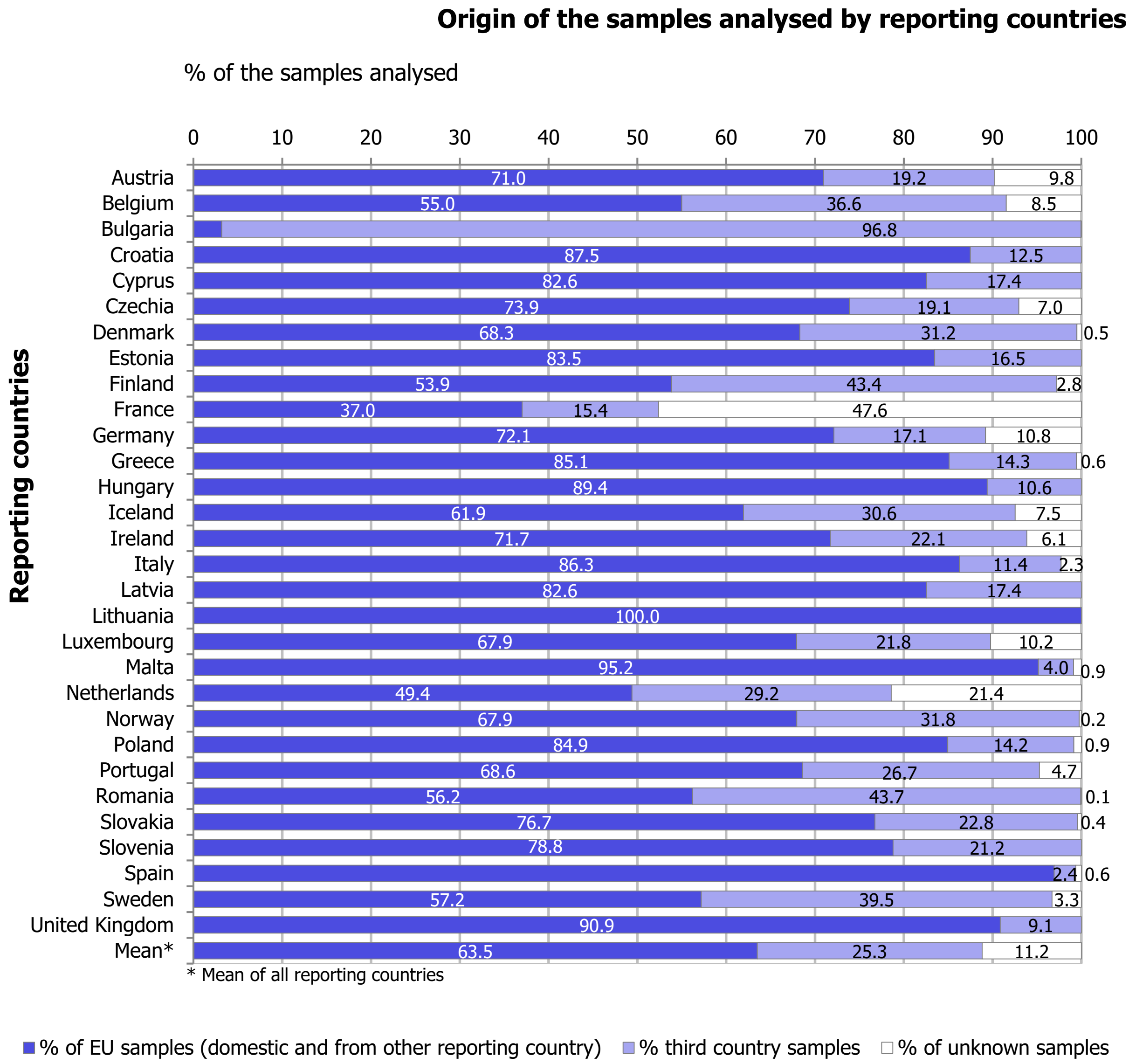

Figure 3: Origin of samples per reporting country

Overall, 61,083 samples (63.4%) originated from EU reporting countries (EU MS, Norway and Iceland), 24,347 samples (25.3%) concerned products imported from third countries and for 10,872 samples (11.3%) no food-product origin was reported. A more detailed analysis of the origin of these samples is presented in Figure 4.

The sampling rates of food produced in EU and in third countries remain practically steady from 2018 to 2019 (from 62.9% to 63.5%, respectively) as well as for third countries (from 26.9% to 25.3%, respectively). The countries with the highest sampling rates of imported products from third countries were Bulgaria (96.8%),[38] Romania (43.3%) and Finland (43.3%); Lithuania, Malta, Spain and the United Kingdom focussed mainly on domestic sampling (more than 90% of the samples analysed). Furthermore, even as the number of samples with unknown origin remains stable (10.1% in 2018 compared to 11.2% in 2019), it still accounts for a high percentage of the total. Of particular note, France reported nearly 50% of its samples (47.6%) as being of unknown origin.

[38] Bulgarian import controls at the border is much greater than their internal market controls, and also notably greater than in other EU Member States.

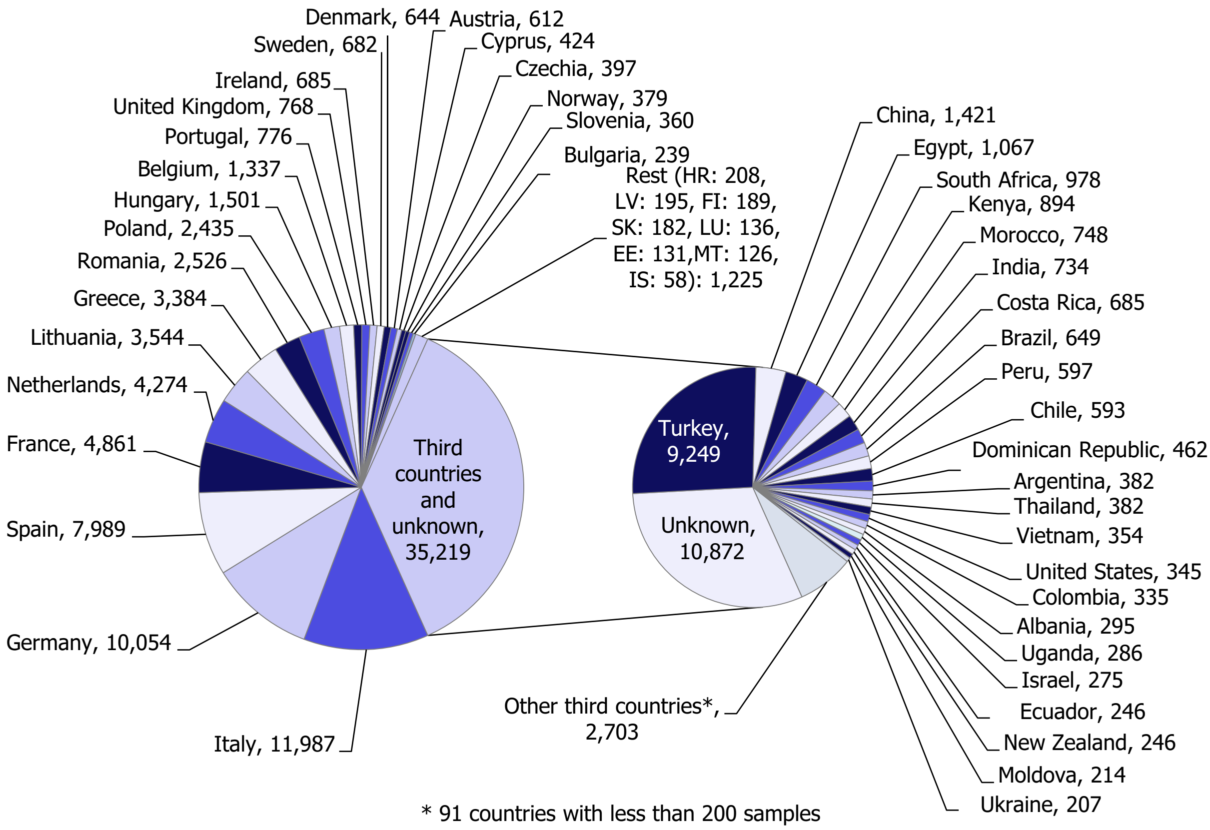

Figure 4: Origin of tested samples

As in previous years, a wide range of pesticides were analysed. Considering all samples, the reporting countries analysed in total, 799 different pesticides. A large analytical scope at country level was noted for Luxembourg (634 pesticides), Germany (617 pesticides), France (610 pesticides) and Belgium (606 pesticides). On average, 233 different pesticides were analysed per sample (239 pesticides in 2018) (Figure 5).

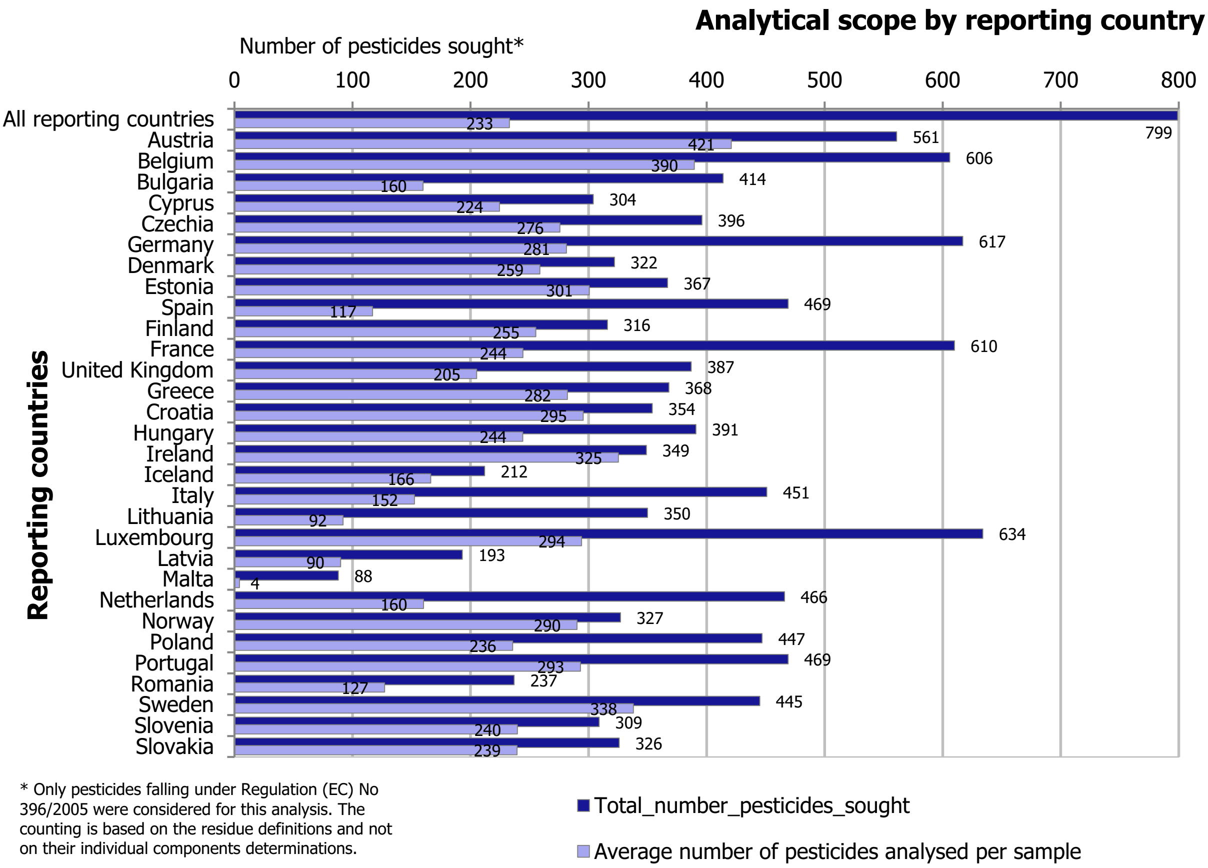

Figure 5: Number of pesticides analysed by reporting country[39]

The diversity of national control programmes needs to be kept in mind when comparing the results from different reporting countries. In the following sections, a detailed analysis of the national control programmes illustrates the various scopes of the national MRL enforcement strategies.

More information on the national control programmes can be found in a separate EFSA technical report that summarises the national results (EFSA, 2021c).

4.2. Results of the EUCP and national monitoring programmes

The results presented in these sections refer to complete data sets for unprocessed and processed food products, comprising results from surveillance samples (meaning samples that were taken without targeting specific growers/producers/importers or consignments likely to be non-compliant) and enforcement samples (where a suspect sampling or targeted strategy was applied). If an analysis is restricted to a subset of results, this is clearly indicated in the relevant section.

Overall, 96.1% of the 96,302 samples analysed in 2019 fell within the legal limits (92,577 samples); of these, 54,517 samples (56.6%) did not contain quantifiable residues (results below the LOQ for all pesticides analysed) while 39.5% of the samples analysed contained quantified residues not exceeding the legal limits (38,065 samples). In total, MRLs were exceeded in 3.9% of the samples analysed in 2019 (3,720 samples). When taking due consideration of the measurement uncertainty that is implemented by food regulatory authorities across Europe, it is found that 2.3% of all samples analysed in 2019 (2,252 samples) exceeded the legal limits, triggering legal sanctions or enforcement actions. These samples with clear exceedances or breaches of their respective MRLs are considered as non-compliant with the legal limits. (Figure 6).

The number of surveillance samples increased slightly in 2019 (85,719 samples, 89.0%) compared to 2018 (80,340 samples; 88.3%). The remaining 11.0% of cases in 2019 were enforcement samples (10,583 samples), practically the same level as observed in 2018 (10,675 samples; 11.7%).

[39] Malta aimed at reporting a higher number of pesticides sought and consequently a higher average on the number of pesticides analysed per sample. The correct numbers can be consulted on the National Summary Report (EFSA, 2021c).

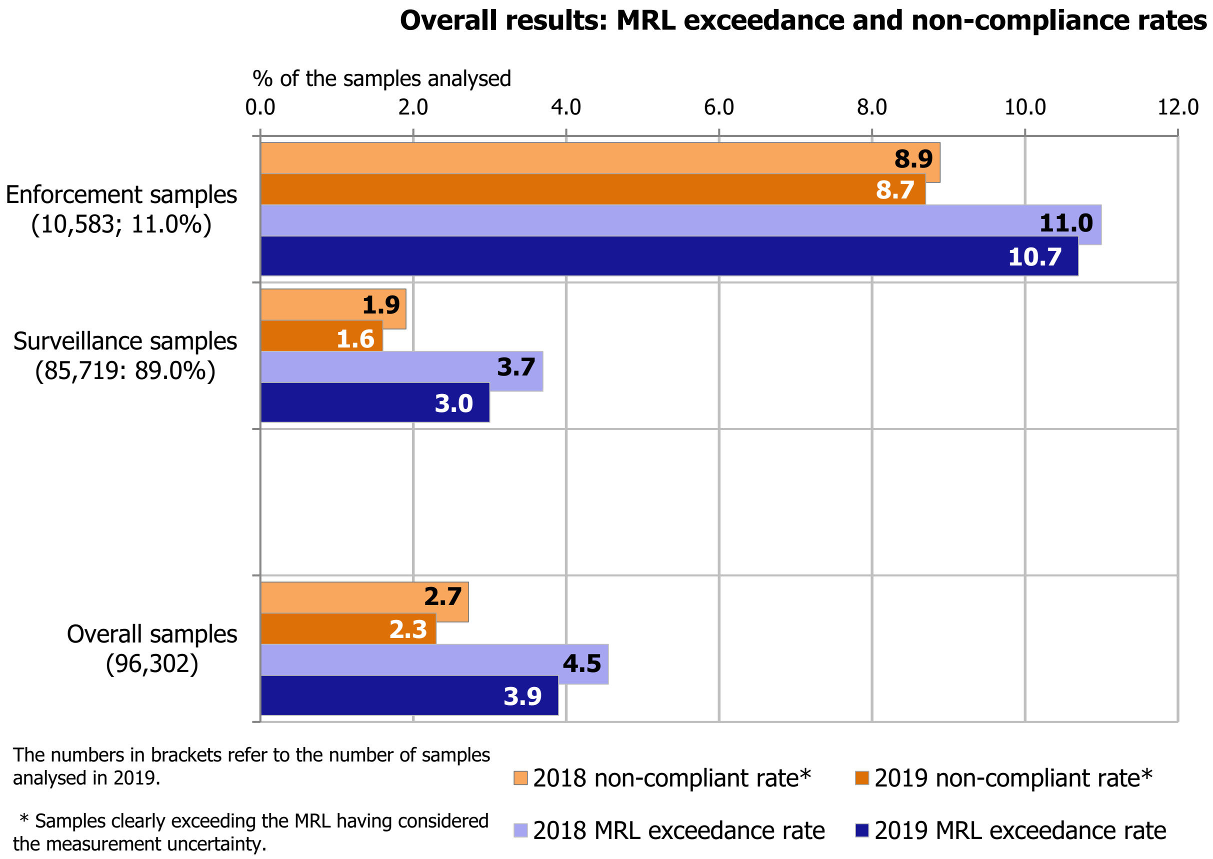

Figure 6: Percentage of non-compliant samples exceeding the MRL, organised by sampling strategy

Overall, MRL exceedance and non-compliance rates decreased slightly in 2019 in comparison with 2018. The MRL exceedance rate decreased from 4.5% in 2018 to 3.9% in 2019; the non-compliance rate decreased from 2.7% in 2018 to 2.3% in 2019.

The rates for surveillance samples regarding MRL exceedances (3.7% in 2018 and 3.0% in 2019) and non-compliances (1.9% in 2018 vs. 1.6% in 2019) also decreased slightly. Similarly, MRL exceedances for enforcement samples also showed a small decrease (11.0% in 2018 and 10.7% in 2019) as did samples with non-compliance results (8.9% in 2018 to 8.7% in 2019).

The number of surveillance samples[40] collected in 2019 (85,719 samples, 89.0%) was greater than in 2018 (80,340 samples; 88.3%) whereas the MRL exceedance rate was lower in 2019 (3.9%) than in 2018 (4.5%).

The required number of enforcement samples[41] taken in 2019 remained similar to that from the previous year (11% in 2019 vs. 11.7% in 2018). This means that following firm indications that certain food may be at higher risk as regards non-compliance or consumer safety, national regulatory authorities across Europe continue to play an important role and reinforce the need to verify the safety for public consumption of food samples and their compliance within the EU market.

4.2.1. Results broken down by country of food origin

In Figure 7, a comparison is presented between the MRL exceedances and non-compliance rate based on the origin of the sample.

From the 96,302 samples taken in 2019, 63.4% (61,083 samples) originated from one of the reporting countries (i.e. from EU Member States, Iceland and Norway) and 25.3% (24,347 samples) came from third countries. Samples with unknown origin increased slightly in 2019 to 11.3% compared to 10% in 2018 (9,234 samples). The country of origin for a sample is a very valuable piece of information for traceability purposes in the case of non-compliance. Food business operators should

[40] Surveillance samples were those falling under ST10A and ST20A sample strategy as define in EFSA's ChemMon Guidance (EFSA, 2020a).

[41] Enforcement samples were those falling under ST30A sample strategy as define in EFSA's ChemMon Guidance (EFSA, 2020a).

make sure this information is available to inspectors and is accessible throughout all stages of the entire food chain.

Of the 61,083 samples originating from one of the reporting countries, 58.3% were found to be below the LOQ while 39.0% contained residues at or above the LOQ but below or equal to the MRL; 2.7% of the samples exceeded the MRL and 1.3% was absolutely non-compliant with the MRL.

The 24,347 samples from third countries were found to have a higher MRL exceedance rate (7.8%) and a higher non-compliance level (5.6%) compared to food produced within the EU. The percentage of samples from third countries without quantifiable residues was 41.1% while the percentage of samples containing quantifiable residues within the legal limits was 51.1%.

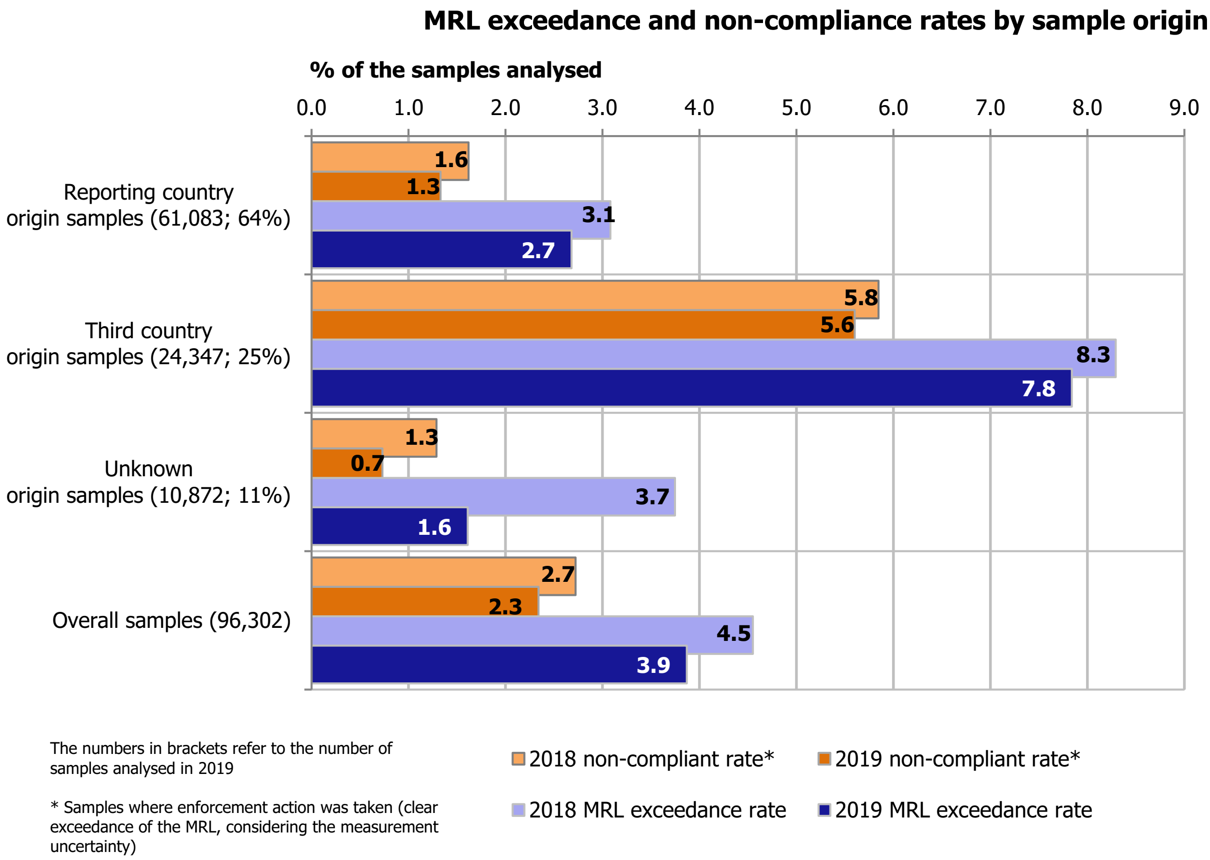

Figure 7: Percentage of samples exceeding the MRL and non-compliant by origin

Figures 8 and 9 plot detailed quantification and MRL exceedance rates for samples grown in reporting countries and samples from third countries, respectively. Results from 2018 are also plotted in both charts, allowing comparison with the 2019 results. The numbers in these plots need to be interpreted with caution when comparing monitoring results between countries with different priorities in the design of their national monitoring plans (e.g. more/less risk-based sampling, different national food trade interests, dietary habits, pattern of pesticides used in crops, etc.).

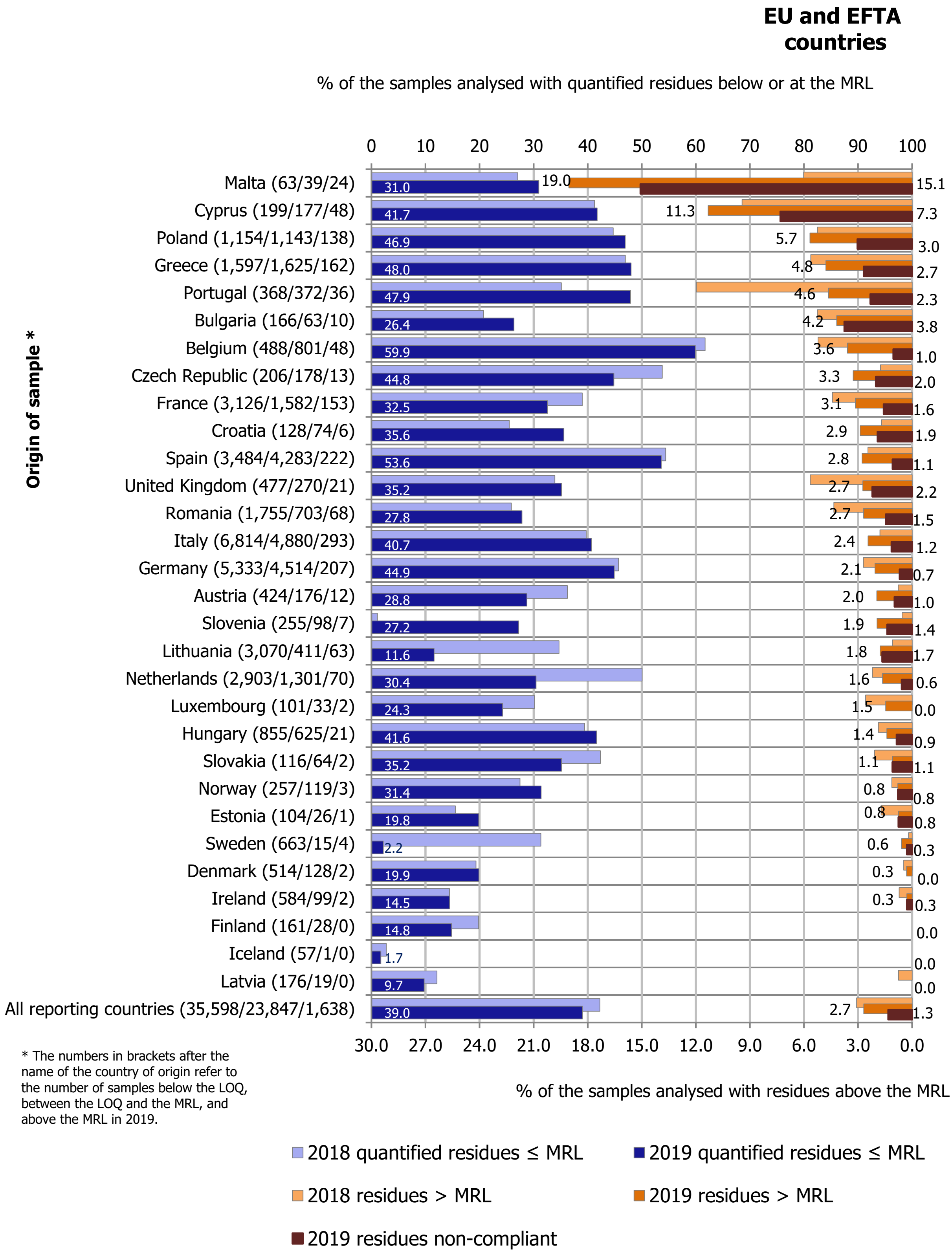

Figure 8: MRL exceedance and quantification rates by country of origin (reporting countries) together with non-compliant rate on the right margin

Among the reporting countries in Figure 8, the highest MRL exceedance rates were associated with products from Malta, Cyprus and Poland, with more than 5% of the samples exceeding the MRL. The non-compliant rate was the highest for products grown in Malta, Cyprus and Bulgaria.

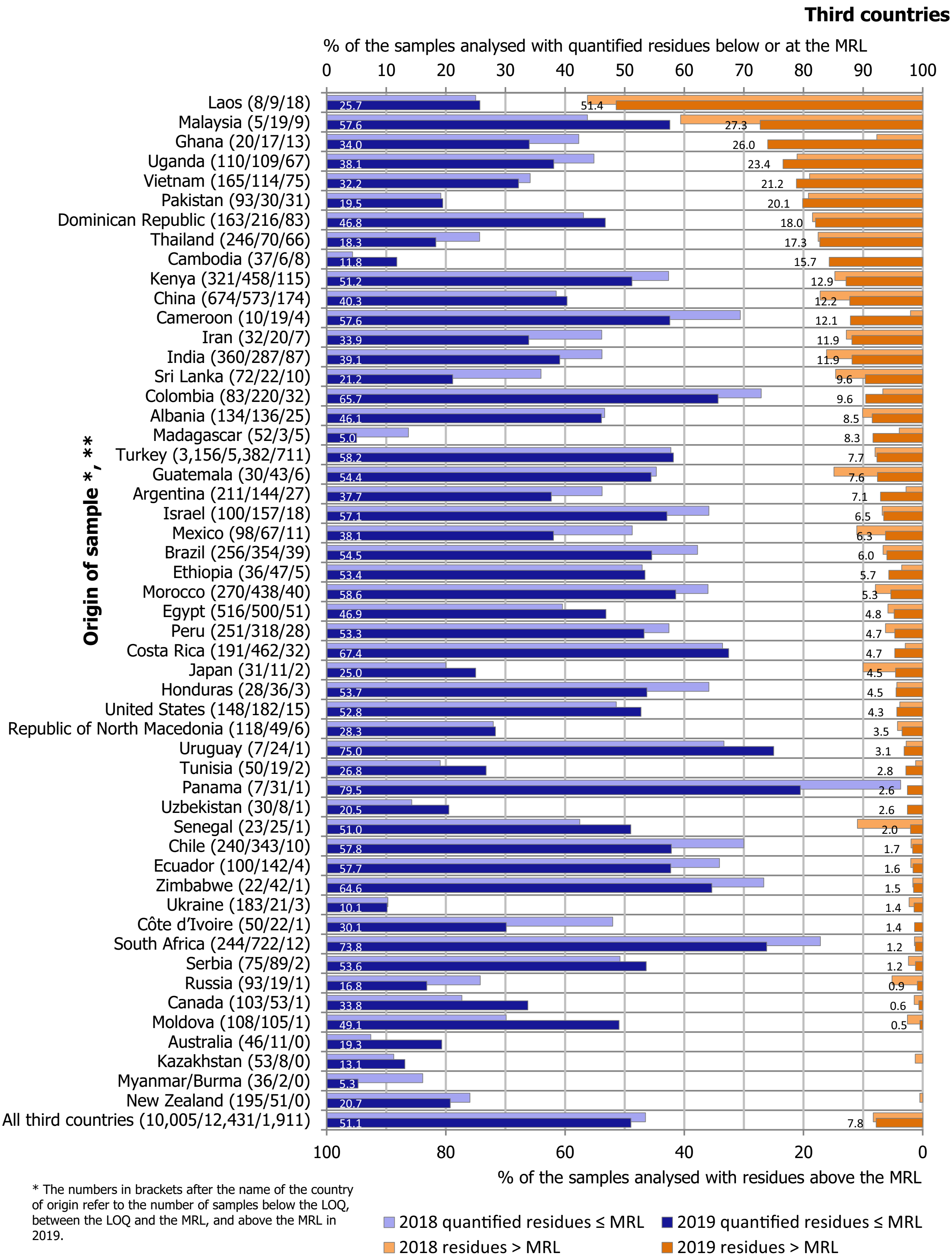

Figure 9: MRL exceedance and quantification rates by country of origin (third countries)

Figure 9 details samples originating from third countries (countries with more than 30 samples analysed are presented). The highest MRL exceedance rates (more than 15% of samples) were reported for Laos, Malaysia, Ghana, Uganda, Vietnam, Pakistan, Dominican Republic, Thailand and Cambodia.

4.2.2. Results broken down by food product

Among 86,319 samples of unprocessed food products,[42] 4% of the samples analysed in 2019 contained residues exceeding their corresponding MRLs (2.4% were non-compliant samples). This percentage of non-compliances is slightly lower when compared with that reported in the 2018 results (4.7%). The percentage of samples containing quantified residues within the legal limits was lower in 2019 (41%) compared to 2018 (45.3%). The samples without quantifiable residues increased in 2019 (55%) compared to 2018 (50.1%). Overall, 2019 presents a better situation as there were lower incidences of samples with MRL exceedances and a greater number of samples with no quantified residues.

Among the unprocessed products (Figure 10) with at least 50 samples analysed, the highest MRL exceedance rates (greater than 15%) were identified for grape leaves, yard-long beans, coriander leaves, chilli peppers, watercresses, passion fruits/maracujas, pitahaya (dragon fruit), celery leaves, pomegranates, basil and edible flowers, teas, cassava roots/manioc and prickly pears/cactus fruits. Some products of particular note exceeding the MRL were risk-based samples subject to increased import controls (i.e. grape leaves, yard-long beans, coriander leaves, chilli peppers, pitahaya, celery leaves, pomegranates and teas) during 2019. Although the number of exceedances identified for these risk-based samples is not indicative of the average pesticide levels expected to be found in these commodities, the monitoring and reporting of these results is a call for action at Member State level in line with Article 50 of Regulation (EC) No 178/2002[43]. Generally, Member States reply with appropriate measures to those MRL exceedances resulting in non-compliant samples (e.g. administrative fines, RASFF notifications,[44] follow-up actions, etc.). Based on the Commission's 2019 RASFF annual report,[45] 188 out of the 253 pesticide residues notifications concerned rejections at the EEA border. More details on results for this specific sampling programme can be found in Section 4.2.5.

No MRL exceedance was reported for unprocessed products with at least 60 samples analysed such as: beans (without pods), tree nuts (i.e. hazelnuts/cobnuts, walnuts), cereals (i.e. maize/corn), oilseeds (i.e. soya-beans), coffee beans and animal products (i.e. swine (liver and kidney), sheep (liver and kidney) and goat milk.

The MRL exceedances in processed food products are checked against the MRL for the raw agricultural commodity after applying the respective processing factor as per Article 20 of Regulation (EC) No 396/2005. The MRL exceedance rate in processed food products for a total 9,983 samples, was lower (2.8%) (Figure 11) than for unprocessed products (4.0%) (Figure 10), and lower than in 2018 (3.6%). Processed products of wild fungi, rice, dates and apricots exceeded the MRL with a frequency greater than 10% of samples (with at least 30 samples analysed).

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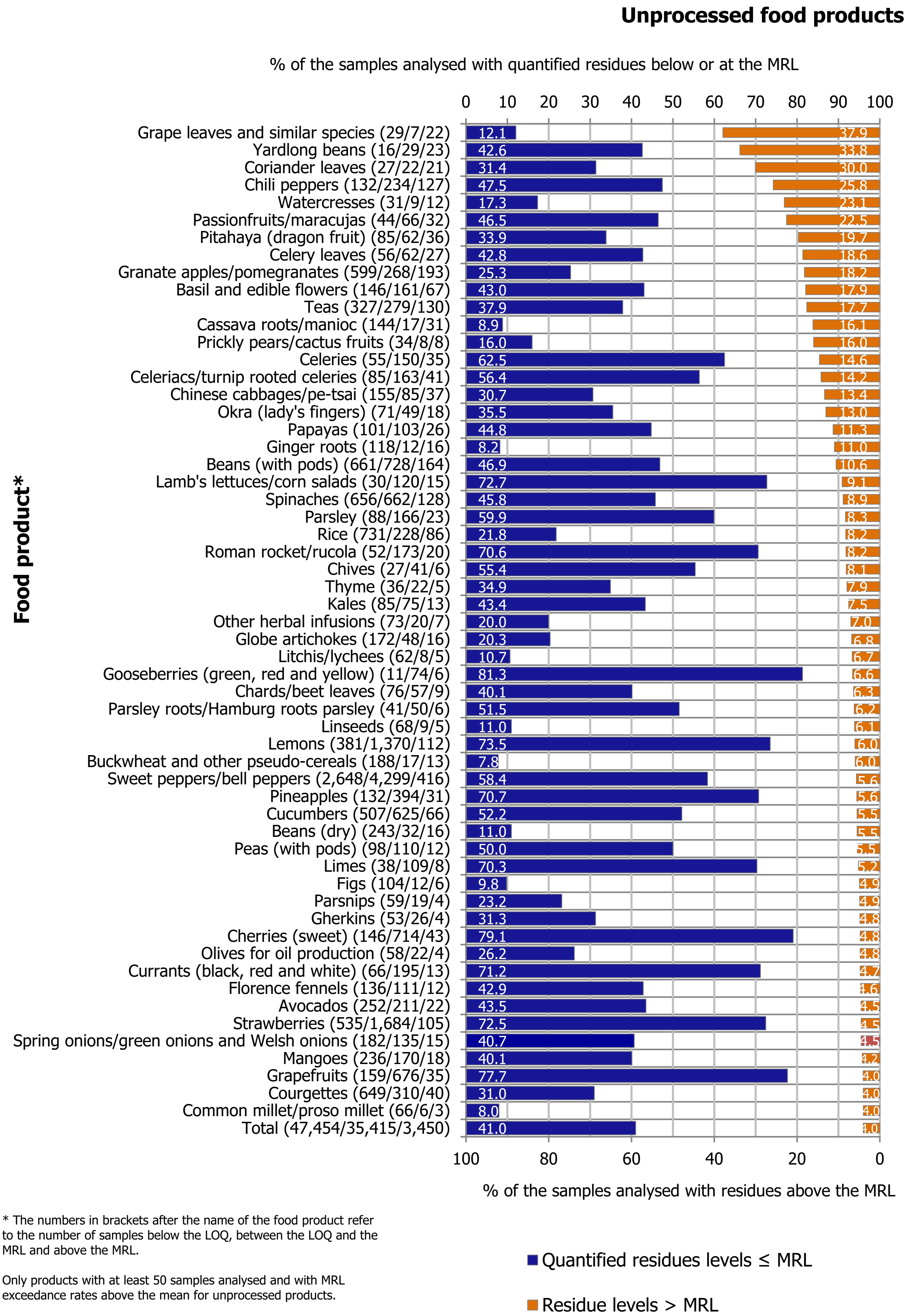
[42] In the framework of this report, unprocessed food products are considered those to which a MRL is directly applicable and are listed in Annex I to Regulation (EC) No 396/2005, i.e. products such as fermented tea, dried spices, dried herbal infusions etc.

[43] Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. OJ L 31, 1.2.2002, p. 1–24.

[44] https://ec.europa.eu/food/safety/rasff_en

[45] https://ec.europa.eu/food/sites/food/files/safety/docs/rasff_annual_report_2018.pdf



* The numbers in brackets after the name of the food product refer to the number of samples below the LOQ, between the LOQ and the MRL and above the MRL.

Only products with at least 50 samples analysed and with MRL exceedance rates above the mean for unprocessed products.

Figure 10: MRL exceedance rate and quantification rate for unprocessed food products

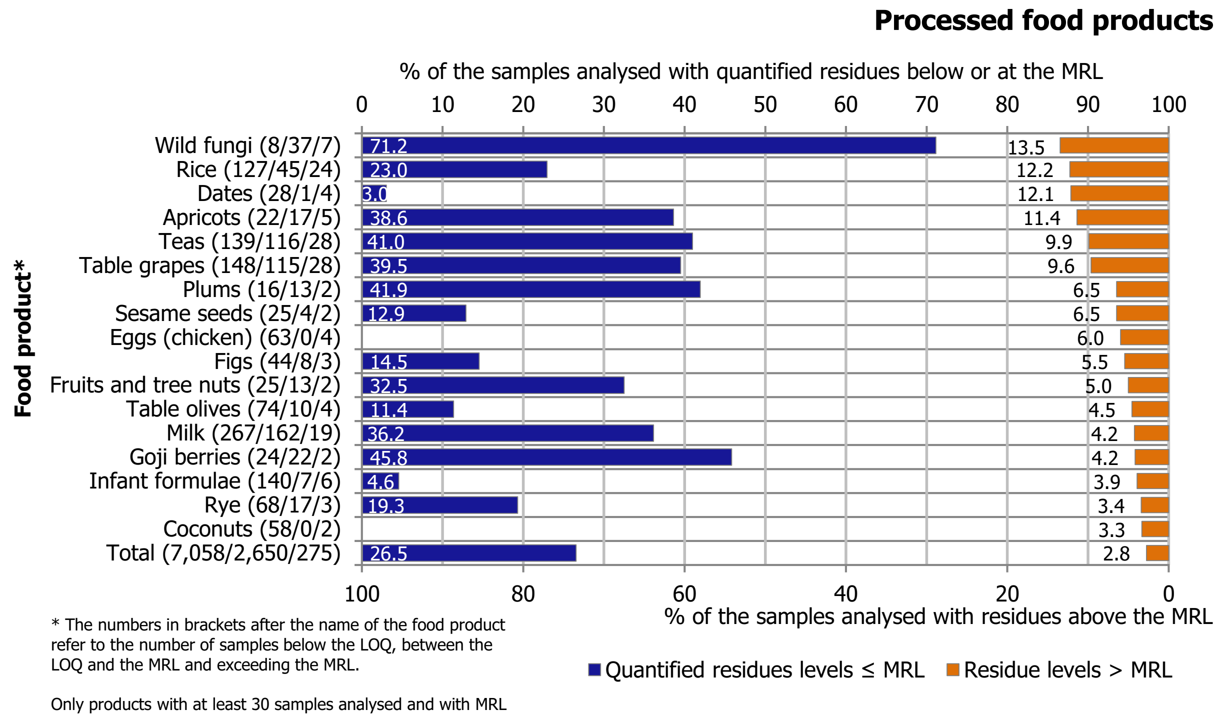


Figure 11: MRL exceedance rate and quantification rate for processed food products[46]

4.2.3. Results broken down by pesticide

In 2019, more than 21.5 million analytical determinations (individual results) were submitted to EFSA and used for the analysis presented in this report. The number of determinations for which residue levels were quantified at or above the LOQ amounted to 108,381 (or 0.5% of total determinations) in relation to 96,302 samples and 799 different pesticides (compared with 821 in 2018).

The most frequently quantified pesticides were copper compounds (RD)[47] (66% of the analytical determinations), fosetyl (RD) (27% of the analytical determinations), phosphane (RD) (16% of the analytical determinations), bromide ion (RD) (16% of the analytical determinations) and chlorates (RD)[48] (13% of the analytical determinations); the full list can be consulted in Annex IV.

MRL exceedances were found in 4,962 analytical determinations from 3,720 samples. The pesticides most frequently exceeding their corresponding MRLs are presented in Figure 12 (pesticides with more than 0.05% of MRL exceedances and with at least 2,000 samples analysed).

The pesticide with the highest MRL exceedance rate was chlorate[47] (7.2%) and this was in line with results from previous years. The MRL in place in 2019 was still the default of 0.01 mg/kg. However, Regulation (EU) 2020/749[49] was approved in 2020 setting new MRLs based on monitoring data and taking different sources and entry points of chlorate residues in the manufacturing processes.

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[46] Excluding baby food samples that are considered processed food, for which analysis is done in Section REF _Ref27489272 \w \h 4.2.6.

[47] No longer used as pesticides but its presence is coming from other sources such as use of feed supplements.

[48] The frequency of occurrence of chlorates can be explained by the fact that they are by-products of chlorine solutions (chlorine dioxide, chlorite and hypochlorite salts) used as sanitizing and disinfection agents in the food industry and as biocides. These uses, being necessary to ensure good hygiene of food products, lead to detectable residues of chlorate in food which is most probably not linked to their use as pesticides. Since these substances have been used as pesticides in the past, they fall under the remit of the pesticide MRLs regulation. Some detections might not have been reported to EFSA in 2019 data collection as the revised MRL were applicable only in 2020[46].

[49] Commission Regulation (EU) 2020/749 of 4 June 2020 amending Annex III to Regulation (EC) No 396/2005 of the European Parliament and of the Council as regards maximum residue levels for chlorate in or on certain products. OJ L 178, 8.6.2020, p. 7–20.

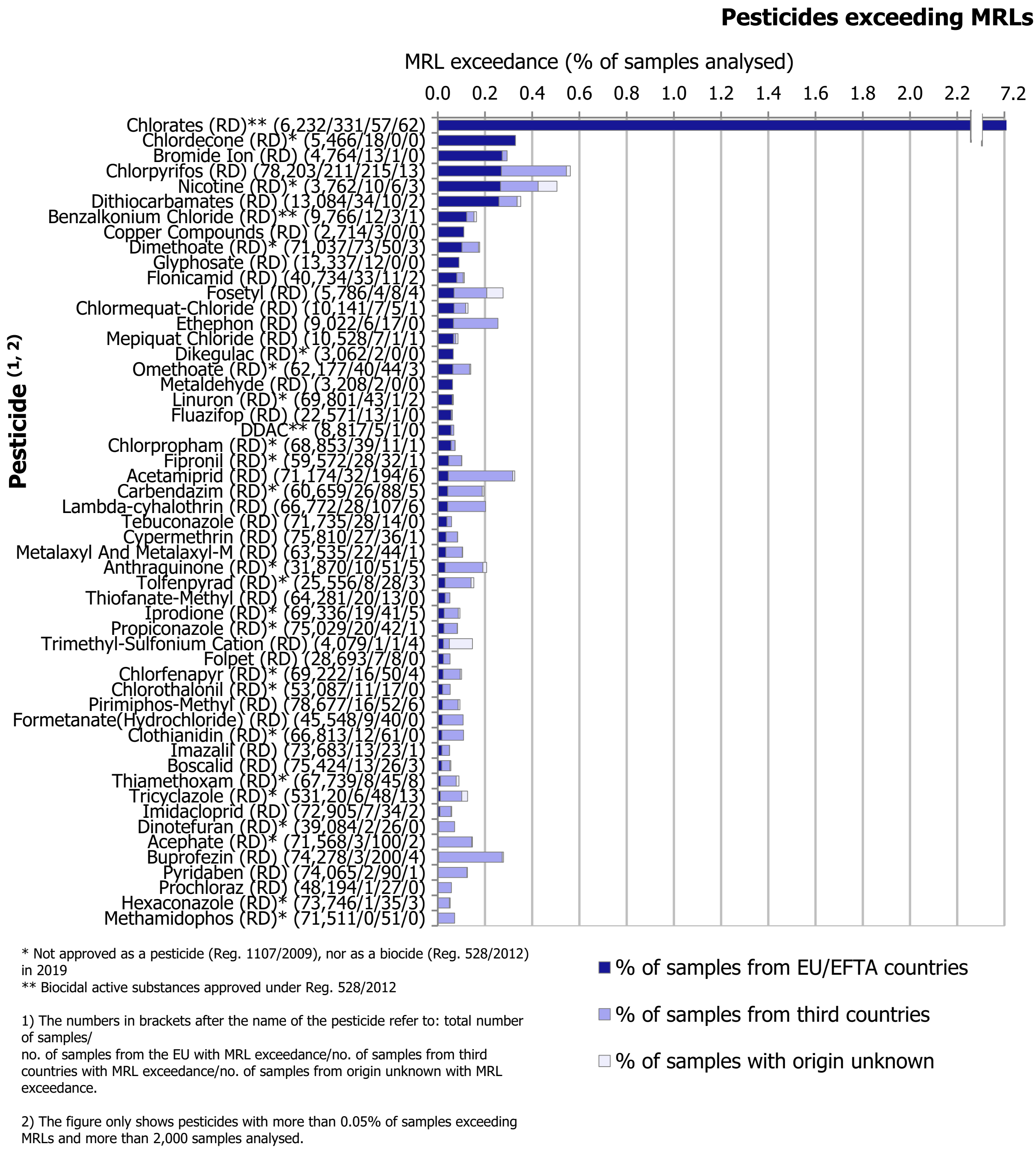

Figure 12: Frequency of MRL exceedances per pesticide and sample origin

Other MRL exceedances reported for non-approved active substances in the EU during 2019 were:

- Nicotine in 19 samples (0.5%) mainly in leafy crops (lettuce, Lamb's lettuce/corn salads, spinach, kale).
- Chlordecone in 18 samples (0.3%), a banned, persistent organic pollutant,[50,51] mainly reported in cassava root samples from French overseas territories (i.e. Guadeloupe and

[50] Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants. OJ L 169, 25.6.2019, p. 45–77.

[51] EFSA has issued a Scientific Opinion reviewing the temporary MRLs for chlordecone in certain products of animal origin with new health-based guidance values derived by the French authorities (EFSA, 2020c). In accordance with the policy for persistent organic pollutants, existing MRLs should be regularly reviewed, taking onto account results from pesticide monitoring programmes, since contamination of food is expected to gradually decrease over time.

Martinique). France reported 300 samples with quantified results on chlordecone mainly in swine and bovine fat, of unknown origin.[52]
- Anthraquinone in 66 samples (0.2%), mainly in teas coming from China (27 samples) and the tea-like beverage mate from Argentina (8 samples).
- Carbendazim in 119 samples (0.2%), mainly in chilli peppers (15 samples from Uganda), rice (20 samples mainly from India and Pakistan) and beans (with pods), 9 samples from Kenya.
- Dimethoate was an approved substance which became not renewed on 30 June 2019[53] with two grace periods, the first until the 30 September 2019 for plant protection products used on cherries and another one until the 30 June 2020 for the rest of the crops. It was reported in 126 samples (0.18%). These samples covered 34 food commodities as well as sweet cherries (12 samples). The highest findings were reported on the following commodities: Chinese cabbages (11 samples), sweet peppers/bell peppers (9 samples), tomatoes (8 samples) and yard-long beans (8 samples). There were 27 countries reporting it of which the ones with higher exceedances were Italy (16 samples), the Dominican Republic (13 samples), Greece (10 samples), Poland (12 samples) and Turkey (10 samples). Bearing in mind the distribution of findings in different parts of the world, EFSA recommends continued monitoring of this substance together with omethoate, being its degradation product, also not approved at EU level and reported by 28 countries (of which 11 were EU MSs) in 87 samples.

Information on the number of analyses/determinations, the number of quantifications per pesticide, the quantification rate and the number of countries analysing for the single pesticides is available in Annex IV.

4.2.4. Results of glyphosate residues in food

In 2019, glyphosate was analysed by 26 reporting countries. Overall, 13,336 samples of different food products (including processed products) were analysed for glyphosate residues, of these 165 were baby food samples[54] and 1,028 were food samples of animal origin (including honey). The results showed that in 97% of the samples, glyphosate was not quantified. In 2.7% of the samples (364 samples), glyphosate was quantified at levels above the LOQ but below the MRL and in 12 samples (0.1%), the residue levels exceeded the MRL. The exceedance rate (0.1%) was the same in comparison to the 2018 results although the quantification rate (2.7%) was increased compared to 2018 (1.9%). Glyphosate residues were not quantified in any baby food samples.[53]

MRL exceedances were identified in European samples grown in Poland (6 samples) and 1 sample in each of the following countries: Croatia, France, Germany, Lithuania, The Netherlands and Spain. In Figure 13, detailed quantification and MRL exceedance rates for glyphosate are plotted by food product where at least 10 samples were reported. The highest occurrence rate was reported for linseeds.

[52] Temporary MRLs for chlordecone in various products were voted in September 2020 Standing Committee (SANTE/12510/2019 Rev. 1).

[53] Commission Implementing Regulation (EU) 2019/1090 of 26 June 2019 concerning the non-renewal of approval of the active substance dimethoate, 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 Commission Implementing Regulation (EU) No 540/2011. OJ L 173, 27.6.2019, p. 39–40.

[54] Baby food samples refer to: 'baby foods other than processed cereal-based foods and processed cereal-based foods for infants and young children.

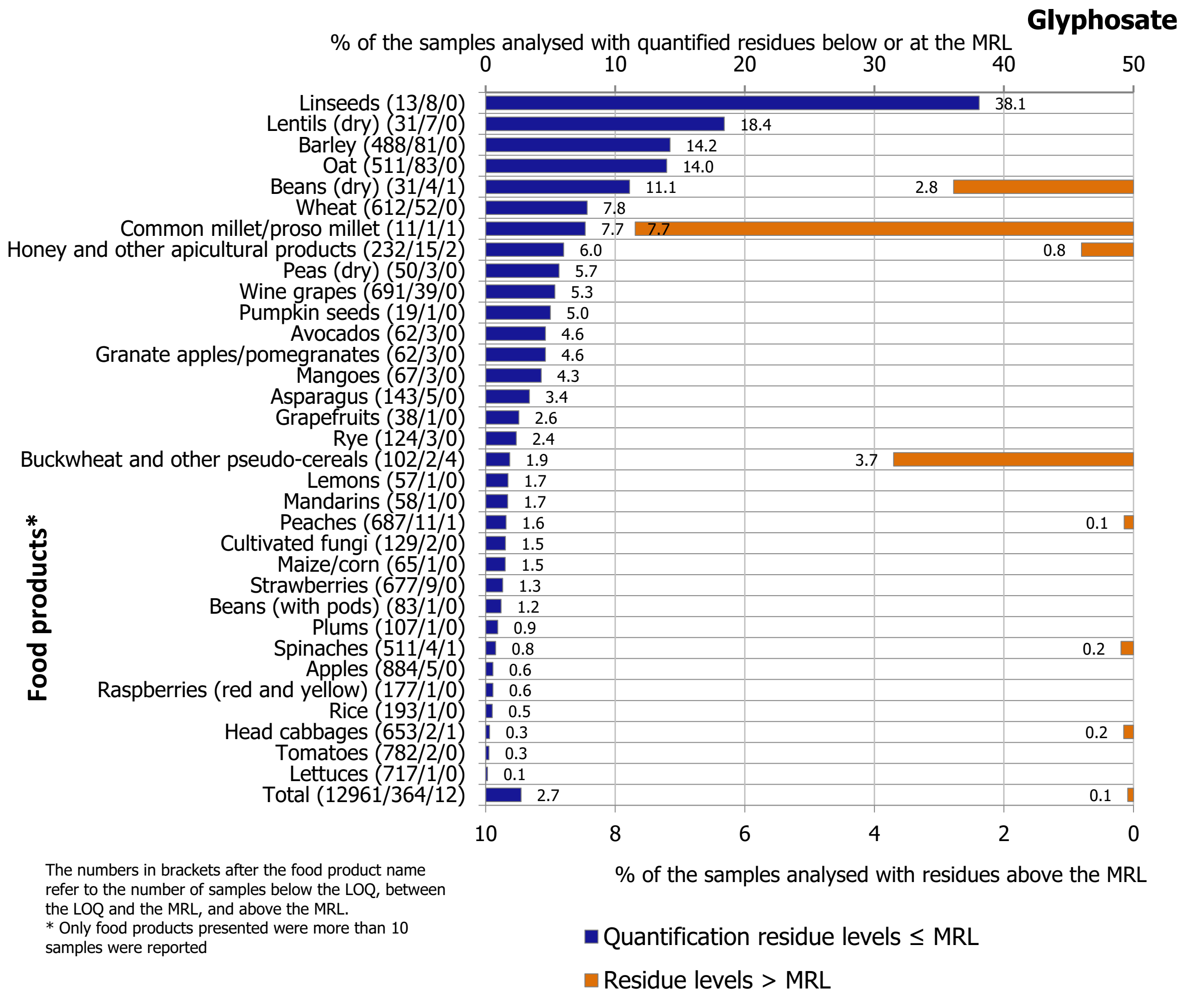

Figure 13: Glyphosate quantification rate and MRL exceedances rates

The use of plant protection products containing glyphosate-trimesium, a variant of glyphosate, may lead not only to residues of glyphosate, but also to residues of trimethyl-sulfonium cation, a compound for which specific MRLs have also been established. However, in a recent EFSA MRL review (EFSA, 2019b), no EU good agricultural practices (GAPs) or import tolerances were reported by Member States for glyphosate-trimesium, and therefore, the MRLs for this compound should be in principle lowered to the LOQ (EFSA, 2019b). Since trimethyl-sulfonium can also be formed when samples undergo processing with heat treatments with a methylating agent, it is difficult to determine its origin and further investigations should be thus performed. Risk managers may consider setting specific MRLs for this compound based on the results of monitoring data. Member States are requested to continue monitoring this compound accordingly.

Trimethyl-sulfonium cation was analysed in 4,079 samples by five reporting countries (Cyprus, Germany, Italy, The Netherlands and Portugal). Of these samples, 99.1% were free of quantifiable residues. In 0.8% of these samples (31 samples), residues were above the LOQ but below the MRL and in 0.1% (6 samples) the MRL of trimethyl-sulfonium cation was exceeded.

In Figure 14, detailed quantification and MRL exceedance rates for trimethyl-sulfonium cation are plotted according to the food product, in each case a minimum of 10 samples were analysed. The highest quantification rate was in cultivated fungi, followed by grapefruit, a situation similar to that in 2018.

MRL exceedances were also reported for 4 samples with unknown origin, from Germany (1 sample) and Kenya (1 sample).

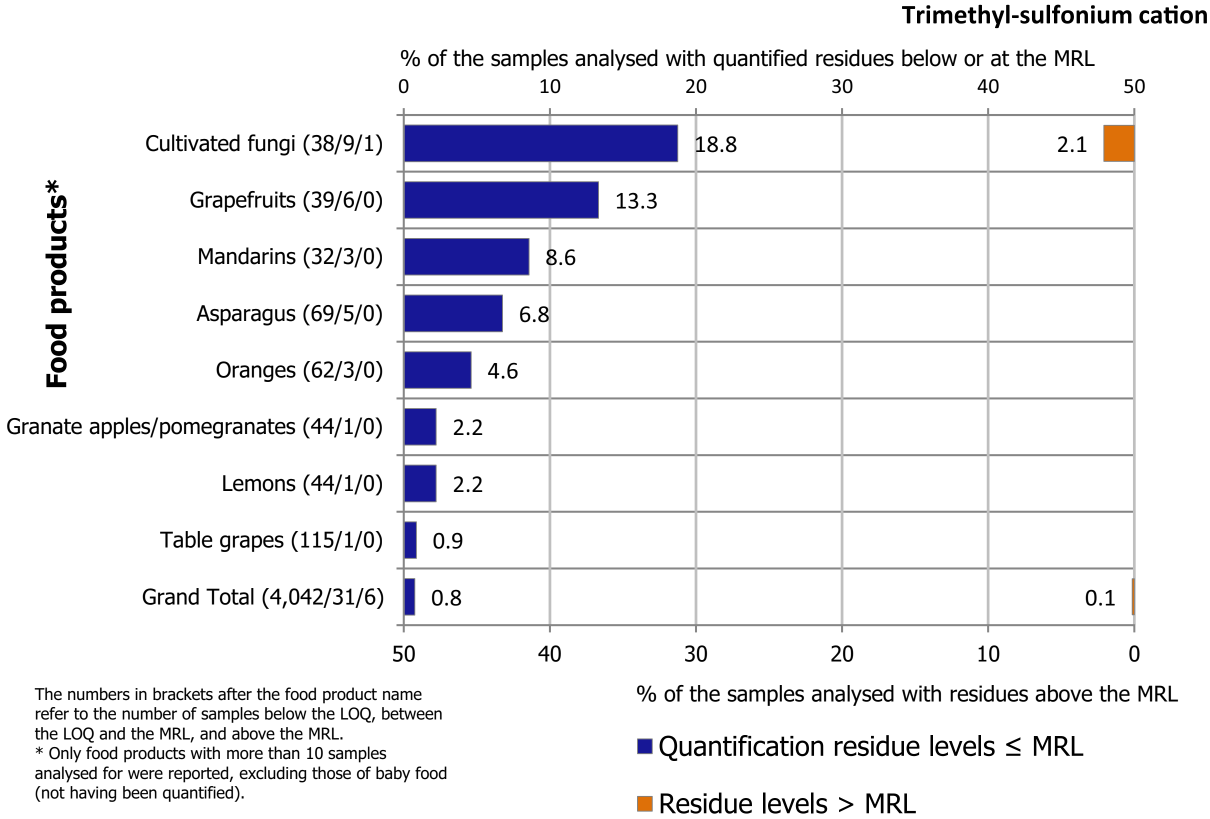

Figure 14: Trimethyl-sulfonium cation quantification rate and MRL exceedances rates

4.2.5. Results for import controls under Regulation (EC) No 669/2009

According to the provisions of Regulation (EC) No 669/2009[19] repealed in late 2019 by Regulation (EU) 2019/1793[20] on import controls, certain foods were subject to an increased frequency of official controls for certain pesticides at the point of entry into the EU territory. A description of the required controls regarding hazard analysis, type of food products and countries of origin, relevant for the calendar year 2019 can be found in Appendix C.

The results presented in this section differ from previous years and are based on the data reported directly to EFSA for the sampling year 2019. Other data might have been reported to DG SANTE. Therefore, this section may not give the whole picture of the situation.[55]

Overall, 8,424 samples were reported. Of those, 8.5% (713 samples) were considered as non-compliant with EU legislation on pesticide residues. Among food commodities analysed in 2019, those reported above a 10% non-compliance rate were: chilli peppers from Vietnam (67%), Pakistan (43%), the Dominican Republic (19%), India (19%), Uganda (17%) and Egypt (11%), grape leaves and similar produce from Turkey (33%), yard-long beans from the Dominican Republic (33%), pomegranates from Turkey (22%) and okra (lady's fingers) from Vietnam (17%). These results are illustrated in Figure 15.

[55] Through IMSOC system, the real number of samples of import control is collected. More information on this can be requested through SANTE-IMPORT-CONTROLS@ec.europa.eu.

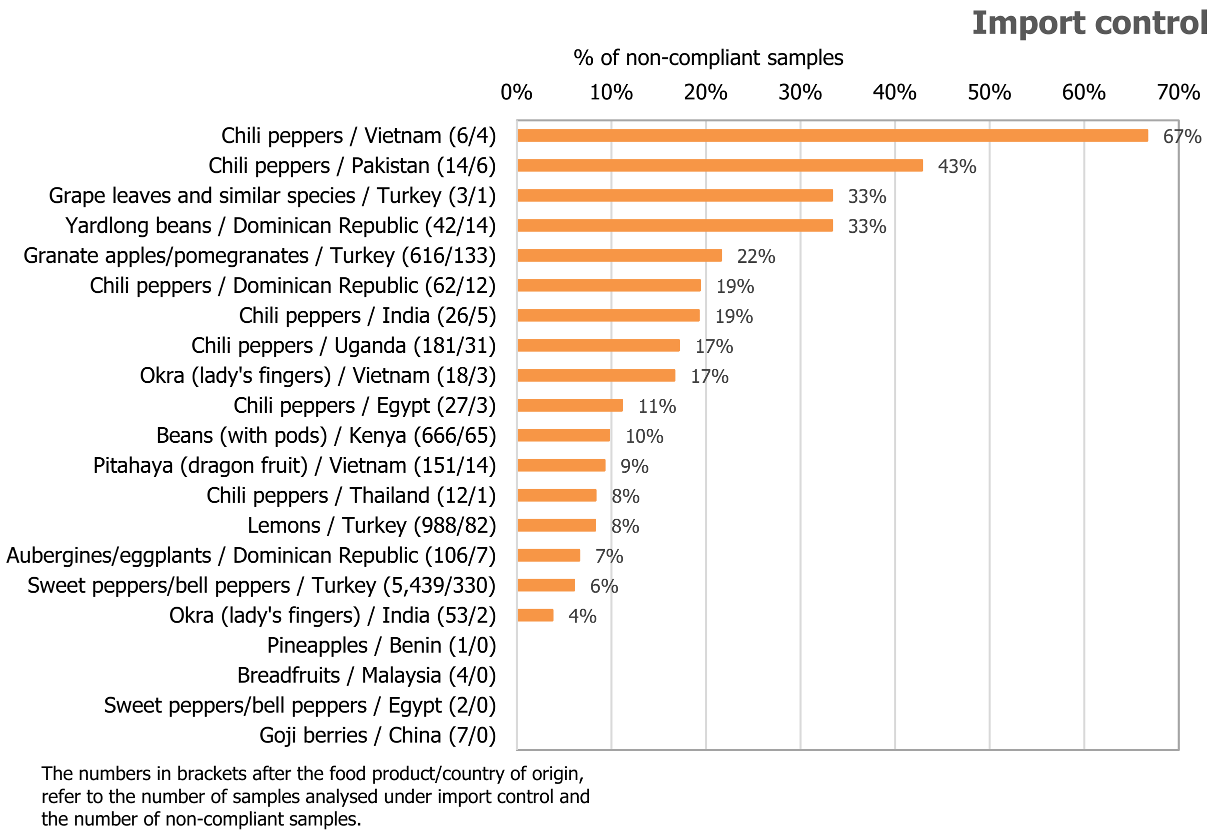

Figure 15: Frequency of non-compliant samples identified in the framework of the reinforced import controls under Regulation (EC) No 669/2009

4.2.6. Results on food for infants and young children

Reporting countries analysed 1,513 samples of foods for infants and young children as defined in Regulation (EU) No 609/2013[14] and covered by Directives 2006/125/EC and 2006/141/EC (herein referred to as baby food). The types of baby food samples were 909 baby foods other than processed cereal-based food samples, 107 follow-on formulae samples, 154 infant formulae samples and 343 processed cereal-based foods for infants and young children. From the overall number of baby food samples analysed, 460 samples were flagged as organic samples. Regulation (EU) No 2018/555 requested Member States to sample 10 samples of baby foods in 2019 other than infant formulae, follow-on formulae and processed cereal-based foods. Of the total, 156 baby food samples were flagged under EUCP.[56]

The incidence of samples with no quantifiable residues was 97.8%, higher than in recent years (90.3% in 2018 and 94.6% in 2017). Quantified residues (at or above the LOQ but below the MRL) were found in 0.9% of cases (14 samples), which was also lower than in 2018 (9.7%). MRL exceedances[4] were reported at 1.3% (or 20 samples), a similar level to that in 2018, and non-compliance was found in 0.3% (5 samples), compared with 0.4% in 2018. In 0.1% of the samples (1 case), five pesticide residues were reported in the same sample (Figure 16).

[56] Only 11 Member States were able to appropriately flag baby food samples under EUCP. Recommend to EFSA in giving further guidance to data providers to flag them correctly.

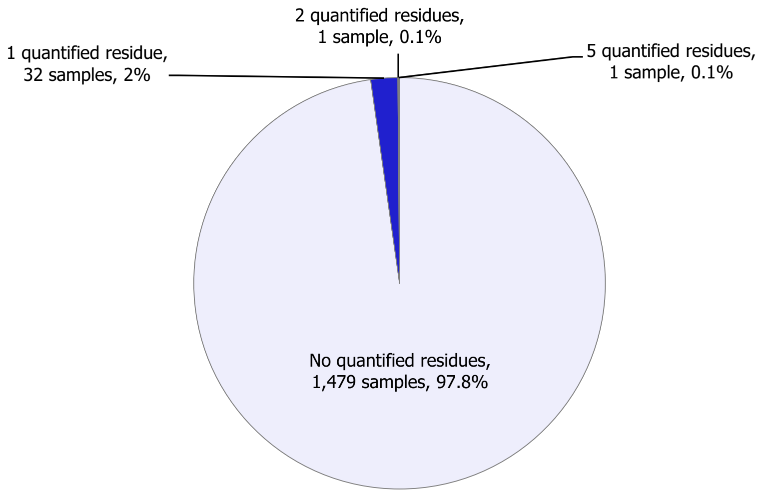

Figure 16: Number of quantified residues per individual baby food samples

Regarding the analytical determinations, 739 different pesticides were analysed, of which 13 were quantified in concentrations at or above the LOQ. Like in the previous reporting years, the most frequently quantified compounds in baby food were chlorates (quantified in 22 samples, 1.5%).[57] Pesticides found to occur in at least three samples were boscalid (RD) and dithiocarbamates (RD). In two samples, fosetyl-Al exceeded the MRL. Overall, the findings in baby food can be considered of low frequencies.

The presence of chlorate can be attributed to residues in treated potable water (used as ingredient and/or in cleaning equipment) and to chlorine-based solutions used in the manufacturing process. These uses, being necessary to ensure good hygiene of food products, lead to detectable residues of chlorate in food most probably not linked to their use as pesticides. Benzalkonium chloride (BAC) belongs to a group of quaternary ammonium compounds that are widely used in biocides (disinfectants). Since these substances have been used as pesticides in the past, they fall under the scope of the pesticide MRL regulation.

The results for fosetyl-Al may include the presence of phosphonic acid residues coming from potassium phosphonates (which can be used as a fertiliser but is also approved as a fungicide) and disodium phosphonate which is also approved for use as a fungicide.

Assessing the risk on baby food samples is done using a different methodology than the one applied in this report (EFSA, 2018b). However, the one used in section 5 (EFSA, 2019c) uses food consumption data from children.

4.2.7. Results on organic food

In 2019, 6,048 samples of organic food (excluding baby food)[58] were analysed. This is 6.2% of the total number of samples, practically the same as in 2018 (6.3%). In the framework of the EUCP, samples from commodities originating from organic farming (if available in Member States and in proportion to the available market share of organic farming for the commodities to be sampled) were to be taken with a minimum of 1 organic sample per commodity. In total, 829 organic samples were taken under the EUCP and are included in the total number of organic samples in this section.

Overall, 5,254 samples flagged as organic did not contain quantifiable residues (86.9% of the analysed samples vs. 84.8% in 2018); 718 samples contained quantified residues below or at the MRL level (11.8% vs. 13.8% in 2018) and 76 samples were reported with residue levels above their corresponding MRLs (1.3% vs. 1.4% in 2018), of which 0.5% (31 samples) were non-compliant in 2019.

Compared to conventionally produced food (non-organic), the MRL exceedance and quantification rate trends are generally lower in organic food. In 2019, the MRL exceedance rate was 1.3% in

[57] In 2019, new MRLs derived for chlorate taking into account sanitation practices in industrial processes did not apply. Could be a reason for having less results than in previous years.

[58] Of the total 1,513 baby food samples, 460 were also flagged as organic samples. These were not included in this section since the results for this food group are presented in detail in Section REF _Ref27489272 \w \h 4.2.6.

organic food, while 4.1% for conventional food[59]; the same pattern was observed for the quantification rates, which were 11.9%[60] in organic food and 41.7% in conventional food.[61] A comparison between organic and conventional foods is presented in Figure 17. Major differences were identified, in particular for fruits and tree nuts, vegetables and cereals. Being the tendency that organic products contained less residues than conventional, it is remarkable that animal products in 2019 show a higher quantification rate in organic samples (15%) than conventional production samples (6%) due mainly to hexachlorobenzene, DDT, thiacloprid and copper findings.

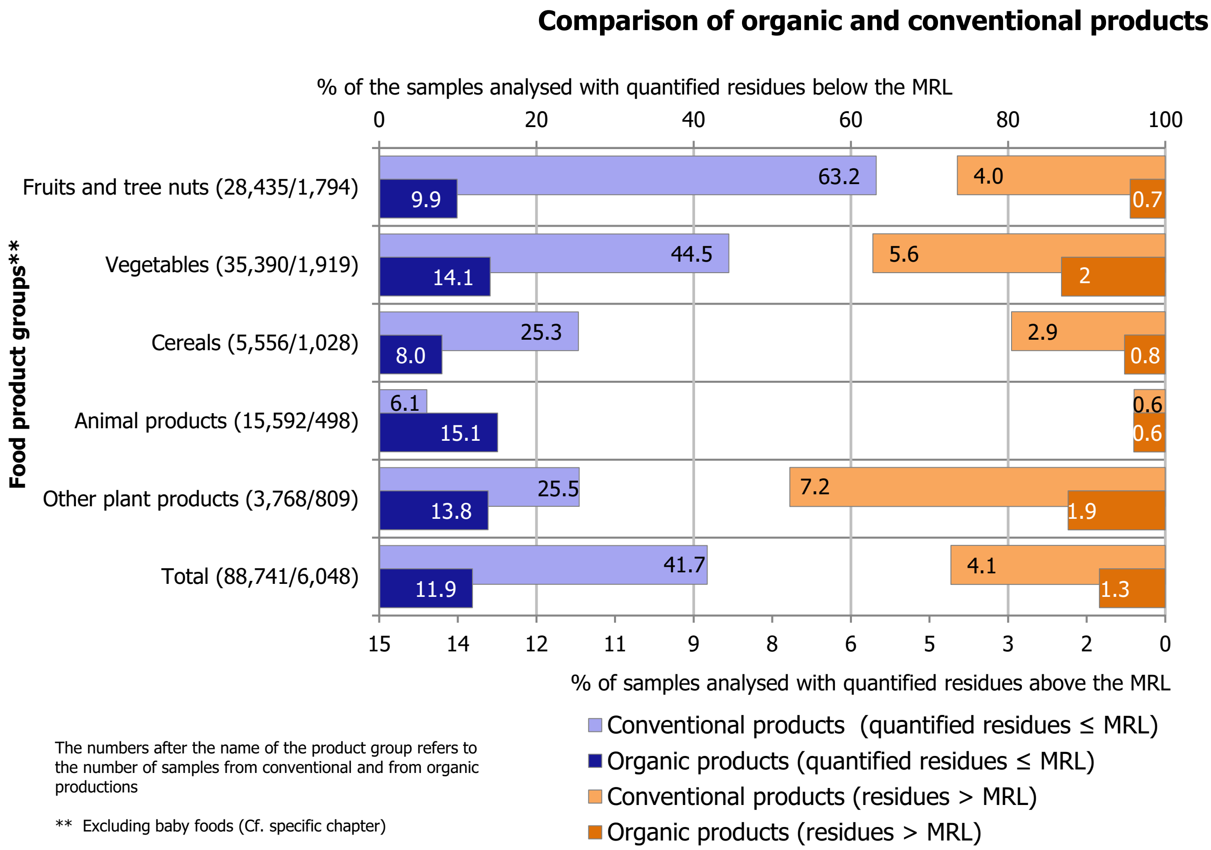

Figure 17: Comparison of organic and conventional foods[62]

In 2019, 130 different pesticides were quantified in concentrations at or above the LOQ. The pesticides most frequently quantified in at least five samples are presented in Figure 18.

[59] The overall MRL exceedance rate for the 96,302 samples is 3.9%. In this section, baby food samples are excluded.

[60] For this comparison, all pesticides were considered; the naturally occurring substances covered by the MRL legislation were not excluded since they are also present in conventional food and are therefore also covered in the calculation of the quantification rate for conventional food.

[61] The overall quantification rate for the 96,302 samples is 39.5%. In this section, baby food samples are excluded.

[62] Figure excluding baby food samples, plotting quantification and MRL exceedance rates for the main food product groups, including all pesticides.

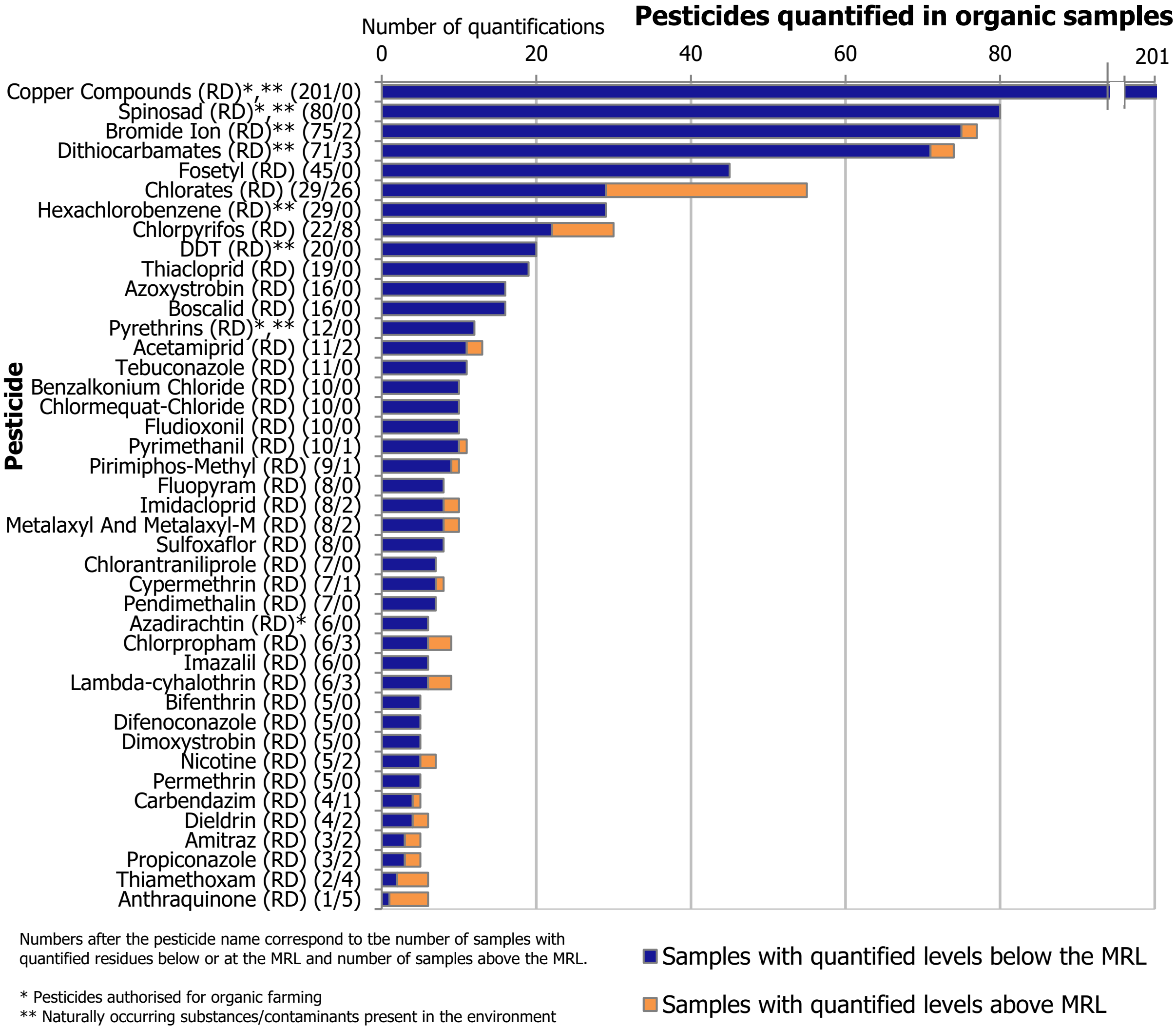

Figure 18: Pesticides most frequently quantified in organic samples (pesticides with at least five positive quantifications reported)

In Figure 18, the pesticides with higher frequency of detections were copper compounds (RD), spinosad (RD), bromide ion (RD) and dithiocarbamates (RD). These are either permitted in organic farming (e.g. spinosad, copper as feed additive) or naturally occurring compounds (e.g. copper, bromide ion and dithiocarbamates[63]). Others lower in the ranking such as azadirachtin[64] and pyrethrins[65] can be used in organic farming as far as their use is covered by the general agricultural policy in the Member State concerned. Substances reported resulting from environmental contamination (persistent pesticides no longer used in the EU), and therefore difficult to control their presence, were DDT (RD), hexachlorobenzene (RD) and dieldrin (RD).

Fosetyl-Al was the fifth most frequently quantified residues in organic food. Its findings may include residues of two approved fungicides: disodium phosphonate and phosphonic acid, this last one resulting from the use of potassium and disodium phosphonates (which can also be used as foliar feed fertiliser). This is due to the current residue definition for enforcement for fosetyl-Al set as the 'sum of fosetyl, phosphonic acid and their salts, expressed as fosetyl'. To have MRLs better reflecting the actual use of fosetyl in the field, EFSA has been mandated by the Commission[66] to perform a comprehensive assessment of the three active substances, considering also monitoring data. New residue definition

[63] Dithiocarbamates (RD) are commonly measured as CS2 which can occur naturally in some plants, particularly in *Brassicaceae* (e.g. broccoli, cauliflower) and *alliaceae.*

[64] Azadirachtin belongs to the limonoid group, a secondary metabolite present in neem seeds.

[65] Pyrethrins are found naturally in some chrysanthemum flowers. They have been used as models for pyrethroid synthesis.

[66] Mandate number: M-2020-0067 and question number: EFSA-Q-2020-00317. Reasoned opinion on the joint review of maximum residue levels (MRLs) for fosetyl and phosphonates.

expressing the results as phosphonic acid is being considered. Therefore, EFSA recommends Member States to continue monitoring phosphonic acid in plant and animal commodities.

MRL exceedances[67] in organic products were reported mainly for chlorate (26 samples). The details on samples of organic products exceeding a legal limit can also be found in Annex II. The occurrence of other pesticides not authorised in organic farming can – as for conventional products – be the result of spray drift, environmental contaminations or contaminations during handling, packaging, storage or processing of organic products. This occurrence could also be linked to the incorrect labelling of conventionally produced food as organic food. Therefore, Member States should try to elucidate the reasons for the presence of pesticides found occasionally in organic food, which are not permitted in these types of products (e.g. chlorpyrifos, thiacloprid, azoxystrobin, boscalid).

4.2.8. Results on animal products

In total, 16,090 samples of products of animal origin were reported to EFSA during the 2020 ChemMon data collection (EFSA, 2020a) under the scope of pesticide[36]. In Figure 19, the total number of samples taken is broken down by food group.

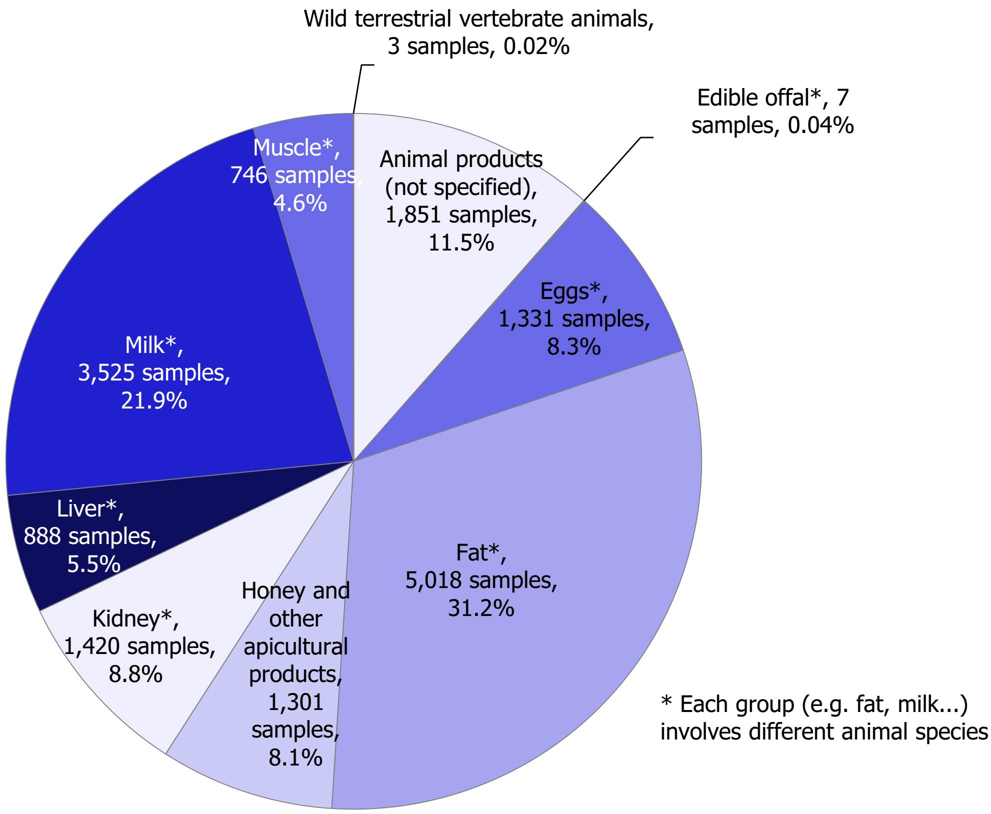

Figure 19: Number of samples of animal products tested, broken-down by food group

The results showed that 14,669 samples were free of quantifiable residues (91.2% vs. 87.8% in 2018) while 1,421 samples (8.8% vs. 12.2% in 2018) contained one or several pesticides in quantifiable concentrations. MRL exceedances were identified in 96 samples (0.6% vs. 1.7% in 2018) of which, 60 samples (0.4%) were non-compliant considering measurement uncertainty.

The products above 10 MRL exceedances were related to chicken eggs (28 samples), milk processed products (i.e. cream sprayable) (19 samples) and honey and other apicultural products (12 samples). Multiple residues were reported in 238 samples (1.5%); up to seven different pesticides were reported in a same veal liver sample (Figure 20).

[67] For conventional and organic products, the MRLs established in Regulation (EC) No 396/2005 are applicable.

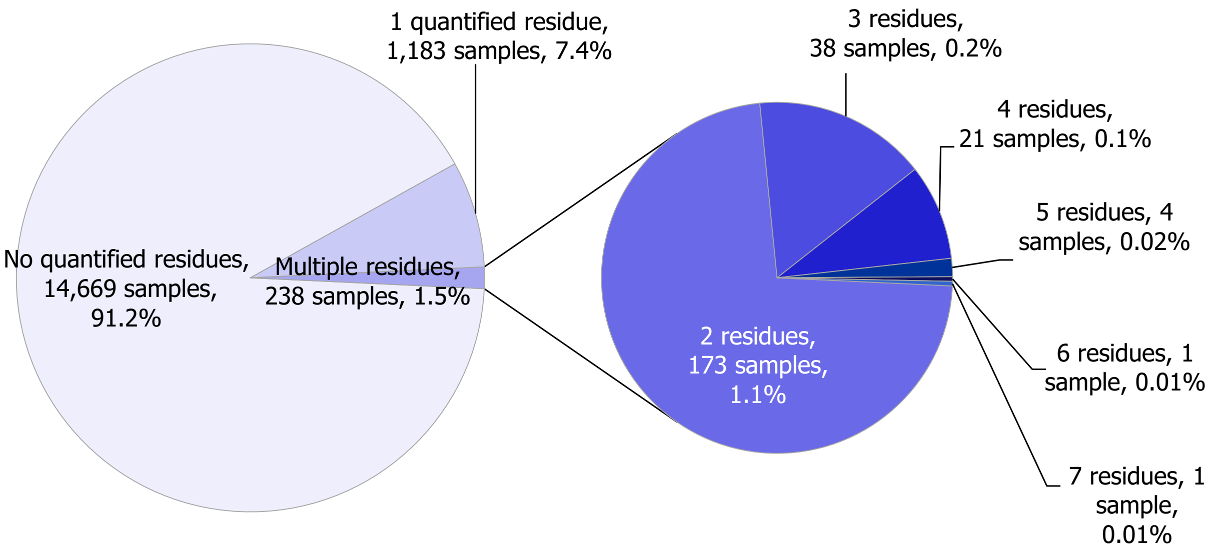

Figure 20: Number of quantified residues per individual sample of animal origin

In Figure 21 and Table 1, the number of different residues quantified by animal product and the identity of the most frequent ones are given, respectively.

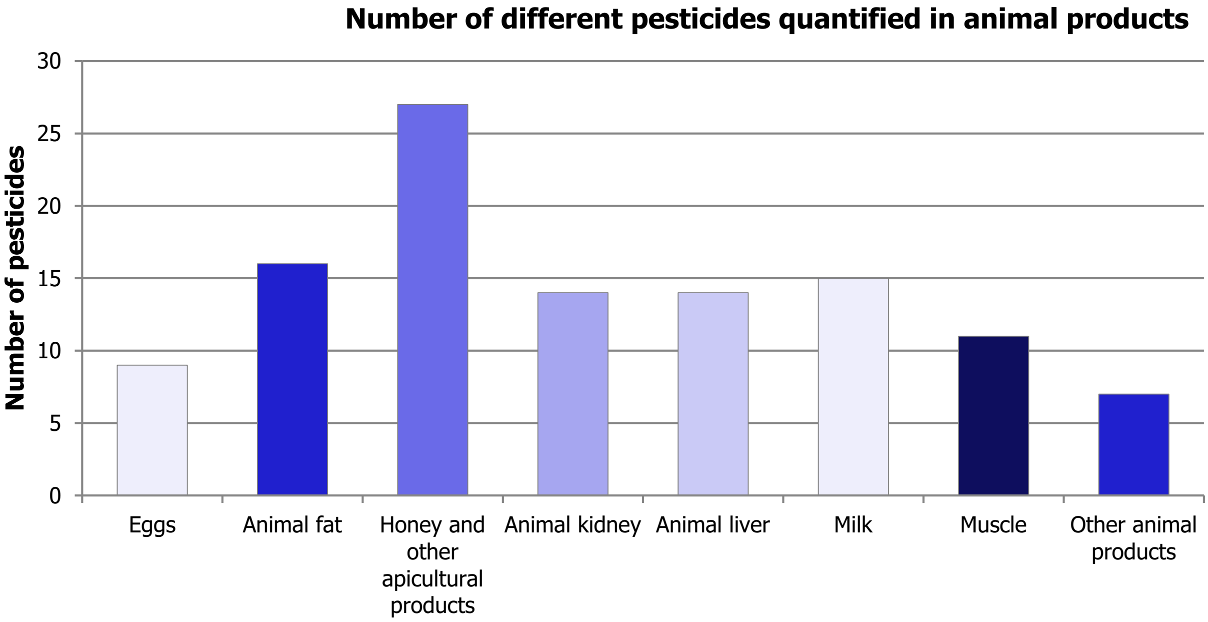

Figure 21: Number of different pesticide residues quantified in animal products

Table 1: Pesticides most frequently quantified in animal products (in absolute at or above 10 number of determinations)

Pesticide	Eggs	Animal fat	Honey and other apicultural products	Animal kidney	Animal liver	Milk	Muscle	Other animal products	Total
Copper Compounds (RD)	28	0	0	100	6	190	128	0	**452**
Thiacloprid (RD)	0	0	173	0	0	0	0	0	**173**
DDT (RD)	31	24	0	4	23	42	10	26	**160**
Hexachlorobenzene (RD)	18	21	0	2	10	61	21	3	**136**
Acetamiprid (RD)	0	0	49	0	0	0	0	0	**49**

Pesticide	Eggs	Animal fat	Honey and other apicultural products	Animal kidney	Animal liver	Milk	Muscle	Other animal products	Total
Mercury (RD)	1	0	0	11	0	18	1	7	**38**
Amitraz (RD)	0	0	37	0	0	0	0	0	**37**
Fipronil (RD)	23	8	0	0	0	0	0	0	**31**
BAC (RD)	0	1	2	0	1	21	5	0	**30**
Dimoxystrobin (RD)	0	0	29	0	0	0	0	0	**29**
Chlorates (RD)	1	0	1	0	0	8	18	0	**28**
Hexachlorocyclohexane, beta- (RD)	0	0	0	0	23	2	1	2	**28**
Azoxystrobin (RD)	0	0	27	0	0	0	0	0	**27**
Pendimethalin (RD)	0	0	0	2	21	0	3	0	**26**
Diazinon (RD)	0	6	0	17	1	0	0	0	**24**
Dieldrin (RD)	2	10	0	0	6	1	1	0	**20**
DDAC (RD)	0	1	0	0	3	7	5	3	**19**
Glyphosate (RD)	0	0	17	0	0	0	0	0	**17**
Chlorpyrifos (RD)	0	0	1	14	0	0	0	0	**15**
Bromide Ion (RD)	9	0	1	0	0	3	0	0	**13**
Fosetyl (RD)	0	10	2	0	0	0	0	0	**12**
Coumaphos (RD)	0	0	10	0	0	0	0	0	**10**
Flonicamid (RD)	0	0	10	0	0	0	0	0	**10**

Of the most frequently quantified substances (at or above 10 samples) DDT (RD), hexachlorobenzene (RD), beta-hexachlorocyclohexane and dieldrin (RD) were found because these are persistent pesticides in the environment. Copper residues found mainly in milk are not necessarily linked to the use of copper as a pesticide, but may result from the use of feed supplements, which contain copper compounds.

Chlorate, benzalkonium chloride and didecyldimethylammonium chloride were reported mainly in milk and muscle. Their presence can be attributed to residues in treated potable water (used as ingredient and/or in cleaning equipment) and to chlorine-based solutions used in the manufacturing process. However, since these substances have been used as pesticides in the past, they still fall under the scope of the pesticide MRL regulation.

In 2019, 1,301 samples of honey and other apicultural products were analysed. In 1,024 samples (78.7%) no quantifiable residues were found. In 265 samples (20.4%) residues at or above the LOQ but below or at the MRL were identified. MRL exceedances were reported in 12 samples (0.9%) of which 5 samples (0.4%) were non-compliant. Overall, 27 different pesticides were quantified. The pesticides most frequently reported in honey and other apicultural products above the LOQ were thiacloprid (RD) (173 samples), acetamiprid (RD) (49 samples), amitraz (RD) (37 samples), dimoxystrobin (RD) (29 samples), azoxystrobin (RD) (27 samples), glyphosate (RD) (17 samples), coumaphos (RD) (10 samples) and flonicamid (RD) (10 samples). MRLs were exceeded for the following substances: amitraz (RD) (4 samples), glyphosate (RD) (2 samples) and 1 sample for each of the following substances: acetamiprid (RD), bromide ion (RD), thiacloprid (RD), azoxystrobin (RD), boscalid (RD) and chlorfluazuron (RD). Overall, findings in honey and other apicultural products relate to neonicotinoids (e.g. thiacloprid, acetamiprid) and veterinary medicinal residue products (e.g. amitraz, coumaphos). Therefore, EFSA recommends continuing the analysis of this food product and trying to reduce pesticides that should not be present, due to the important function of bees as pollinators.

Fipronil findings are still featured in eggs (23 samples) as well as in animal fat (8 samples). Fipronil, is a veterinary medicinal product or biocide and its presence in eggs is the result of illegal use. EFSA recommends that Member States continue analysing this acaricide in animal products.

Chlorpyrifos was reported mainly in animal kidney. Its presence is likely to be due to a carryover of its use in feed. However, it is important to track this finding due to its potential genotoxicity (Rodríguez-Cortez and Menendez, 2020) and the welfare of animals.

In Annex II, further detailed data on the pesticide/food combinations found to exceed the legal limits in animal products is presented.

4.2.9. Multiple residues in the same sample

Multiple residues in one single sample may result from the application of different types of pesticides (e.g. application of herbicides, fungicides or insecticides against different pests or diseases) or the use of different active substances to avoiding the development of resistant pests or diseases and/or uptake of persistent residues from soil from treatments used in previous seasons treatments or spray/dust drift to fields adjacent to treated fields. Besides In addition to multiple residues resulting from agricultural practice, multiple residues may also occur due to mixing or blending of products with different treatment histories at different stages in the supply chain, including contamination during food processing. According to the present EU legislation, the presence of multiple residues within a sample is remains compliant, as long as each individual residue level does not exceed the individual MRL set for each active substance.

Of the 94,789 samples analysed,[68] 41,756 samples (44.1%) contained one or several pesticides in quantifiable concentrations (a decreased compared to 47.8% in 2018). Multiple residues were reported in 25,584 samples (27% vs. 29% in 2018); in an individual dried vine fruit sample with unknown origin, up to 28 different pesticides were reported (Figure 22).

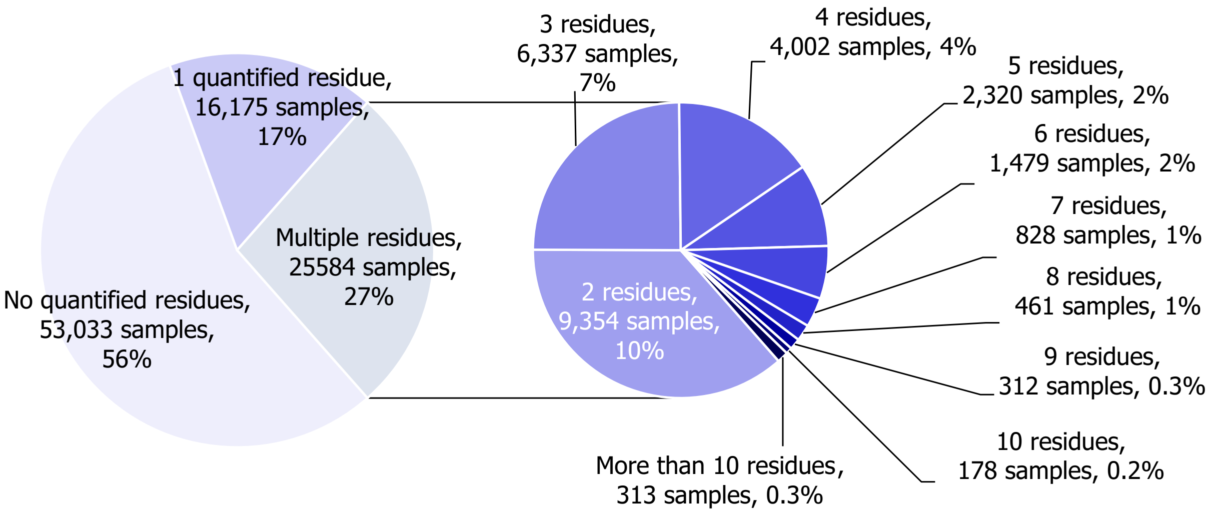

Figure 22: Percentage of samples with single and multiple quantified residues

The frequency of multiple residue samples in concentrations higher or equal to the LOQ was higher in unprocessed products (24,154 samples; 28%) compared to processed products (1,430 samples; 16.8%). In 313 samples (0.3%), more than 10 pesticides were found in the same sample. Of those, 78 samples corresponded to processed products and 235 to unprocessed products.

In Figure 23, the 86,269 total number of unprocessed food samples is broken down by the number of residues found in quantified concentrations; only food products with at least 100 samples analysed and more than 35% of multiple residues are included.

The highest frequency of multiple residues in unprocessed products (above 60%) was found in currants (black, red and white) (72.6%), sweet cherries (69.2%), grapefruits (68.6%), roman rocket/rucola (67.8%), table grapes (66.1%), lemons (63.6%), strawberries (63.6%) and pears (60.2%).

[68] The 1,513 baby food samples are not included in this analysis.

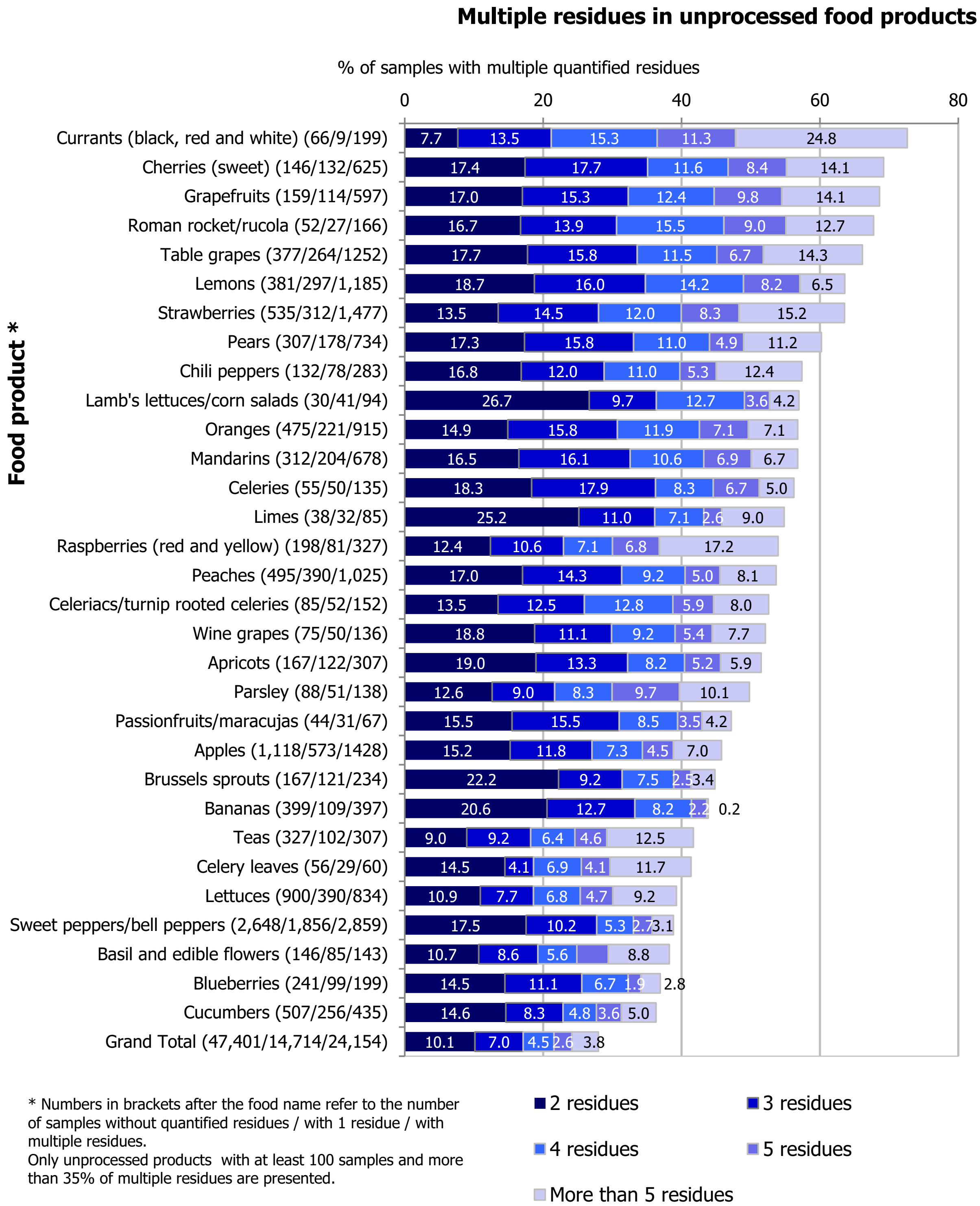

Figure 23: Unprocessed food products most frequently containing multiple quantified residues

A similar analysis was performed for the 8,520 processed food samples broken down by multiple residues. In Figure 24, the results for the top ranked processed food products with multiple residues are broken down by the number of residues found in quantified concentrations; only food products with at least 10 samples analysed are included.

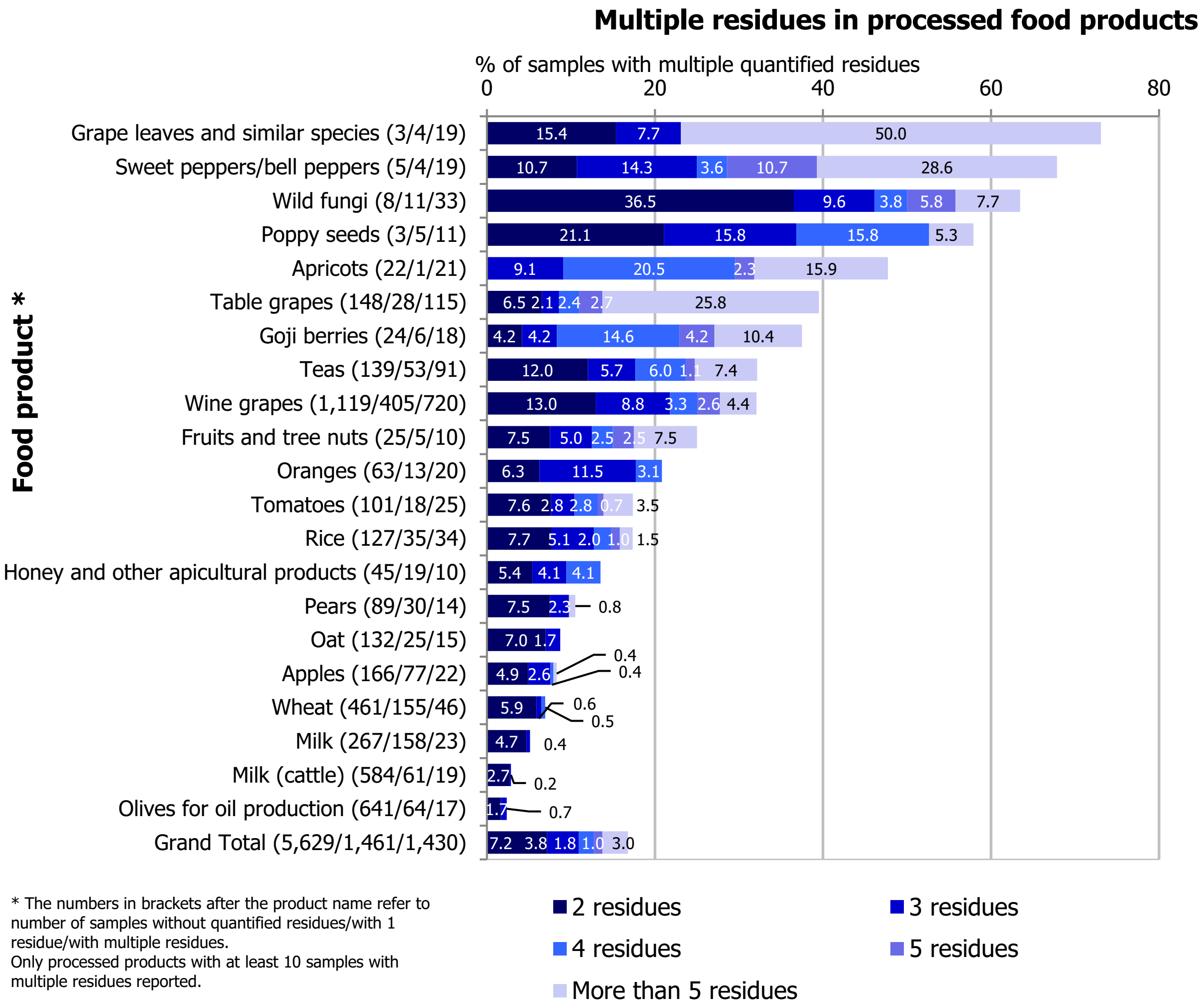

Figure 24: Processed food products most frequently containing multiple quantified residues

The highest frequency of multiple residues (above 40%) was found for grape leaves and similar products (73%), paprika powder (68%), dried mushrooms (63%), poppy seeds (58%) and dried apricots (48%).

4.3. Reasons for MRL exceedances

The legal limits (MRLs) are established based on supervised residue trials that reflect the residue levels expected under field conditions or, for animal products, animal feeding studies based on appropriate dietary requirements of different food producing animals. The MRL value is estimated using statistical methods and is usually established to cover at least the upper confidence interval of the 95th percentile of the expected residue distribution. Therefore, a percentage of approximately 1% of MRL exceedances is expected even if GAPs are fully respected.

In 2019, 3.9% of samples contained pesticide residues exceeding their respective MRLs (3,720 samples). The MRL exceedance rate in 2018 was 4.5%.

Several possible reasons for MRL exceedances are summarised below:

- For samples coming from third countries:
  - The use of non-approved pesticides for which no import tolerance is in place (either because not requested or because having done so, the request was unsuccessful) (e.g. carbendazim in chilli peppers, rice and beans (with pods)).
  - presence of contaminants with unknown origin in concentrations exceeding the legal limit (e.g. anthraquinone in tea and the tea-like beverage mate, nicotine in leafy crops).
- For samples originating from the internal market (reporting countries):

- Good Agricultural Practice (GAP) may not be adhered to changes to the published GAP application rates, pre-harvest intervals, number or method of applications of the pesticide product (e.g. ethion in aubergines).
- Drift-contamination resulting from inappropriate application during adverse weather conditions or unauthorised use of EU approved pesticides in crops where MRLs have not been set,
- Misuses of an approved pesticide: use of an approved pesticide not authorised on the specific crop as recommended in the GAP (e.g. chlorpyrifos in apples and spinach, tebuconazole in spinach)
- Use of non-EU approved pesticides (e.g. chlorfenapyr in tomatoes) that have not been subject to emergency authorisations granted during 2019.
- Changes on the authorisation status within the same year from approval to non-approval without grace period, impacting on agricultural practices.
- Natural presence of the substance in the crop (e.g. CS_2 in brassica and allium vegetables, bromide ion),
- Presence of biocide residues used as pesticides in the past and continuing to be monitored under the pesticide legislation (Regulation (EU) No 528/2013[69]) (e.g. BAC and DDAC in baby food),
- The use of chlorine solutions (chlorine dioxide, chlorite and hypochlorite salts) in treated potable water used as ingredient and/or for cleaning equipment which generate chlorate salts that exceed the default MRL of 0.01 mg/kg,
- Environmental contamination of persistent organic pollutants (POP) included in the Stockholm Convention of prohibited substances (UNEP, 2001). These substances are no longer used as pesticides but are very persistent in the environment and found to contaminate and concentrate in the food chain (e.g. chlordecone in animal commodities but also in root commodities, DDT (RD) in swine fat and milk).

More details on the pesticide/crop combinations exceeding the legal limits are compiled in Annex II.

5. Dietary exposure and analysis of health risks

Regulation (EC) No 396/2005, Article 32, requests EFSA to conduct an analysis on the health-risks to European consumers and publish this within its annual report on pesticide residues. This analysis is based on the results from the official controls provided by reporting countries. The analysis of the risk to health posed by the finding of residues is aided by the assessment of data on food consumption.

In the context of this report, the analysis on the health-risk to consumers has been performed using a deterministic model that bases its calculations on conservative model assumptions.

A more realistic methodology based on probabilistic modelling to exposure to multiple chemicals was developed by EFSA. Cumulative assessment groups (CAGs) (i.e. groups of pesticides that produce similar toxic effects in a specific organ, tissue or system) were established in 2013 and updated in 2019, the cumulative exposure was assessed in 2019 and the cumulative risk characterisation was published in 2020 (EFSA, 2020d,e).

The work conducted in CRA so far has covered the monitoring years 2014–2016. To investigate if exposure patterns have changed during the 3-year cycle for which monitoring data currently is available in EFSA (i.e. 2016–2018), the assessments were repeated with the new data and the results were compared with the previous reference period (i.e. 2014–2016). The report by EFSA (EFSA, 2021a) did not indicate apparent changes in exposure patterns and a repetition of the complete risk characterisation process for 2016–2018 (including analysis of all uncertainties) was deemed unnecessary.

This assessment mentioned above will be repeated upon completion of each 3-year-cycle (i.e. 2018–2020). As new CAGs continue being developed, further exposure and risk characterisation reports will be published together with the analysis of possible differences in the data of the exposure patterns.

Therefore, despite the methodology to multiple pesticides developed by EFSA, exposure assessment for single substances will remain as the tool to identify possible concerns of specific pesticides and food commodities on a yearly basis. However, in future reports on pesticide residues in

[69] Regulation (EU) No 528/2012 of the European Parliament and of the council of 22 May 2012 concerning the making available on the market and use of biocidal products, OJ L167, 27.6.2012, p. 1–123.

food, the deterministic exposure assessments will be accompanied by probabilistic assessments to single substances allowing to quantify better the possible risk encountered, and the uncertainties associated.

In the present report, the deterministic tool used is the Pesticide Residues Intake Model (PRIMo), which integrates the principles of the WHO methodologies for acute and chronic risk assessment (FAO, 2017) and is adjusted to allow for food consumption data from the EU population.

In this report, dietary exposure assessments are performed with revision 3.1 of the PRIMo model (EFSA, 2019c). The file including the exposure assessments is presented in Annex III.

Two types of dietary exposure assessment were performed:

- The acute exposure assessment assumes that a 'large portion' of a commodity is consumed within a short period of time, typically on a single day or meal. There have been no changes to this approach from that published previously (EFSA, 2015a, 2018c).
- The chronic exposure assessment estimates the dietary exposure from the average concentration of a pesticide residue in food commodities present together with the average daily consumption of these over a prolonged period of time. The chronic dietary exposure to pesticides was estimated for all food items for which average consumption data were available in PRIMo revision 3.1 and for which residue concentrations were reported (EFSA, 2019c).

In order to analyse acute (short-term) and chronic (long-term) risks to consumer health, EFSA relates dietary exposure to the amount of a residue consumed with its corresponding health-based guidance value. Health-based guidance values set residue intake levels at a limit, above which possible negative health effects cannot be excluded, i.e. there is a possible risk to consumer health.

- For acute risk assessment, the acute dietary exposure from a pesticide residue is compared to the substance's Acute Reference Dose (ARfD, in mg of residue/kg body weight (bw)).
- For chronic risk assessment, the chronic dietary exposure from a pesticide residue is compared to the substance's Acceptable Daily Intake (ADI, in mg of residue/kg bw per day).

Based on current scientific knowledge, when the dietary exposure to a substance is found to be lower than or equal to its health-based guidance value, the risk to health for the consumer is low. When it exceeds its health-based guidance value then possible negative health outcomes cannot be excluded.

5.1. Acute risk assessment

Monitoring data is reported to EFSA from two different sampling plans. One, the EUCP which undergoes random sampling. The other derives data from the various national programmes that are risk based (Art. 30 of Regulation (EC) No 396/2005). Acute risk assessment is estimated for samples reported as EUCP but also to those samples matching the pesticide/crop combinations as laid down in 2019 EUCP. The ARfD values used in this assessment for the active substances covered by the 2019 EU-coordinated programme are reported in Appendix D.[70]

Overall, this assessment report considers the results submitted for 182[71] pesticides covering the 12 food products in the 2019 EUCP: apples, head cabbages, lettuce, peaches, spinach, strawberries, tomatoes, barley grain, oat grain, wine grapes, swine fat and cattle milk from a total of 19,767 samples. Nearly 36% of samples (7,032 samples) were taken under the framework of the national programmes for the above-mentioned crop/pesticides combinations i.e. based on a targeted (risk-based) sampling strategy. Within these targeted samples, those under import control were also pooled on the assumption that they may have entered the EU market if not stopped at the border.[72]

5.1.1. Methodology for the estimation of acute exposure

The acute dietary exposure to pesticides was calculated using the International Estimation of Acute Intake (IESTI) equation, based on the methodology as described by the experts of the Joint Meeting

70 Not only health-based guidance values used to carry out risk assessments taken note in SCoPAFF meetings are used to carry out the risk assessments, but also recent values derived from EFSA toxicological expert groups not yet voted.

71 The total number of pesticides covered by 2019 EUCP is 182. However, six different scenarios are considered for the different dithiocarbamates, raising the number to 187 pesticides.

72 This assumption is based on the fact that not all the imported goods are stopped at EU borders for control.

on Pesticide Residues (JMPR) (FAO, 2017). This methodology was implemented by EFSA into the PRIMo model as follows:

- Each food item records the highest measured residue concentration reported to EFSA and it is assumed that a large portion[73] per item is consumed. Thus, the highest residue level measured at or above the LOQ was identified for each single pesticide/crop or product combination and used in the acute exposure estimate. This also applied to bulk samples (e.g. barley or oats). To retrieve the highest residue concentration for barley or oats, results from raw grains and whole grain flour[74] were pooled.
- In the case of wine, a large portion was based on the adult consumption data and the calculation from wine grapes to wine consumption employed a wine yield factor of 0.7 (Scholz, 2018). In addition, monitoring results from both red and white wine samples were combined because no differences were observed in the residue levels measured in the two types of wine.
- The residue concentration in the first unit of a food product consumed is typically five to seven times higher than that measured in the samples. The approach followed by EFSA uses the so-called unit variability factor which aims to cover the non-uniform residue distribution among the individual samples. For food commodities with a unit weight of more than 250 g (i.e. head cabbage and lettuce), a variability factor of 5 is applied. For mid-sized products (i.e. apples, peaches and tomatoes) with a unit size anywhere from 25 to 250 g, a variability factor of 7 is applied; no variability factor is used for commodities with unit weights less than 25 g, or composite or animal products (i.e. strawberries, spinach, barley grain, oat grain, wine, swine fat or cattle milk).[75]
- In the 2019 EUCP, default processing factors (PF) for barley flour, oat flour and wine were specified to convert the measured residues back to the raw agricultural products (barley grain, oat grain and wine grapes, respectively). As the proposed PF for the three food products was 1, no refinement using other processing factors was required. The other crops within the 2019 EUCP were possibly consumed raw and therefore no further refinement of the exposure was performed.
- Both surveillance and enforcement samples (EFSA, 2020a) (i.e. sample strategies ST10A, ST20A and ST30A) were used in the estimation of the exposure based on the assumption that enforcement samples may also be placed on the market and consumed by EU citizens, if not removed from the EU food supply at an early stage.
- The exposure calculations were carried out independently for each pesticide/crop or product combination as it is considered unlikely that a consumer would eat two or more different food products in large portions within a short period of time and that all these food products would contain residues of the same pesticide at the highest level observed during the reporting year.
- Pesticide/commodity combinations for which no sample had quantified residues were not considered in the acute exposure assessment. These are assumed to represent a no residue/no exposure situation.
- The exposure estimation to pesticides was based on the residue definition employed for enforcement (which is in accordance with the EU MRL legislation), and not the residue definition for risk assessment. The residue results for commodities tested under the monitoring programmes refer only to the residue definition for enforcement. Currently a comprehensive list of conversion factors between the enforcement definition and the definitions set for risk assessment is not available.

The above bases the acute exposure to pesticides for each food item analysed on the worst assumptions.

[73] Normally, the 97.5th percentile of the daily food consumption reported in food surveys considers only those people who have consumed the pertinent food item during the reference period.
[74] According to the 2019 EUCP control programme, samples of barley and oat whole grain flour could have been taken in case samples of each grain were not available for monitoring purposes.
[75] In 2017, JMPR recommended using a variability factor of 3 (which is the rounded mean of 2.8) for all commodities (FAO, 2017). At EU level, the choice of the most appropriate variability factor to be used for the acute risk assessment is still under discussion. So far, Member States have not agreed to reduce the variability factor.

5.1.2. Results

The results of the acute risk assessment are summarised in Figure 25. The numbers in the cells are read and interpreted based on the following information:

- Numbers in the cells express the exposure to a specific pesticide per commodity as a percentage of the ARfD (or ADI, if ARfD not available). Each result corresponds to the sample containing the highest residue concentration for a given pesticide/food combination (this is the most conservative estimate).
- When no numbers are reported in the cells, either (i) no residues were quantified for that specific pesticide/food combination (i.e. residue concentration < LOQ), (ii) the acute risk assessment is not relevant and therefore not calculated or iii) the acute risk assessment is relevant but not calculated due to the absence of health-based guidance values (i.e. ARfD/ADI values are not available).

The colour of the plot cells should be interpreted as follows:

- White cells in the grid refer to zero quantified residues for specific pesticide/crop combinations (i.e. residue concentration < LOQ) or where an ARfD was unnecessary or not otherwise available.
- Yellow cells refer to pesticide/crop combinations where the exposure was lower than the residue's ARfD, i.e. where values did not exceed 100% of the acute reference value.
- Red cells refer to pesticide/crop combinations where the calculated dietary exposure indicates a potential risk to consumer health because it is higher than the residue's ARfD; light red cells correspond to acute exposure estimates ranging from above 100% to 1000% of the ARfD, and dark red cells correspond to acute exposure estimates above 1000% of the ARfD.
- Grey cells refer to pesticide/crop combinations not covered by the 2019 EUCP.
- Residues marked with an asterisk (*) refer to pesticide/crop combinations with quantified residues for which the health-based guidance values (ADI/ARfD) are not available.

For the acute risk assessment of the 2019 results, EFSA considered the following:

- For bromopropylate (RD), chlordane (RD), heptachlor (RD), hexaconazole (RD) and methoxychlor (RD), the acute risk assessment was performed with the available ADI reference value. ARfD values are not currently available for these pesticides (Figure 25). The use of the ADI instead of the ARfD is an additional conservative element to consider in the risk assessment for these substances. This presents a worse-case scenario and overestimates the result for each of these compounds.
- For the legal residue definition of fenvalerate containing esfenvalerate (a compound with a different toxicological profile) the acute risk assessment was based on the ARfD of the authorised active substance esfenvalerate.
- In most cases, dithiocarbamates were analysed using a common moiety method measuring the generation of CS_2. However, this method has a lack of specificity towards the individual active substances applied in the field. Therefore, a conservative approach involving five different scenarios was used. This approach assumed that the CS_2 concentrations measured, referred exclusively to each dithiocarbamate i.e. either mancozeb, maneb, propineb, thiram or ziram, as each one of these has a different toxicological profile. For metiram, no ARfD was considered necessary. Thus, no metiram scenario is considered.

Among the 182 pesticides in 19,767 food samples, the acute risk assessment results were as follows (Figure 25):

- No health-based guidance values (ARfD/ADI) are available for 6 pesticides: EPN, fenamidone,[76] hexachlorobenzene, hexachlorocyclohexane (alpha), hexachlorocyclohexane (beta) and isocarbophos. These pesticides are marked with footnote c) in Figure 25.

[76] No health-based guidance values were set for fenamidone at the Pesticides Peer Review Experts' Meeting, number 134 (EFSA, 2017a), because of the lack of conclusive data on potential genotoxicity. During the renewal procedure most of the experts considered that the setting of reference values for fenamidone could not be supported because no conclusion on the genotoxic potential of fenamidone could be drawn leading to a critical area of concern. This is the reason why the reference values set in 2003 were not used in the current exposure assessment.

- The setting of an ARfD was not relevant (or not necessary) for 37 pesticides. Therefore, acute adverse effects to the consumer would not be expected for the following substances: 2-Phenylphenol (RD), ametoctradin (RD), azoxystrobin (RD), biphenyl (RD), boscalid (RD), bromide ion (RD), bupirimate (RD), chlorantraniliprole (RD), clofentezine (RD), cyazofamid (RD), cyprodinil (RD), DDT (RD), diethofencarb (RD), diflubenzuron (RD), diphenylamine (RD), ethirimol (RD), etoxazole (RD), fenhexamid (RD), fludioxonil (RD), flufenoxuron (RD), hexythiazox (RD), iprovalicarb (RD), kresoxim-Methyl (RD), lufenuron (RD), mandipropamid (RD), metrafenone (RD), pencycuron (RD), pyrimethanil (RD), pyriproxyfen (RD), quinoxyfen (RD), spinosad (RD), spirodiclofen (RD), tebufenozide (RD), teflubenzuron (RD), tetradifon (RD), tolclofos-Methyl (RD), triflumuron (RD). These pesticides are marked with footnote a) in Figure 25.
- There were no quantified results for 24 pesticides, in the tested samples. The specific pesticides were: 2,4-D (RD), aldicarb (RD), azinphos-Methyl (RD), chlordane (RD), diazinon (RD), dicloran (RD), endosulfan (RD), ethion (RD), fenthion (RD), fluquinconazole (RD), flusilazole (RD), heptachlor (RD), lindane (RD), malathion (RD), methidathion (RD), methoxychlor (RD),[77] monocrotophos (RD), oxydemeton-Methyl (RD), parathion (RD), parathion-methyl (RD), tefluthrin (RD), thiodicarb (RD), triazophos (RD) and vinclozolin (RD). Acute dietary exposure to any of these pesticides would not be expected to pose a concern to consumer health.
- Quantified levels resulting in exposures below their corresponding health-based acute reference values were observed for 87 pesticides. The specific pesticides were: acephate (RD), acrinathrin (RD), bifenthrin (RD), bitertanol (RD), bromopropylate (RD), buprofezin (RD), carbaryl (RD), chlormequat-chloride (RD), chlorothalonil (RD), chlorpropham (RD), chlorpyrifos-methyl (RD), clothianidin (RD), cyfluthrin (RD), cymoxanil (RD), cypermethrin (RD), cyproconazole (RD), cyromazine (RD), dichlorvos (RD), dicofol (RD), dieldrin (RD), difenoconazole (RD), dimethomorph (RD), diniconazole (RD), dithianon (RD), dodine (RD), emamectin (RD), epoxiconazole (RD), etofenprox (RD), famoxadone (RD), fenarimol (RD), fenazaquin (RD), fenbuconazole (RD), fenbutatin oxide (RD), fenitrothion (RD), fenoxycarb (RD), fenpropathrin (RD), fenpropidin (RD), fenpropimorph (RD), fenpyroximate (RD), fenvalerate (RD), fipronil (RD), fluazifop (RD), flubendiamide (RD), fluopyram (RD), flutriafol (RD), fluxapyroxad (RD), fosthiazate (RD), glyphosate (RD), haloxyfop (RD), imidacloprid (RD), indoxacarb (RD), linuron (RD), mepanipyrim (RD), mepiquat chloride (RD), metalaxyl and metalaxyl-M (RD), methamidophos (RD), methiocarb (RD), methoxyfenozide (RD), myclobutanyl (RD), oxadixyl (RD), paclobutrazol (RD), penconazole (RD), pendimethalin (RD), permethrin (RD), pirimiphos-methyl (RD), procymidone (RD), profenofos (RD), propargite (RD), propiconazole (RD), propyzamide (RD), prosulfocarb (RD), prothioconazole (RD), pymetrozine (RD), pyridaben (RD), spiromesifen (RD), spirotetramat (RD), spiroxamine (RD), tau-fluvalinate (RD), tebufenpyrad (RD), terbuthylazine (RD), tetraconazole (RD), thiacloprid (RD), thiamethoxam (RD), thiofanate-methyl (RD), triadimefon (RD), triadimenol (RD) and trifloxystrobin (RD). Acute dietary exposure to these pesticides, would not be expected to be of concern to consumer health.
- There were 28 pesticides quantified in one or more food commodities at levels exceeding their corresponding health-based acute reference values: abamectin (RD), acetamiprid (RD), captan (RD), carbendazim (RD), carbofuran (RD), chlorfenapyr (RD), chlorpyrifos (RD), deltamethrin (RD), dimethoate (RD), dithiocarbamates (RD) (scenarios: maneb, mancozeb, propineb, thiram, ziram), ethephon (RD), fenamiphos (RD), flonicamid (RD), fluopicolide (RD), folpet (RD), formetanate (hydrochloride) (RD), hexaconazole (RD), imazalil (RD), iprodione (RD), lambda-cyhalothrin (RD), methomyl (RD), oxamyl (RD), phosmet (RD), pirimicarb (RD), propamocarb (RD), pyraclostrobin (RD), tebuconazole (RD) and thiabendazole (RD).

The dietary exposure to the 28 pesticides mentioned in the last point exceeded the health-based guidance values in 170 samples out of 19,767 samples (0.9%). The results of the acute exposure assessment reflect the outcome of a deterministic method which uses several conservative assumptions. In all cases, the exposure calculations were performed for extreme consumers, where large portions were considered, the variability factor taken for apples, peaches and tomatoes was 7 (i.e. the highest residue in one individual unit due to a lack of uniformity for the sample, could be seven times higher) and 5 for head cabbage and lettuce. The usual consumer practices of peeling,

[77] Council Decision (EU) 2019/448 of 18 March 2019 on the submission, on behalf of the European Union, of a proposal for the listing of methoxychlor in Annex A to the Stockholm Convention on Persistent Organic Pollutants. OJ L 77, 20.3.2019, p. 74–75.

cooking, frying and baking were not considered to further reduce the residue concentrations in the consumed food. Among the EUCP food items, the ARfD exceedances were distributed in the following way: apples (45 samples), lettuce (41 samples), peaches (40 samples), tomatoes (24 samples), spinach (13 samples), strawberries (6 samples) and head cabbage (1 sample). The available health-based guidance values for acute exposure were not exceeded in cereal grains (barley and oats), wine or animal commodities (swine fat and cow's milk).

The number of samples where the level of a pesticide exceeded their corresponding health-based acute reference values[78] were: chlorpyrifos (RD) (29 samples), lambda-cyhalothrin (RD) (21 samples), pyraclostrobin (RD) (20 samples), deltamethrin (RD) (16 samples), tebuconazole (RD) (16 samples), acetamiprid (RD) (13 samples), ethephon (RD) (6 samples), formetanate (hydrochloride) (RD) (5 samples), phosmet (RD) (5 samples), imazalil (RD) (4 samples), iprodione (RD) (4 samples), carbendazim (RD) (4 samples), methomyl (RD) (4 samples), dimethoate (RD)[79] (3 samples), abamectin (RD) (3 samples), flonicamid (RD) (3 samples), thiabendazole (RD) (3 samples), carbofuran (RD) (2 samples), pirimicarb (RD) (1 sample), hexaconazole (RD) (1 sample), captan (RD) (1 sample), propamocarb (RD) (1 sample), fenamiphos (RD) (1 sample), chlorfenapyr (RD) (1 sample), oxamyl (RD) (1 sample), fluopicolide (RD) (1 sample), folpet (RD) (1 sample)). A more detailed analysis of pesticides (where the sample number was > 10), exceeding their ARfD is presented in the following paragraphs.

Dithiocarbamates (RD)

Concerning the dithiocarbamates, levels exceeding their corresponding health-based acute reference values were found in the following scenarios:

- *mancozeb scenario* in apples,
- *ziram scenario* in apples, lettuce, peaches, spinach and tomatoes,
- *maneb scenario* in apples, lettuce, peaches and tomatoes,
- *propineb scenario* in apples, lettuce, peaches and tomatoes,
- *thiram scenario* in apples, lettuce, peaches, spinach and tomatoes.

Only mancozeb, metiram and ziram were approved for use in the EU in 2019. Exceedances of the ARfD in the case of maneb, propineb and thiram may be disregarded due to these active substances denied regulatory approval in the EU unless an illegal use has occurred.

MRL exceedances were reported for samples of lettuce and spinach. No MRL exceedances were reported for other types of commodities where dithiocarbamates (RD) were to be analysed in accordance with the 2019 EUCP Regulation (i.e. apples, peaches and tomatoes).

Regarding the renewal of the approval status for mancozeb at EU level, it has not been renewed.[80] Metiram and ziram are under renewal process of the approval.

EFSA will perform a comprehensive MRL review (foreseen in 2021) for all authorised uses of the dithiocarbamates, taking into consideration their different approval status, the naturally occurring background levels of CS_2 and any import tolerance in place.

EFSA recommends developing specific analytical methods which identify the individual dithiocarbamates used under field conditions.

Chlorpyrifos (RD) (29)

Chlorpyrifos (RD) exceeded the ARfD in 29 samples. The break-down by commodity is apples (11 samples), peaches (8 samples), tomatoes (7 samples), spinach (2 samples) and lettuce (1 sample). Most were non-compliant samples either falling into a RASFF notification or had a follow-up investigation.

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[78] There were samples with pesticide levels exceeding their corresponding health-based acute reference values more than once due to multiple residues in the same sample.

[79] The estimation of the exposure to pesticides was based on the residue definition for enforcement (RD-Mo) and not the residue definition for risk assessment (RD-RA). This approach may lead for certain substances to an underestimation of consumer exposure (e.g. for dimethoate and omethoate) (EFSA, 2016). In order to perform a more accurate risk assessment, conversion factors would be required to take into account the metabolites relevant for dietary exposure. However, since at the moment a comprehensive database is not available, it was not possible to perform the risk assessment in line with the residue definition for risk assessment.

[80] Commission Implementing Regulation (EU) 2020/2087 of 14 December 2020 concerning the non-renewal of the approval of the active substance mancozeb, 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 Commission Implementing Regulation (EU) No 540/2011. OJ L 423, 15.12.2020, p. 50–52.

In 5 samples, the residue level reported did not exceed the MRL (1 peach sample and 4 tomato samples). The residue level reported in peach was 0.07 mg/kg, lower than the MRL of 0.08 mg/kg (the % of ARfD was 138). Tomato residues were reported at or below the MRL value of 0.1 mg/kg with ARfD exceedances of 115%). The methodology in place for calculating the MRL using the IESTI equation (FAO, 2017) may result in this divergency (EFSA and RIVM, 2015) due to the gap between the highest residue derived from residue trial results and the statistical estimation of the MRL in accordance with the OECD calculator (EFSA, 2017c).

Lambda-cyhalothrin (RD) (21)

Lambda-cyhalothrin (RD) exceeded the ARfD in 21 samples. These were comprised of 6 apple samples, 5 lettuce samples, 5 spinach samples, 4 peach samples and 1 head cabbage sample. Of these, 15 samples were reported to be below the MRL and no actions were taken, despite the exceedances of the ARfD. For apples the highest residue value was reported at the MRL of 0.08 mg/kg leading to 176% of ARfD, for head cabbage the highest residue was 0.12 mg/kg leading to an exceedance of 105%, for lettuce the highest residue reported is 0.14 mg/kg leading to 110% of the ARfD, for peaches a residue level of 0.088 mg/kg led to 170% of the ARfD and for spinach the highest residue level of 0.33 mg/kg led to 147% of the ARfD.

The latest risk assessment model used in the MRL review for lambda-cyhalothrin (EFSA, 2015c) was done using an older revision of the PRIMo model (i.e. rev. 2). This explains the exceedances of the ARfD due to differences in the large portion consumption data incorporated in PRIMo revision 3.1 compared to previously released versions.

Pyraclostrobin (RD) (20)

Pyraclostrobin (RD) exceeded the ARfD in 20 samples (11 samples of lettuce, 7 samples of apples and 2 samples of spinach). Of those, 11 lettuce samples and 6 apples samples did not exceed the MRL.

EFSA's MRL review of pyraclostrobin (EFSA, 2017b) used PRIMo rev. 2. In the most recent revision (3.1), the large edible portion for children in apples was 209.4 g/person whereas previous in revision 2 this was 180.8 g/person.

A more recent EFSA assessment on the modification of the existing MRLs for lettuce using revision 2 of PRIMo anticipated a possible acute intake concern for the intended southern European GAP (EFSA, 2018d). The samples concerned contained residues between 0.8 and 1.44 mg/kg, values that did not exceed the existing MRL of 2 mg/kg. The health-based guidance value (ARfD) of pyraclostrobin for 11 lettuce samples is exceeded, ranging from 102% to 183% of the ARfD. Therefore, EFSA recommends the revision of the MRL in place in Europe for pyraclostrobin in lettuce. Although the risk assessment assumptions are very conservative, EFSA recommends that risk managers should discuss the need for a review of the existing EU MRL for pyraclostrobin on lettuce in view of the overestimation of risk to consumer health.

Deltamethrin (RD) (16)

Deltamethrin (RD) exceeded the ARfD in 16 samples (8 peach samples, 5 lettuce samples, 2 apple samples and 1 spinach sample). All except a sample of spinach, did not exceed the MRL. The MRLs for those commodities were derived using PRIMo revision 2 (EFSA, 2015b) which at the time was considered safe with the then available consumption figures.

Tebuconazole (RD) (16)

Tebuconazole (RD) exceeded the ARfD in 16 peach samples. Of these, 2 samples exceeded the MRL. For the remaining 14 samples, all were below the MRL. The highest residue level reported was 0.591 mg/kg leading to 191% of the ARfD. An EFSA's revision of the GAPs in place (EFSA, 2011) was performed using PRIMo revision 2.

Acetamiprid (RD) (13)

Acetamiprid exceeded the ARfD in 13 samples (9 samples in lettuce and 4 samples, one in each of the following crops: apple, peach, spinach and tomato). Of these, 4 samples exceed the MRL, but the samples are compliant due to measurement uncertainty. However, in one lettuce sample the acute exposure exceeded 450% with a residue concentration of 2.886 mg/kg which is compliant with the existing MRL of 1.5 when taking into consideration the measurement uncertainty. In view of the new

RASFF guidance[81] this sample could have gone under the notification system. For samples not exceeding the MRL (8 lettuce samples and 1 apple sample), the highest exposure exceeded the ARfD (218%) on a lettuce sample with a reported residue level of 1.4 mg/kg. During 2019, the MRLs for acetamiprid changed.[82]

Other pesticides that exceeded the ARfD without breaching the MRL included abamectin (RD) in strawberries and lettuce. These exceedances were due to the use of the most recently derived acute health-guidance value for abamectin (approved at SCoPAFF level 3 December 2020). For captan (RD) in apples, the concentration reported was 3.3 mg/kg which did not exceed the MRL (10 mg/kg), however, exposure was estimated to be 121% of the ARfD. Others included imazalil (RD) in four apple samples, iprodione (RD) in four apple samples, thiabendazole (RD) in three apple samples and propamocarb (RD) in a lettuce sample.

The acute risk assessment of fenamidone (RD), marked with an asterisk in Figure 25, could not be based on ARfD or an ADI from European evaluations, as none have been set. However, an estimated acute exposure using the food consumption data from EFSA PRIMo rev. 3.1 is presented in Table 2.

Table 2: Estimated acute exposure to fenamidone without ARfD/ADI values

Pesticide	Food product	Acute exposure (in mg/kg bw per day)
Fenamidone (RD)	Strawberries	1.0×10^{-3}
	Tomatoes	0.9×10^{-3}
	Lettuce	1.4×10^{-3}
	Wine	2.0×10^{-5}

The detailed acute dietary exposure assessment results for the pesticide residues found in the 12 food products covered by the 2019 EU-coordinated control programme are presented in Appendix D – Figures D.1–D.11. In these charts the results for samples containing residues at or above the LOQ are presented individually, expressing the exposure as a percentage of the ARfD. The different dithiocarbamate scenarios have not been addressed here.

[81] https://ec.europa.eu/food/sites/food/files/safety/docs/rasff_reg-guid_sops_2018_01-06_en.pdf

[82] Commission Regulation (EU) 2019/88 of 18 January 2019 amending Annex II to Regulation (EC) No 396/2005 of the European Parliament and of the Council as regards maximum residue levels for acetamiprid in certain products. OJ L 22, 24.1.2019, p. 1–12.

Pesticides	Apples	Head cabbages	Lettuce	Peaches	Spinach	Strawberries	Tomatoes	Barley	Oat	Wine	Fat (swine)	Milk (cattle)
2,4-D (RD)												
2-Phenylphenol (RD)(a)												
Abamectin (RD)			260			113	58					
Acephate (RD)	3					0.6	2					
Acetamiprid (RD)	101	26	450	112	107	22	184			2		
Acrinathrin (RD)			62	29		5	67					
Aldicarb (RD)												
Ametoctradin (RD)												
Azinphos-Methyl (RD)												
Azoxystrobin (RD)(a)												
Bifenthrin (RD)	0.7		1		0.2	0.2	4					
Biphenyl (RD)(a)												
Bitertanol (RD)				12								
Boscalid (RD)(a)												
Bromide Ion (RD)												
Bromopropylate (RD)(b)	15											
Bupirimate (RD)(a)												
Buprofezin (RD)			43			0.1	0.5					
Captan (RD)	121			14	0.4	31						
Carbaryl (RD)										19		
Carbendazim (RD)	143	31	6	101	20	6	58	0.5		62		
Carbofuran (RD)			52			1,447						
Chlorantraniliprole (RD)(a)												
Chlordane (RD)(b)												
Chlorfenapyr (RD)		5		1			104					
Chlormequat-Chloride (RD)									10			
Chlorothalonil (RD)	0.5	0.3	31	5	8	5	14	0.009				
Chlorpropham (RD)	6	0.2		0.2	0.2	0.06	0.2	0.007	0.002			
Chlorpyrifos (RD)	615	80	144	1,783	2,010	27	2,354	49	4	2		
Chlorpyrifos-Methyl (RD)	4		0.6	9	0.7	2	45	1				
Clofentezine (RD)(a)												
Clothianidin (RD)	1	10	1	3	4	0.2	1					
Cyazofamid (RD)												
Cyfluthrin (RD)	20		29	29	5							
Cymoxanil (RD)			0.7		0.5		6					
Cypermethrin (RD)	26	3	32	50	16	1	16	5			0.02	
Cyproconazole (RD)	7	4		5				2		0.9		
Cyprodinil (RD)(a)												
Cyromazine (RD)							3					
DDT (RD)(a)												
Deltamethrin (RD)	181	10	175	145	114	27	41	42	0.4		0.2	
Diazinon (RD)												
Dichlorvos (RD)						45						

Pesticides	Apples	Head cabbages	Lettuce	Peaches	Spinach	Strawberries	Tomatoes	Barley	Oat	Wine	Fat (swine)	Milk (cattle)
Dicloran (RD)												
Dicofol (RD)				0.5								
Dieldrin (RD)				49							9	
Diethofencarb (RD)(a)												
Difenoconazole (RD)	55	11	41	9	6	12	22	0.2				
Diflubenzuron (RD)(a)												
Dimethoate (RD)	220	21	78	89	36	13	47			0.2		
Dimethomorph (RD)	0.7	0.5	23	0.2	13	0.2	3			0.9		
Diniconazole (RD)	6											
Diphenylamine (RD)(a)												
Dithianon (RD)	50			7								
Dithiocarbamates (RD) - maneb sc.	333		239	130	41	10	106	7	0.1			
Dithiocarbamates (RD) - mancozeb sc.	109		78	42	13	3	35	2	0			
Dithiocarbamates (RD) - metiram sc.(a)												
Dithiocarbamates (RD) - propineb sc.	691		496	269	85	21	219	14	0.2			
Dithiocarbamates (RD) - thiram sc.	1,466		1,051	570	181	45	465	29	0.4			
Dithiocarbamates (RD) - ziram sc.	916		657	356	113	28	291	18	0.2			
Dodine (RD)	39			4	3							
Emamectin (RD)			74	29		3	9					
Endosulfan (RD)												
EPN (RD)(c)												
Epoxiconazole (RD)			0.2	6				2	0.3			
Ethephon (RD)	18						2,093			3		
Ethion (RD)												
Ethirimol (RD)(a)												
Etofenprox (RD)	11		2	15	2	0.1	3					
Etoxazole (RD)												
Famoxadone (RD)							9					
Fenamidone (RD)(c)			*			*	*			*		
Fenamiphos (RD)						18	368					
Fenarimol (RD)			0.2			0.08						
Fenazaquin (RD)	1					0.9	4					
Fenbuconazole (RD)	0.7			9						0.1		
Fenbutatin Oxide (RD)						0.1				0.2		
Fenhexamid (RD)(a)												
Fenitrothion (RD)	25				2							
Fenoxycarb (RD)	0.3			0.1								
Fenpropathrin (RD)						0.3						
Fenpropidin (RD)					2			2				
Fenpropimorph (RD)	3				0.5							
Fenpyroximate (RD)	34			11		16	17					
Fenthion (RD)												
Fenvalerate (RD)												

Pesticides	Apples	Head cabbages	Lettuce	Peaches	Spinach	Strawberries	Tomatoes	Barley	Oat	Wine	Fat (swine)	Milk (cattle)
Fipronil (RD)							10					
Flonicamid (RD)	66		18	54	135		225	5				
Fluazifop (RD)		25	12		58	2						
Flubendiamide (RD)	6			5		0.5	2					
Fludioxonil (RD)(a)												
Flufenoxuron (RD)(a)												
Fluopicolide (RD)	0.06	1	216		11	0.8	2			0.7		
Fluopyram (RD)	5	0.8	16	21	0.09	4	3	0.05		0.2		
Fluquinconazole (RD)												
Flusilazole (RD)												
Flutriafol (RD)	6			3		11	5			3		
Fluxapyroxad (RD)	3	0.4	12	1		0.4	1	0.1	0.04	0.1		
Folpet (RD)	20	0.5		2	0.2	0.2	342		0.01	27		
Formetanate(Hydrochloride) (RD)	11		5	12		180	541					
Fosthiazate (RD)		11					27					
Glyphosate (RD)	2	1	0.8	5	0.5	0.3	0.2	3	0.3	0.2		
Haloxyfop (RD)		0.6										
Heptachlor (RD)(b)												
Hexachlorobenzene (RD)(c)												
Hexachlorocyclohexane, alpha- (RD)(c)												
Hexachlorocyclohexane, beta- (RD)(c)												
Hexaconazole (RD)(b)						1	207					
Hexythiazox (RD)(a)												
Imazalil (RD)	396		2	6	1	0.6	16			1		
Imidacloprid (RD)	3	5	88	13	2	5	55			3		
Indoxacarb (RD)	6	3	22	9	39	1	10					
Iprodione (RD)	386	2	234	40		0.7	101			9		
Iprovalicarb (RD)(a)												
Isocarbophos (RD)(c)												
Kresoxim-Methyl (RD)(a)												
Lambda-cyhalothrin (RD)	479	105	435	171	581	22	46					
Lindane (RD)												
Linuron (RD)			2		4	0.7						
Lufenuron (RD)(a)												
Malathion (RD)												
Mandipropamid (RD)(a)												
Mepanipyrim (RD)						22	12					
Mepiquat Chloride (RD)								0.6	0.3			
Metalaxyl And Metalaxyl-M (RD)	0.2	0.5	5	0.2	0.1	0.4	1			2		
Methamidophos (RD)												
Methidathion (RD)												
Methiocarb (RD)		21	29	17	11	0.1						
Methomyl (RD)			26,482		30	261						
Methoxychlor (RD)(b)												
Methoxyfenozide (RD)	18		0.2	17	5	4	21			4		

Pesticides	Apples	Head cabbages	Lettuce	Peaches	Spinach	Strawberries	Tomatoes	Barley	Oat	Wine	Fat (swine)	Milk (cattle)
Metrafenone (RD)												
Monocrotophos (RD)												
Myclobutanyl (RD)	3		0.2	4		5	3			0.1		
Oxadixyl (RD)										20		
Oxamyl (RD)			117			23						
Oxydemeton-Methyl (RD)												
Paclobutrazol (RD)	2			0.3								
Parathion (RD)												
Parathion-Methyl (RD)												
Penconazole (RD)	0.4			0.4		1	0.5			0.1		
Pencycuron (RD)(a)												
Pendimethalin (RD)	0.4	0.2	1	0.7	0.1	0.6				0.1		
Permethrin (RD)	4		0.7		0.4		0.8	0.03				
Phosmet (RD)	149			409			10					
Pirimicarb (RD)	15	1	51	6	141	16	0.06					
Pirimiphos-Methyl (RD)						0.9	2	15	0.8		0.02	
Procymidone (RD)						3				3		
Profenofos (RD)	0.09											
Propamocarb (RD)		2	132		54	0.3	9	0.003				
Propargite (RD)						0.5						
Propiconazole (RD)	2			5	0.5		0.8	0.1		0.2		
Propyzamide (RD)			6	0.8	0.2	0.09						
Prosulfocarb (RD)	2	0.3			0.4	0.6						
Prothioconazole (RD)		35						0.8	0.7			
Pymetrozine (RD)			26			13	12					
Pyraclostrobin (RD)	234	12	187	81	268	35	40	0.4	0.2			
Pyridaben (RD)	3		1	4		0.6	9					
Pyrimethanil (RD)(a)												
Pyriproxyfen (RD)(a)												
Quinoxyfen (RD)(a)												
Spinosad (RD)(a)												
Spirodiclofen (RD)(a)												
Spiromesifen (RD)		0.04				0.3	1					
Spirotetramat (RD)	1	2	5	1	0.5	1	4			0.2		
Spiroxamine (RD)					0.04	0.2	8	0.3		0.3		
Tau-Fluvalinate (RD)	11	1	0.2	19	8	6	21					
Tebuconazole (RD)	95	69	90	522	3	12	44	5	0.1	2		
Tebufenozide (RD)(a)												
Tebufenpyrad (RD)	36			22		23	52					
Teflubenzuron (RD)(a)												
Tefluthrin (RD)												
Terbuthylazine (RD)				18	4							
Tetraconazole (RD)	53	2		19		4	10	0.6				
Tetradifon (RD)(a)												
Thiabendazole (RD)	385	0.3		1								

Pesticides	Apples	Head cabbages	Lettuce	Peaches	Spinach	Strawberries	Tomatoes	Barley	Oat	Wine	Fat (swine)	Milk (cattle)
Thiacloprid (RD)	61	5	21	61	0.9	30	67					
Thiamethoxam (RD)	0.6	4	20	0.2	0.06	0.6	1			0.2		
Thiodicarb (RD)												
Thiofanate-Methyl (RD)	36	0.5		68	11	0.6	29	0.02		9		
Tolclofos-Methyl (RD)(a)												
Triadimefon (RD)							2					
Triadimenol (RD)	2			1		30	22			3		
Triazophos (RD)												
Trifloxystrobin (RD)	5	1	18	0.7	0.8	4	3					

Pesticides	Apples	Head cabbages	Lettuce	Peaches	Spinach	Strawberries	Tomatoes	Barley	Oat	Wine	Fat (swine)	Milk (cattle)
Triflumuron (RD)(a)												
Vinclozolin (RD)												

Sc.: scenario

(a): No ARfD necessary due to low acute toxicity.

(b): Acute risk assessment was performed with the ADI, since no ARfD is available for the active substance.

(c): No ADI/ARfD allocated; in case quantified residues are reported in one or several commodities, an asterisk (*) is used to highlight it. See exposure assessment in Table 2.

Figure 25: Results of acute dietary risk assessment without risk refinement for the highest residues reported by pesticide/crop combination (values are expressed as a percentage of the health-based acute reference value or ARfD).

5.2. Chronic risk assessment

The chronic risk assessment compares the dietary exposure for a pesticide residue (mg of residue/kg bw per day) to that substance's chronic health-based reference value, the Acceptable Daily Intake (ADI in mg of residue/kg bw per day). The ADI values for all the active substances mentioned in this report are found in Appendix D.[71]

5.2.1. Methodology for the estimation of chronic exposure

The chronic exposure assessment estimates the dietary exposure to pesticides from food over a long period aiming at predicting the lifetime exposure to pesticide residues in the diet. Its calculation is based on a deterministic approach developed by JMPR (FAO, 2017). It consists of multiplying the average measured pesticide concentration by the average commodity's daily intake consumption per capita and summing up the results for all commodities within a particular dietary plan.

The assessment deals with samples submitted by the reporting countries for the pesticides covered by the 2019 EUCP and the unprocessed products covered by Annex I (part A) of Reg. (EC) No 396/2005. In total, 79,895 samples were pooled from the EUCP and national programmes.

EFSA calculated three scenarios for chronic exposure assessment and risk assessment: the lower bound scenario, the middle bound scenario and the adjusted upper bound scenario.

- The lower bound scenario assumes that samples with non-quantified residues (i.e. samples with residue levels < LOQ) are treated as if the residues are not present in the food product analysed. This scenario is less conservative than the others, and it may result in an underestimation of chronic exposure.
- The adjusted middle bound scenario assumes that samples with non-quantified residues (i.e. samples with residue levels < LOQ) are present in the sample at level of LOQ/2.[83] This results in an overestimated scenario than the previous one and contributing to a likely overestimate of the chronic exposure.
- The adjusted upper bound scenario assumes that samples with non-quantified residues (i.e. samples with residue levels < LOQ) are present in the sample at the level of LOQ.[77] This scenario is the most overestimated.

The lower, adjusted middle and adjusted upper bound assessments are used by EFSA to frame the boundaries of a more realistic exposure estimate to pesticide residues. The use of limit of detection (LOD) to refine the adjusted middle or upper bound is not used by reporting countries as they do not systematically report these levels. The aim of the different scenarios is to better address the uncertainties linked to the presence of residues at levels below the LOQ.

For the three scenarios, the following assumptions were considered:

- The mean residue concentration from the analytical results for any given pesticide/crop combination, was used.
- Only results for unprocessed products with availability of consumption data were used for this exposure calculation.
- Only data on the 182 pesticides of the 2019 EUCP and for which the analysis covered their full RD were used. Results of part of a residue definition (i.e. reported as P002A[84]) were not taken into consideration.
- Results from samples analysed with analytical methods for which the LOQ was greater than the corresponding MRL were disregarded.
- If results reported for a given pesticide/crop combination were below the LOQ for all samples analysed, this pesticide/crop combination was excluded from the calculations.
- Both surveillance and enforcement samples (EFSA, 2020a–e) (i.e. sample strategies ST10A, ST20A and ST30A) were used in the estimation of the exposure in recognition that enforcement

[83] To judge on samples reported without quantifiable residues, SANCO/12574/2015 (rev. 5) (European Commission, 2018) was applied in those cases of multicomponent residue definitions when resInfo.notSummed=Y. EFSA calculated the sum LOQ based on the individual LOQ reported and the molecular weight factor. This recalculation was used when calculating the mean middle bound and upper bound scenarios. In case no individual LOQs were reported, EFSA did not recalculate a summed LOQ and disregarded the record.

[84] P002A in accordance with ChemMon Guidance means results reported as part of a residue definition for pesticide residues, i.e. individual components of a multicomponent residue definition.

samples are also placed on the market and consumed by EU citizens, if not destroyed at an early stage.
- Residue levels of fat soluble pesticides in milk and egg samples for which results were expressed on a fat basis, were recalculated for the whole product (if fat content was not reported), assuming a default fat content of 4% in milk and 10% in eggs (FAO, 2017). This approach was implemented only in the case of samples with quantified residues (results ≥ LOQ).
- Similar to the situation with acute exposure assessments, the estimation of chronic exposure is also based on the residue definition for enforcement and not the residue definition for risk assessment. This approach should be supplemented with an assessment based on the residue definition for risk assessment. However, until a comprehensive list of conversion factors between the enforcement and the risk assessment residue definitions is available, this cannot be achieved.

5.2.2. Results

The results of the chronic exposure assessment expressed as percentage of the ADI for each pesticide (lower bound, adjusted middle bound and adjusted upper bound scenarios) are reported in Table 3.

For the legal residue of fenvalerate containing esfenvalerate, a compound with a different toxicological profile, the chronic risk assessment was based on the ADI of the authorised active substance esfenvalerate.

For dithiocarbamates, six scenarios were calculated considering that the measured CS_2 concentrations originated exclusively from maneb, mancozeb, metiram, propineb, thiram or ziram, each with a different ADI.

Table 3: Results of the chronic dietary exposure assessment

Pesticide	Chronic exposure (in % of ADI)		
	Lower bound	Middle bound	Ad. upper bound
2,4-D (RD)	0.31	12.6	25.1
2-Phenylphenol (RD)	0.14	1.5	3.0
Abamectin (RD)	0.07	2.6	5.2
Acephate (RD)	0.02	0.3	0.58
Acetamiprid (RD)	0.43	2.9	5.8
Acrinathrin (RD)	0.01	0.7	1.3
Aldicarb (RD)	n.r.		
Ametoctradin (RD)	0.0003	0.01	0.02
Azinphos-Methyl (RD)	0.0003	0.22	0.43
Azoxystrobin (RD)	0.15	1.50	3.0
Bifenthrin (RD)	0.14	1.00	2.0
Biphenyl (RD)	0.003	0.09	0.18
Bitertanol (RD)	0.005	0.75	1.5
Boscalid (RD)	1.5	7.15	14.3
Bromide ion (RD)**	1.2	7.35	14.7
Bromopropylate (RD)	0.001	0.20	0.4
Bupirimate (RD)	0.015	0.55	1.1
Buprofezin (RD)	0.17	3.05	6.1
Captan (RD)	2.2	8.40	16.8
Carbaryl (RD)	0.12	2.95	5.9
Carbendazim (RD)	0.27	2.05	4.1
Carbofuran (RD)	0.08	15.00	30.0
Chlorantraniliprole (RD)	0.005	0.05	0.10
Chlordane (RD)	0.00001	0.04	0.08

Pesticide	Chronic exposure (in % of ADI)		
	Lower bound	Middle bound	Ad. upper bound
Chlorfenapyr (RD)	0.06	0.25	0.49
Chlormequat-Chloride (RD)	1.3	7.40	14.8
Chlorothalonil (RD)	0.2	9.25	18.5
Chlorpropham (RD)	2.3	3.00	6.0
Chlorpyrifos (RD)	7.7	140	272
Chlorpyrifos-Methyl (RD)	0.29	8.35	16.7
Clofentezine (RD)	0.012	2.00	4.0
Clothianidin (RD)	0.012	0.35	0.69
Cyazofamid (RD)	0.003	0.08	0.15
Cyfluthrin (RD)	0.067	8.15	16.3
Cymoxanil (RD)	0.004	0.43	0.85
Cypermethrin (RD)	0.111	2.90	5.8
Cyproconazole (RD)	0.002	0.60	1.2
Cyprodinil (RD)	0.62	4.50	9.0
Cyromazine (RD)	0.02	0.11	0.22
DDT (RD)	0.04	6.40	12.8
Deltamethrin (RD)	0.77	9.85	19.7
Diazinon (RD)	0.80	11.15	22.3
Dichlorvos (RD)	0.12	13.70	27.4
Dicloran (RD)	0.001	0.13	0.25
Dicofol (RD)	0.08	0.28	0.563
Dieldrin (RD)	0.427	231	461
Diethofencarb (RD)	0.00004	0.03	0.054
Difenoconazole (RD)	0.54	8.10	16.2
Diflubenzuron (RD)	0.003	0.55	1.1
Dimethoate (RD)	0.54	13.70	27.4
Dimethomorph (RD)	0.13	1.25	2.5
Diniconazole (RD)	0.0003	0.31	0.617
Diphenylamine (RD)	0.001	0.22	0.438
Dithianon (RD)	1.1	4.05	8.1
Dithiocarbamates (RD) – maneb sc.	3.9	10.95	21.9
Dithiocarbamates (RD) – mancozeb sc.	4.1	11.35	22.7
Dithiocarbamates (RD) – metiram sc.	28.6	89.8	159
Dithiocarbamates (RD) – propineb sc.	28.6	89.8	159
Dithiocarbamates (RD) – thiram sc.	11.4	31.75	63.5
Dithiocarbamates (RD) – ziram sc.	38.2	120	212
Dodine (RD)	0.08	0.13	0.259
Emamectin (RD)	0.131	6.45	12.9
Endosulfan (RD)	0.001	0.27	0.533
EPN (RD)*	n.r.		
Epoxiconazole (RD)	0.07	5.55	11.1
Ethephon (RD)	1.3	2.00	4.0
Ethion (RD)	0.01	0.24	0.47
Ethirimol (RD)	0.008	0.39	0.78
Etofenprox (RD)	0.31	2.80	5.6
Etoxazole (RD)	0.004	0.40	0.8
Famoxadone (RD)	0.085	3.85	7.7

Pesticide	Chronic exposure (in % of ADI)		
	Lower bound	Middle bound	Ad. upper bound
Fenamidone* (RD)	No ADI		
Fenamiphos (RD)	0.03	3.90	7.8
Fenarimol (RD)	0.002	0.30	0.6
Fenazaquin (RD)	0.088	4.05	8.1
Fenbuconazole (RD)	0.068	5.45	10.9
Fenbutatin Oxide (RD)	0.011	4.15	8.3
Fenhexamid (RD)	0.089	0.70	1.4
Fenitrothion (RD)	0.003	1.25	2.5
Fenoxycarb (RD)	0.009	1.00	2.0
Fenpropathrin (RD)	0.027	0.90	1.8
Fenpropidin (RD)	0.018	0.65	1.3
Fenpropimorph (RD)	0.191	9.05	18.1
Fenpyroximate (RD)	0.035	3.10	6.2
Fenthion (RD)	0.006	0.50	1.0
Fenvalerate (RD)	0.005	0.80	1.6
Fipronil (RD)	0.581	18.35	36.7
Flonicamid (RD)	0.439	8.65	17.3
Fluazifop (RD)	0.03	1.90	3.8
Flubendiamide (RD)	0.006	1.15	2.3
Fludioxonil (RD)	0.259	1.25	2.5
Flufenoxuron (RD)	0.004	0.02	0.04
Fluopicolide (RD)	0.056	0.35	0.7
Fluopyram (RD)	0.97	9.35	18.7
Fluquinconazole (RD)	n.r.		
Flusilazole (RD)	0.054	0.20	0.4
Flutriafol (RD)	0.088	3.60	7.2
Fluxapyroxad (RD)	0.258	4.75	9.5
Folpet (RD)	0.041	1.20	2.4
Formetanate (Hydrochloride) (RD)	0.095	2.70	5.4
Fosthiazate (RD)	0.038	1.00	2.0
Glyphosate (RD)	0.034	0.10	0.2
Haloxyfop (RD)	1.4	5.30	10.6
Heptachlor (RD)	n.r.		
Hexachlorobenzene (RD)*			
Hexachlorocyclohexane, (alpha)* (RD)			
Hexachlorocyclohexane, (beta)* (RD)			
Hexaconazole (RD)	0.009	0.60	1.2
Hexythiazox (RD)	0.02	2.30	4.6
Imazalil (RD)	15	14.30	28.6
Imidacloprid (RD)	0.052	1.15	2.3
Indoxacarb (RD)	0.376	8.80	17.6
Iprodione (RD)	0.116	15.80	31.6
Iprovalicarb (RD)	0.052	0.70	1.4
Isocarbophos (RD)*	n.r.		
Kresoxim-Methyl (RD)	0.001	0.05	0.1
Lambda-cyhalothrin (RD)	0.98	11.85	23.7
Lindane (RD)	0.0003	0.35	0.7

Pesticide	Chronic exposure (in % of ADI)		
	Lower bound	Middle bound	Ad. upper bound
Linuron (RD)	0.107	0.65	1.3
Lufenuron (RD)	0.016	0.95	1.9
Malathion (RD)	0.085	13.25	26.5
Mandipropamid (RD)	0.023	0.25	0.5
Mepanipyrim (RD)	0.027	1.20	2.4
Mepiquat chloride (RD)	0.055	0.85	1.7
Metalaxyl and metalaxyl-M (RD)	0.025	0.95	1.9
Methamidophos (RD)	0.138	1.65	3.3
Methidathion (RD)	0.004	2.25	4.5
Methiocarb (RD)	0.004	0.65	1.3
Methomyl (RD)	0.234	0.90	1.8
Methoxychlor (RD)	n.r.		
Methoxyfenozide (RD)	0.036	1.25	2.5
Metrafenone (RD)	0.025	0.15	0.3
Monocrotophos (RD)	0.036	1.65	3.3
Myclobutanyl (RD)	0.253	3.70	7.4
Oxadixyl (RD)	0.012	0.30	0.6
Oxamyl (RD)	0.003	1.00	2.0
Oxydemeton-Methyl (RD)	0.001	0.65	1.3
Paclobutrazol (RD)	0.001	1.10	2.2
Parathion (RD)	0.2×10^{-6}	0.01	0.013
Parathion-Methyl (RD)	0.005	0.75	1.5
Penconazole (RD)	0.028	0.65	1.3
Pencycuron (RD)	0.001	0.02	0.04
Pendimethalin (RD)	0.002	0.10	0.2
Permethrin (RD)	0.009	0.35	0.7
Phosmet (RD)	5.4	5.30	10.6
Pirimicarb (RD)	0.094	1.20	2.4
Pirimiphos-Methyl (RD)	6.6	45.35	90.7
Procymidone (RD)	0.064	0.15	0.3
Profenofos (RD)	0.002	1.35	2.7
Propamocarb (RD)	0.09	0.25	0.5
Propargite (RD)	0.003	0.03	0.05
Propiconazole (RD)	0.856	3.70	7.4
Propyzamide (RD)	0.001	0.06	0.12
Prosulfocarb (RD)	0.065	2.10	4.2
Prothioconazole (RD)	0.006	0.95	1.9
Pymetrozine (RD)	0.016	0.30	0.6
Pyraclostrobin (RD)	0.415	2.45	4.9
Pyridaben (RD)	0.033	3.85	7.7
Pyrimethanil (RD)	1.1	4.55	9.1
Pyriproxyfen (RD)	0.02	0.44	0.88
Quinoxyfen (RD)	0.002	0.04	0.08
Spinosad (RD)	0.19	4.15	8.3
Spirodiclofen (RD)	0.13	4.80	9.6
Spiromesifen (RD)	0.033	0.28	0.55
Spiroxamine (RD)	0.019	3.00	6.0

Pesticide	Chronic exposure (in % of ADI)		
	Lower bound	Middle bound	Ad. upper bound
Spirotetramat (RD)	0.14	3.90	7.8
Tau-Fluvalinate (RD)	0.133	6.65	13.3
Tebuconazole (RD)	0.266	2.10	4.2
Tebufenozide (RD)	0.084	4.30	8.6
Tebufenpyrad (RD)	0.05	3.35	6.7
Teflubenzuron (RD)	0.018	2.25	4.5
Tefluthrin (RD)	0.016	1.90	3.8
Terbuthylazine (RD)	0.001	0.13	0.26
Tetraconazole (RD)	0.117	6.40	12.8
Tetradifon (RD)	4×10^{-5}	0.02	0.04
Thiabendazole (RD)	1.4	4.30	8.6
Thiacloprid (RD)	0.50	3.10	6.2
Thiamethoxam (RD)	0.042	1.25	2.5
Thiodicarb (RD)	0.006	0.03	0.06
Thiofanate-Methyl (RD)	0.102	1.55	3.1
Tolclofos-Methyl (RD)	0.001	0.08	0.15
Triadimefon (RD)	0.001	0.06	0.12
Triadimenol (RD)	0.005	0.45	0.90
Triazophos (RD)	0.031	1.10	2.2
Trifloxystrobin (RD)	0.065	0.70	1.4
Triflumuron (RD)	0.178	1.05	2.1
Vinclozolin (RD)	n.r.		

*: Active substance for which no ADI was established.
**: Tentative risk assessment based on ADI of 1 mg/kg bw per day set by JMPR (FAO, 1988).
n.r.: No quantified residues in any of the samples analysed.
sc.: scenario.

No chronic consumer intake concerns or risks to health were identified for any of the European diets incorporated in PRIMo rev. 3.1 when the risk assessment was based on the lower bound scenario. The top 3 highest chronic risk estimates corresponded to dithiocarbamate (RD) scenarios: ziram 38.2% of the ADI (IT, adult), propineb 28.6% of the ADI (IT, adult) and metiram 28.6% of the ADI (NL, toddler), followed by imazalil (RD) with 15% of the ADI (DE, child).

When chronic risk assessment was based on the most conservative adjusted upper bound scenario, the chronic intake for dieldrin (RD) was up to 461% of the ADI (NL, toddler). The major food contributors to the total chronic exposure were milk (411.1% of ADI), bovine meat (26.3% of ADI) and carrots (12.6% of ADI). Under the adjusted middle bound scenario, the total chronic intake decreased to 231% of ADI (NL, toddler) due to the lowering of the LOQ value. From the comparison with the lower bound exposure, it can be concluded that the middle and upper bound exposures to dieldrin (RD) are entirely driven by the assumptions applied to the left censored data, especially for the milk samples. The same finding was observed in the 2016 report (EFSA, 2018c). EFSA recommends official laboratories to adjust their analytical method for dieldrin (RD) to 0.002 mg/kg, i.e. a lower LOQ value in line with the recent validation conducted by the EURL-AO.[85] During the EUPT-AO-13,[86] the assigned value for dieldrin present in milk powder was 0.045 mg/kg with 87% of laboratories having acceptable z-scores. However, this value was not low enough to reach the MRL in place of 0.006 mg/kg. EFSA recommends EURLs, lowering the Minimum Required Reporting Levels (MRRLs)[87] on their EUPT especially for those substances with low MRLs.

Chlorpyrifos (RD) had the second highest exceedance of the ADI when the chronic risk assessment was based on the more conservative adjusted upper bound scenario, presenting a value that was 272% of the ADI (NL, toddler). The major food contributors to the total chronic exposure were

[85] EURL_AO_Validation_report_2020-01_GCMSMS_and_GC-HRMS_quantification_milk.pdf
[86] https://www.eurl-pesticides.eu/docs/public/tmplt_article.asp?LabID=300&CntID=1081&Theme_ID=1&Pdf=False&Lang=EN
[87] https://www.eurl-pesticides.eu/docs/public/tmplt_article.asp?CntID=821&LabID=100&Lang=EN

bananas (192% of ADI), wheat (21.4% of ADI) and oranges (20.8% of ADI). Under the assumptions used in the middle bound scenario, the exceedance decreases to 140% of ADI (NL, toddler). However, in these more conservative scenarios, the highest contribution to the risk assessment comes from the use of left-censored determinations in samples with non-quantified residues. It must be noted that the MRL in place in 2019 for bananas was 4 mg/kg. MRL values are expected to be reflected on the LOQs at which laboratories validate their analytical method. Therefore, a high MRL for chlorpyrifos in bananas might explain the high contribution to the upper and middle bound scenarios of the left censored values. Recently, the MRL has been lowered to the LOQ of 0.01 mg/kg.[88] EFSA recommends official laboratories to adjust their analytical methods taking into account the new MRL.[89]

The dithiocarbamates (RD) family exceeded the ADI with the more conservative adjusted upper bound scenario for the following active substances:

- ziram (212% of ADI – NL, toddler). The major food contributors to the total chronic exposure were 57.1% of the ADI in apples, 33.7% in oranges and 29.9% in pears,
- metiram (159% of ADI – NL, toddler). The major food contributors to the total chronic exposure were 42.8% of the ADI in apples, 25.3% in oranges and 22.4% in pears,
- propineb (159% of ADI – NL, toddler). The major food contributors to the total chronic exposure were 42.8% of the ADI in apples, 25.3% in oranges and 22.4% in pears.

The propineb scenario can be disregarded as it was not authorised in 2019 and therefore unlikely to occur in foodstuffs. Both the ziram and metiram scenarios are influenced by the LOQ value contributions in a classical method that degrades the dithiocarbamates to CS_2.[90] Although official laboratories undergo good performance in the EUPT,[91] EFSA recommends that analytical methods are developed to be selective for each dithiocarbamate and so avoid the uncertainty related to the assignment of the measurements to specific active substances.

In the upper bound scenario, the estimated chronic exposure for 136 pesticides/scenarios was less than 10% of the ADI whereas for 51 of them, the result was lower or equal to 1% of the ADI.

For aldicarb (RD), EPN (RD), fluquinconazole (RD), heptachlor (RD), isocarbophos (RD), methoxychlor (RD) and vinclozolin (RD) covered by the 2019 EUCP, quantifiable residues were not reported for any of the food items tested.

The active substances fenamidone, hexachlorobenzene, hexachlorocyclohexane (alpha)[92] and hexachlorocyclohexane (beta) were quantified in one or more food commodities. As no internationally agreed health-based guidance values are currently set for these pesticides, no exposure could be calculated.[93] EFSA recommends deriving these values. An estimation of chronic exposure using the food consumption in EFSA PRIMo rev. 3.1, is reported in Table 4.

For bromide ion, a tentative risk assessment was carried out based on an ADI of 1 mg/kg bw[94] per day set by JMPR (FAO, 1988). In all scenarios, the exposure to the naturally occurring bromide ion was below this ADI.

88 Corrigendum to Commission Regulation (EU) 2020/1085 of 23 July 2020 amending Annexes II and V to Regulation (EC) No 396/2005 of the European Parliament and of the Council as regards maximum residue levels for chlorpyrifos and chlorpyrifos-methyl in or on certain products. OJ L245, 30.7.2020, p. 31–42.

89 EURL-FV validation of chlorpyrifos in banana: https://www.eurl-pesticides.eu/userfiles/file//2020_M36.pdf

90 https://www.eurl-pesticides.eu/library/docs/srm/meth_DithiocarbamatesCs2_EurlSrm.PDF

91 https://www.eurl-pesticides.eu/library/docs/srm/EUPT_SRM12_FinalReport.pdf

92 Results were reported only in 'Other farm animals' to which no consumption data is available.

93 In the framework of the Pesticides Peer Review Experts' Meeting 134 on fenamidone (EFSA, 2017a), no health-based guidance values were set because of the lack of conclusive data on the potential genotoxicity. During the renewal procedure, most of the experts considered that the setting of reference values of fenamidone cannot be supported because of no conclusion on the genotoxic potential of fenamidone could be drawn leading to a critical area of concern. That is why the reference values set in 2003 were not used in the exposure assessment.

94 The JMPR ADI uses human data. If this substance would have been characterised under the European principles the ADI would probably be one order of magnitude lower. In EFSA's scientific report where the CAGs for the thyroid were established, the NOAEL for hypothyroidism was set at 12 mg/kg bw per d on the basis of rat studies (EFSA, 2019a).

Table 4: Results of chronic exposure assessment for active substances without ADI values

Pesticide	Chronic exposure (in mg/kg bw per day)		
	Lower bound approach	**Adjusted middle bound approach**	**Adjusted upper bound approach**
Fenamidone	2×10^{-6}	3.5×10^{-4}	7×10^{-4}
Hexachlorobenzene (HCB)	2×10^{-7}	2×10^{-5}	4×10^{-5}
Hexachlorocyclohexane (beta)	4×10^{-7}	1×10^{-5}	2×10^{-5}

In general, the estimated exposure was notably lower in the lower bound scenario compared to the adjusted upper bound approach. EFSA noted that the high proportion of samples with pesticide residues below the LOQ may result in particularly high upper bound exposure values due to the assumption that even if not quantified, residues are present in all samples at the level of LOQ. This ensures a high level of conservatism within the exposure assessment methodology, basing it on the sensitivity of the analytical equipment used and the LOQ value derived. Furthermore, high LOQs explain the differences in the exposure estimates between the lower bound, middle and upper bound scenarios. High LOQs reported to EFSA might be reporting levels (RL) which could be equal or higher to the LOQ (European Commission, 2020).

Taking into consideration all food items for which consumption data are provided in PRIMo rev. 3.1, the highest contributors to the overall EU pesticide dietary exposure remain those food items covered by the 3-year cycle of the EU-coordinated programme. This can be seen in Annex III, on the contribution to chronic exposure of 'other products'.

Based on the results of the 2019 pesticide monitoring programmes (EUCP and NP), EFSA concludes that where health-based guidance values are available, the chronic dietary exposure to pesticides is unlikely to pose a risk to EU consumer health.

6. Conclusions and recommendations

The 2019 EU report on pesticide residues in food, prepared by EFSA in accordance with Article 32 of Regulation (EC) No 396/2005, provides an overview of the official control activities on pesticide residues carried out in the EU Member States[1], Iceland and Norway.

Overall, the number of samples analysed by reporting countries for pesticide residues (i.e. 96,302), increased by 5.8% compared with 2018 (91,015). The MRL exceedance rate decreased from 4.5% in 2018 to 3.9% in 2019; the non-compliance rate decreased from 2.7% in 2018 to 2.3% in 2019. Regarding the country of origin, the sampling rate of commodities produced in EU remains practically the same from 2018 to 2019 (62.9%–63.5%, respectively), and a similar situation exists for third countries (26.9%–25.3%, respectively). The number of samples with unknown origin also remains steady (10.1% in 2018 vs. 11.3% in 2019) but is still considered high. Detailed reporting by Member States is encouraged by EFSA to help improve the accuracy of these findings.

The random sampling of the main EUCP commodities consumed by EU citizens (i.e. apples, head cabbages, lettuce, peaches, spinach, strawberries, tomatoes, oat grain, barley grain, red or white wine, swine fat and cow's milk) provides a snapshot of the level of pesticide residues in those food products. These results are presented in Annex I[2] allowing stakeholders to scroll through the results. As sampled commodities in the 2019 and 2016 EUCPs were not completely aligned, no direct overall comparison of MRL exceedance can be drawn. When arranged according to food commodities, the individual MRL exceedance rate increased from 2016 to 2019 in strawberries (from 1.8% to 3.3%), head cabbages (from 1.1% to 1.9%), wine grapes[95] (from 0.4% to 0.9%) and swine fat (from 0.1% to 0.3%). In contrast, the rate decreased in 2019 compared to 2016 for peaches (from 1.9% to 1.5%), lettuce (from 2.4% to 1.8%), apples (from 2.7% to 2.1%) and tomatoes (from 2.6% to 1.7%). For cattle milk the situation remains steady with no MRL exceedances for both time periods.

The results from the residue monitoring programmes are a valuable source of information for estimating the dietary exposure of EU consumers. In the context of this report, the analysis on the

[95] The EUCP Regulation listed wine as a food commodity to be sampled during 2019. When aa competent authority checks for MRL compliance, it does so against the MRL set in wine grapes and reports it to EFSA. Therefore, the recommendation derived here refers to *wine grapes* to which the MRL is set. Furthermore, the competent authority reports, the country of origin. In this case, the origin of the sample refers to the *wine* as it is not possible to know whether the wine grapes used to make the wine were grown in the EU or outside.

health-risk to consumers has been performed using a deterministic model to single pesticide residues (not to all the pesticides together though) that bases its calculations on conservative model assumptions. PRIMo rev. 3.1 was this deterministic model used to perform acute risk assessment for the pesticide/food product combinations covered by the 2019 EUCP and chronic risk assessment to all raw commodities for which consumption data were available under PRIMo rev. 3.1 and the pesticides listed in the 2019 EUCP.

The acute exposure assessment was carried out for 182 pesticides on 19,767 samples. The health-based guidance value (ARfD) was found to be exceeded in 0.9% of these samples. The pesticides found most responsible (more than 10 samples) included chlorpyrifos (RD) (29 samples), lambda-cyhalothrin (RD) (21), pyraclostrobin (RD) (20), deltamethrin (RD) (16), tebuconazole (RD) (16) and acetamiprid (RD) (13). These results are based on a deterministic method which uses several highly conservative assumptions. On this basis and on the fact that under the European Rapid Alert System samples may be withdrawn from the market when there is a non-compliant result and/or a result that exceeds the health-based guidance value (ARfD), EFSA considers unlikely that this limited number indicates any concern for consumer health. Nevertheless, EFSA will develop in the next report a new approach based on probabilistic modelling to single substances to perform more refined risk assessments.

The chronic exposure assessment was conducted on 79,895 samples. In general, the estimated exposure was notably lower in the lower bound scenario compared to the adjusted upper bound approach. EFSA noted that the high proportion of samples with pesticide residues below the limit of quantification (LOQ), may result in particularly high upper bound exposure values due to the assumption that even if not quantified, residues are present in all samples at the level of LOQ. This ensures a high level of conservatism within the exposure assessment methodology, basing it on the sensitivity of the analytical equipment used and the LOQ value derived. Furthermore, high LOQs explain the differences in the exposure estimates between the lower bound and the middle/upper bound scenarios. Therefore, EFSA concludes that according to current scientific knowledge, chronic dietary exposure to the 182 pesticide residues of the 2019 EUCP is unlikely to pose any concern for EU consumer health.

Based on the 2019 pesticide monitoring findings, EFSA recommends the following:

- Considering that the EUCP sampling is not only used for evaluating MRL compliance but also for performing deterministic and probabilistic exposure assessments to individual and multiple pesticides, EFSA recommends revisiting the minimum number of samples to be taken by commodity and their distribution among EU Member States.
- Several EU non-approved pesticides were found repeatedly in randomly sampled food grown in the EU at levels exceeding the legal limits, e.g.:
  - apples: acephate (RD), chlorpropham (RD),
  - lettuce: chlorothalonil (RD),
  - peaches: dieldrin (RD), iprodione (RD),
  - spinach: chlorothalonil (RD), clothianidin (RD), cyfluthrin (RD), methomyl (RD),
  - strawberries: carbofuran (RD),
  - tomatoes: chlorfenapyr (RD), triadimefon (RD),
  - wine grapes[94]: iprodione (RD) and oxadixyl (RD).

Since these results indicate possible misuses of non-approved active substances, it is recommended that Member States follow-up on these findings, investigating the reasons for their presence and/or use and taking corrective measures where appropriate.

- Similarly, several EU non-approved pesticides were found in concentrations exceeding the legal limit in randomly sampled food grown in third countries:
  - head cabbage: clothianidin (RD) and thiamethoxam (RD),
  - lettuce: permethrin (RD),
  - spinach: permethrin (RD) and clothianidin (RD),
  - strawberries: dichlorvos (RD),
  - tomatoes: acephate (RD), chlorfenapyr (RD), fipronil (RD), permethrin (RD).

EFSA recommends follow-up by Member States on import controls for these pesticides/crop combinations.

- Due to the high MRL exceedance rate observed in spinach (6.7%) and the presence of up to 5 non-approved pesticides all exceeding their legal limits (chlorothalonil (RD), clothianidin (RD), cyfluthrin (RD), methomyl (RD) and permethrin (RD)), it is recommended to keep monitoring spinach within the EU-coordinated programme.
- The detection rate of persistent organic pollutants (POPs) in milk in 2019 decreased in comparison with 2016. However, the rate of POPs in swine fat remained steady in both periods covered by the monitoring programmes in place. Continuous monitoring of animal fat products is again recommended to assess the evolution of levels of POPs.
- Fosetyl-Al (RD) was the fifth most frequently quantified residue in organic food. In view of EFSA current assessment of a comprehensive review of fosetyl-Al and phosphonates expressed as phosphonic acid and the use of available monitoring data, EFSA recommends that Member States continue monitoring phosphonic acid in plant and animal commodities.
- The percentage of samples of unknown origin (11.3%) remained at a high incidence and was similar in comparison with results from 2018 (10.1%). The country of origin of a sample remains a valuable piece of information for traceability of non-compliant samples and gives relevant information on potential problems in third countries. Member States' competent authorities should make sure that this information is provided when reporting the sample results to EFSA.
- The rate of MRL exceedances remains high for specific crops (e.g. grape leaves, wild fungi) that are not covered in the EUCP. Therefore, it is recommended to continue monitoring these food items in the various national control programmes throughout the EU.
- MRL exceedances for chlordecone (RD) were reported in 18 samples (mostly in cassava roots). Quantified results on chlordecone were also reported in 300 samples, consisting mainly of swine and bovine fat with unknown origin. The overall MRL exceedance rate was 0.3%. Considering that chlordecone is highly persistent in the environment, EFSA recommends continuing the monitoring of this banned pollutant under focussed controlled programmes for products produced in areas where chlordecone was used in the past.
- Other non-approved pesticides have been identified in at least one sample exceeding the legal limit. National authorities should consider the following pesticide/sample groupings when planning their monitoring programmes:
  - carbendazim (RD) in chilli pepper, grape leaves and rice,
  - nicotine (RD) in leafy crops (lettuce, lamb's lettuce/corn salads, spinach, kale),
  - anthraquinone (RD) in teas and the tea-like infusion mate,
  - tolfenpyrad (RD) in teas
  - chlorpropham (RD) in apples and pears,
  - chlorfenapyr in peppers (sweet and chilli) and tomatoes
- Risk managers may consider setting specific MRLs (other than the LOQ) for trimethyl-sulfonium cation. Member States are recommended to continue monitoring trimethyl-sulfonium cation, investigating further the potential sources of this compound other than as a degradation product of glyphosate-trimesium.
- The following pesticides not authorised in organic farming were sporadically found in crops label as such: chlorpyrifos, thiacloprid, azoxystrobin and boscalid. Member States should investigate the reason for their presence. Animal product samples flagged as being grown under organic production conditions presented a higher quantified sample rate (15%) than conventional production samples (6%). Member States should try to elucidate the reasons for these findings and foresee appropriate follow up actions.
- Fipronil (RD) is still found in chicken eggs in the EU. EFSA repeats its recommendation of previous years for Member States to continue analysing this substance in animal products. Furthermore, as it continues to be reported in chilli peppers (originating mainly from the Dominican Republic and Pakistan), EFSA reiterates its previous recommendation to Member States of including it in their analysis of fruit and vegetable samples.
- Environmental contaminants used as pesticides in the past (e.g. DDT (RD), hexachlorobenzene (RD), beta-hexachlorocyclohexane, dieldrin (RD)), constituted the main findings in animal products. Other, substances with uses other than as a pesticide were also found (e.g. copper, BAC (RD), chlorates, DDAC) along with substances likely to be carried over into tissues and milk as a result of animal intake in feed (e.g. acetamiprid (RD), chlorpyrifos). EFSA recommends

continuing to monitor these substances in animal products. Special attention should be paid to chlorpyrifos in animal kidney.
- Non-approved amitraz (RD), chlorfluazuron (RD) and coumaphos (RD) were detected in honey and other apicultural products. Thiacloprid, an approved substance in 2019, but for which a decision for non-renewal of approval was taken in 2020, was also quantified. EFSA recommends that Member States investigate the reasons for the presence of these active substances in honey and other apicultural products. The following active substances exceeded their respective MRLs in honey and other apicultural products: amitraz (RD), glyphosate (RD), acetamiprid (RD), bromide ion (RD), thiacloprid (RD), azoxystrobin (RD), boscalid (RD) and chlorfluazuron (RD). EFSA recommends that Member States keep monitoring honey in their national programmes, with an analytical scope as wide as possible.
- The number of samples with multiple pesticide residues decreased slightly in 2019 compared with the previous year (from 29% to 27%). Nevertheless, unprocessed food products (e.g. currants, sweet cherries, grapefruits, roman rocket/rucola, table grapes, lemons, strawberries and pears) and those considered processed (e.g. grape leaves and similar species, paprika powder and dried mushrooms) still represented more than 60% of samples with multiple quantified residues. Hence, EFSA recommends Member States to continue monitoring these foodstuffs under their national programmes.
- For EFSA to perform exposure calculations according to both the residue definition for enforcement and the pesticide residue definition for risk assessment, EFSA recommends building a comprehensive database of conversion factors.
- Acute risk was identified for dithiocarbamates – especially the mancozeb and ziram scenarios. EFSA will perform a comprehensive MRL review (foreseen in 2021) of all authorised uses of dithiocarbamates, while taking into account their different approval status and the natural occurring background levels of CS_2. Additionally, a chronic risk was identified for the adjusted upper bound scenarios for both – metiram and ziram. Concerning dithiocarbamates, EFSA reiterates its previous recommendation to develop specific analytical methods which identify the individual active substances used in the field.
- EFSA reiterates its recommendation to build a European database on processing factors that will allow Member States and EFSA to refine exposure assessments as needed. EFSA has started working with the Federal Institute for Risk Assessment (BfR)[96] in building such a database.
- In view of misreported samples by some Member States, EFSA recommends an earlier submission of the monitoring data, allowing enough time to perform through checks before it is being accepted and stored in EFSA's scientific Data Warehouse.

This report is intended to provide information to the general and informed public and stakeholders with an interest and responsibilities in the food chain, in particular food supply chain operators. Its aim is to present a comprehensive overview of residue findings in food placed on the EU market, including possible non-compliances with legal limits, and to assess the potential exposure of consumers to pesticide residues. Furthermore, it gives recommendations on various possible risk management options where appropriate. The report's findings are systematically used by the Commission and the Member States to establish priorities for controls on food on the market, including the most relevant substance/commodity combinations to be included in the EUCP regulation or in the national control programmes of Member States.

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Abbreviations

EU/EEA country codes

AT Austria
BE Belgium
BG Bulgaria
CY Cyprus
CZ Czechia
DE Germany
DK Denmark
EE Estonia
EL Greece
ES Spain
FI Finland
FR France
HR Croatia
HU Hungary
IE Ireland
IS Iceland
IT Italy
LT Lithuania
LU Luxembourg
LV Latvia
MT Malta
NL The Netherlands
NO Norway
PL Poland
PT Portugal
RO Romania
SE Sweden
SI Slovenia
SK Slovak Republic
UK The United Kingdom

Other abbreviations

ADI Acceptable Daily Intake
ARfD Acute Reference Dose
BAC Benzalkonium Chloride
CAG Cumulative Assessment Group

CS_2	Carbon disulfide
DDAC	Didecyldimethylammonium chloride
DWH	EFSA's scientific Data Warehouse
EEA	European Economic Area
EFTA	European Free Trade Association
EUCP	EU-coordinated programme
EUPT	European Proficiency Test
EURL	European Union Reference Laboratory
FAO	Food and Agriculture Organization of the United Nations
GAP	Good Agricultural Practice
HCH	Hexachlorocyclohexane
HRM	Highest Residue Measured
LOD	Limit of Detection
LOQ	Limit of Quantification
MRL	Maximum Residue Level
NP	National control programme
POP	Persistent Organic Pollutants
PRIMo	Pesticide Residue Intake Model
RD	Residue Definition
VMPR	Veterinary medicinal product residues
WHO	World Health Organization

Appendix A – Authorities responsible in the reporting countries for pesticide residue monitoring

Country	National competent authority	Web address for published national monitoring reports
Austria	Federal Ministry of Social Affairs, Health, Care and Consumer Protection	https://www.verbrauchergesundheit.gv.at/lebensmittel/lebensmittelkontrolle/monitoring/pestizid.html
	Austrian Agency for Health and Food Safety	http://www.ages.at/themen/rueckstaende-kontaminanten/pflanzenschutzmittel-rueckstaende/pestizidmonitoringberichte/
Belgium	Federal Agency for the Safety of the food Chain (FASFC)	http://www.favv-afsca.fgov.be/publicationsthematiques/pesticide-residue-monitoring-food-plant-origin.asp
Bulgaria	Risk Assessment Centre on Food Chain	http://www.babh.government.bg/en/
Croatia	Ministry of Agriculture	http://www.mps.hr/
Cyprus	Ministry of Health, Pesticides Residues Laboratory of the State General LaboratoryMinistry of Health, Department of Medical and Public Health Services (MPHS)	http://www.moh.gov.cy/sgl
Czech Republic	Czech Agriculture and Food Inspection Authority	http://www.szpi.gov.cz
	State Veterinary Administration	http://www.svscr.cz
Denmark	Danish Veterinary and Food Administration	https://www.foedevarestyrelsen.dk/Kontrol/Kontrolresultater/Sider/Pesticidrester.aspx
	National Food Institute, Technical University of Denmark	http://www.food.dtu.dk/publikationer/kemikaliepaavirkninger/pesticider-i-kosten
Estonia	Veterinary and Food Board	http://www.vet.agri.ee
Finland	Finnish Food Authority, Finnish Customs and National Supervisory Authority for Welfare and Health	https://www.ruokavirasto.fi/en/companies/food-sector/production/common-requirements-for-composition/residues-of-plant-protection-products/control-of-plant-protection-product-residues-in-food/
France	Ministère de l'économie et des finances/Direction générale de la concurrence, de la consommation et de la répression des fraudes (DGCCRF)	http://www.economie.gouv.fr/dgccrf/securite/produits-alimentaires
	Ministère de l'Agriculture et de l'Alimentation, Direction générale de l'alimentation (DGAL)	http://agriculture.gouv.fr/plans-de-surveillance-et-de-controle
Germany	Federal Office of Consumer Protection and Food Safety (BVL)	www.bvl.bund.de/berichtpsm
Greece	Ministry of Rural Development and Food	http://www.minagric.gr/index.php/en/citizen-menu/foodsafety-menu
		http://www.minagric.gr/index.php/el/for-farmer-2/crop-production/fytoprostasiamenu/ypoleimatafyto
Hungary	National Food Chain Safety Office	https://www.nebih.gov.hu
Iceland	MAST – The Icelandic Food and Veterinary Authority	http://www.mast.is
Ireland	Department of Agriculture Food and the Marine	www.pcs.agriculture.gov.i.e
Italy	Ministero della Salute – Direzione Generale per l'Igiene e la Sicurezza degli Alimenti e la Nutrizione – Ufficio 7	http://www.salute.gov.it/portale/temi/p2_6.jsp?lingua=italiano&id=1105&area=fitosanitari&menu=vegetali

Country	National competent authority	Web address for published national monitoring reports
Latvia	Ministry of Agriculture Food and Veterinary Service of Latvia	www.zm.gov.lv
Lithuania	National Food and Veterinary Service (SFVS)	http://www.nmvrvi.lt
Luxembourg	Ministry of Health, Directorate for public health, Division of Food Safety (Secualim)	http://www.securite-alimentaire.public.lu
	Ministry of Health, Administration of Veterinary Services (ASV)	
Malta	Malta Competition and Consumer Affairs Authority	www.mccaa.org.mt
Netherlands	Netherlands Food and Consumer Product Safety Authority (NVWA)	www.nvwa.nl
Norway	Norwegian Food Safety Authority	www.mattilsynet.no https://www.mattilsynet.no/mat_og_vann/uonskede_stofferimaten/rester_av_plantevernmidler_i_mat/#overvakings_og_kartleggingsprogrammer
Poland	The State Sanitary Inspection	http://www.gis.gov.pl
Portugal	Direção-Geral de Alimentação e Veterinária (DGAV)	http://www.dgv.min-agricultura.pt/portal/page/portal/DGV/genericos?generico=4217393&cboui=4217393t
Romania	National Sanitary Veterinary and Food Safety Authority	http://www.ansvsa.ro
	Ministry of Agriculture and Rural Development	http://www.madr.ro
	Ministry of Health	
Slovakia	State Veterinary and Food Administration of the Slovakian Republic	http://www.svps.sk/
	Public Health Authority of the Slovakian Republic	
Slovenia	Administration of the Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection	http://www.uvhvvr.gov.si/si/delovna_podrocja/ostanki_pesticidov
Spain	Spanish Agency for Food Safety and Nutrition (AESAN)	http://www.aecosan.msssi.gob.es/AECOSAN/web/seguridad_alimentaria/subseccion/programa_control_residuos.htm
Sweden	National Food Agency	www.livsmedelsverket.se
United Kingdom	Health and Safety Executive, Chemicals Regulation Division	https://www.gov.uk/government/publications/expert-committee-on-pesticide-residues-in-food-prif-annual-report

Appendix B – Description of the 2019 EU-coordinated control programme

Pesticide	Type of food analysed[(a)]	Residue definition[(d)] according to Regulation (EC) No 396/2005 on EU MRLs[(b)]	Analysis mandatory for the following food products[(c)]
2,4-D (RD)	P	2,4-D (sum of 2,4-D, its salts, its esters and its conjugates, expressed as 2,4-D)	Le, Sp, To
2-Phenylphenol (RD)	P	2-Phenylphenol (sum of 2-phenylphenol and its conjugates, expressed as 2-phenylphenol)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Abamectin (RD)	P	Abamectin (sum of avermectin B1a, avermectin B1b and delta-8,9 isomer of avermectin B1a, expressed as avermectin B1a)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Acephate (RD)	P	Acephate	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Acetamiprid (RD)	P	Acetamiprid	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Acrinathrin (RD)	P	Acrinathrin and its enantiomer	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Aldicarb (RD)	P	Aldicarb (sum of Aldicarb, its sulfoxide and its sulfone, expressed as Aldicarb)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Ametoctradin (RD)	P	Ametoctradin	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Azinphos-Methyl (RD)	P	Azinphos-methyl	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Azoxystrobin (RD)	P	Azoxystrobin	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Bifenthrin (RD)	PA	Bifenthrin (sum of isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Biphenyl (RD)	P	Biphenyl	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Bitertanol (RD)	P	Bitertanol (sum of isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Boscalid (RD)	P	Boscalid	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Bromide Ion (RD)	P	Bromide ion	Le, To
Bromopropylate (RD)	P	Bromopropylate	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Bupirimate (RD)	P	Bupirimate	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Buprofezin (RD)	P	Buprofezin	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Captan (RD)	P	Captan (sum of captan and THPI, expressed as captan)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Carbaryl (RD)	P	Carbaryl	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Carbendazim (RD)	P	Carbendazim and benomyl (sum of benomyl and carbendazim expressed as carbendazim)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Carbofuran (RD)	P	Carbofuran (sum of carbofuran (including any carbofuran generated from carbosulfan, benfuracarb or furathiocarb) and 3-OH carbofuran expressed as carbofuran)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Chlorantraniliprole (RD)	P	Chlorantraniliprole (DPX E-2Y45)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Chlordane (RD)	A	Chlordane (sum of cis- and trans-isomers and oxychlordane expressed as chlordane)	Cm, Sf
Chlorfenapyr (RD)	P	Chlorfenapyr	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Chlormequat-chloride (RD)	P	Chlormequat (sum of chlormequat and its salts, expressed as chlormequat-chloride)	To, Og

Pesticide	Type of food analysed[(a)]	Residue definition[(d)] according to Regulation (EC) No 396/2005 on EU MRLs[(b)]	Analysis mandatory for the following food products[(c)]
Chlorothalonil (RD)	P	Chlorothalonil	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Chlorpropham (RD)	P	Chlorpropham	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Chlorpyrifos (RD)	PA	Chlorpyrifos	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Chlorpyrifos-Methyl (RD)	PA	Chlorpyrifos-methyl	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Clofentezine (RD)	P	Clofentezine	Ap, Hc, Le, Pe, Sp, St, To, Og
Clothianidin (RD)	P	Clothianidin	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Cyazofamid (RD)	P	Cyazofamid	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Cyfluthrin (RD)	P	Cyfluthrin (Cyfluthrin including other mixtures of constituent isomers (sum of isomers))	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Cymoxanil (RD)	P	Cymoxanil	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Cypermethrin (RD)	PA	Cypermethrin (Cypermethrin including other mixtures of constituent isomers (sum of isomers))	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Cyproconazole (RD)	P	Cyproconazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Cyprodinil (RD)	P	Cyprodinil	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Cyromazine (RD)	P	Cyromazine	Le, To
DDT (RD)	A	DDT (sum of p,p′-DDT, o,p′-DDT, p-p′-DDE and p,p′-TDE (DDD) expressed as DDT)	Cm, Sf
Deltamethrin (RD)	PA	Deltamethrin (cis-deltamethrin)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Diazinon (RD)	PA	Diazinon	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Dichlorvos (RD)	P	Dichlorvos	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Dicloran (RD)	P	Dicloran	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Dicofol (RD)	P	Dicofol (sum of p, p′ and o,p′ isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og
Dieldrin (RD)	PA	Aldrin and Dieldrin (Aldrin and dieldrin combined expressed as dieldrin)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Diethofencarb (RD)	P	Diethofencarb	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Difenoconazole (RD)	P	Difenoconazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Diflubenzuron (RD)	P	Diflubenzuron	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Dimethoate (RD)	P	Dimethoate	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Dimethomorph (RD)	P	Dimethomorph (sum of isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Diniconazole (RD)	P	Diniconazole (sum of isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Diphenylamine (RD)	P	Diphenylamine	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Dithianon (RD)	P	Dithianon	Ap, Pe
Dithiocarbamates (RD)	P	Dithiocarbamates (dithiocarbamates expressed as CS2, including maneb, mancozeb, metiram, propineb, thiram and ziram)	Ap, Le, Pe, Sp, St, To, Og, Bg
Dodine (RD)	P	Dodine	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Emamectin (RD)	P	Emamectin benzoate B1a, expressed as emamectin	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg

Pesticide	Type of food analysed[(a)]	Residue definition[(d)] according to Regulation (EC) No 396/2005 on EU MRLs[(b)]	Analysis mandatory for the following food products[(c)]
Endosulfan (RD)	PA	Endosulfan (sum of alpha- and beta-isomers and endosulfan-sulfate expresses as endosulfan)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
EPN (RD)	P	EPN	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Epoxiconazole (RD)	P	Epoxiconazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Ethephon (RD)	P	Ethephon	Ap, Pe, To, Wg
Ethion (RD)	P	Ethion	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Ethirimol (RD)	P	Ethirimol	Ap, Hc, Le, Pe, Sp, St, To, Og
Etofenprox (RD)	P	Etofenprox	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Etoxazole (RD)	P	Etoxazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Famoxadone (RD)	PA	Famoxadone	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Fenamidone (RD)	P	Fenamidone	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fenamiphos (RD)	P	Fenamiphos (sum of fenamiphos and its sulfoxide and sulfone expressed as fenamiphos)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fenarimol (RD)	P	Fenarimol	Ap, Hc, Le, Pe, Sp, St, To, Og
Fenazaquin (RD)	P	Fenazaquin	Ap, Hc, Le, Pe, Sp, St, To, Og
Fenbuconazole (RD)	P	Fenbuconazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fenbutatin Oxide (RD)	P	Fenbutatin oxide	Ap, Pe, St, To, Wg
Fenhexamid (RD)	P	Fenhexamid	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fenitrothion (RD)	P	Fenitrothion	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fenoxycarb (RD)	P	Fenoxycarb	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fenpropathrin (RD)	P	Fenpropathrin	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fenpropidin (RD)	P	Fenpropidin (sum of fenpropidin and its salts, expressed as fenpropidin)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fenpropimorph (RD)	P	Fenpropimorph (sum of isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fenpyroximate (RD)	P	Fenpyroximate	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fenthion (RD)	P	Fenthion (fenthion and its oxygen analogue, their sulfoxides and sulfone expressed as parent)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fenvalerate (RD)	PA	Fenvalerate (any ratio of constituent isomers (RR, SS, RS and SR) including esfenvalerate)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Fipronil (RD)	PA	Fipronil (sum Fipronil and sulfone metabolite (MB46136) expressed as Fipronil)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Flonicamid (RD)	P	Flonicamid (sum of flonicamid, TNFG and TNFA expressed as flonicamid)	Ap, Le, Pe, Sp, To, Og, Bg
Fluazifop (RD)	P	Fluazifop-P (sum of all the constituent isomers of fluazifop, its esters and its conjugates, expressed as fluazifop)	Hc, Le, Sp, St, To
Flubendiamide (RD)	P	Flubendiamide	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fludioxonil (RD)	P	Fludioxonil	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Flufenoxuron (RD)	P	Flufenoxuron	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fluopicolide (RD)	P	Fluopicolide	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fluopyram (RD)	P	Fluopyram	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg

Pesticide	Type of food analysed[(a)]	Residue definition[(d)] according to Regulation (EC) No 396/2005 on EU MRLs[(b)]	Analysis mandatory for the following food products[(c)]
Fluquinconazole (RD)	P	Fluquinconazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Flusilazole (RD)	P	Flusilazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Flutriafol (RD)	P	Flutriafol	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fluxapyroxad (RD)	P	Fluxapyroxad	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Folpet (RD)	P	Folpet (sum of folpet and phthalimide, expressed as folpet)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Formetanate (Hydrochloride) (RD)	P	Formetanate: Sum of formetanate and its salts expressed as formetanate(hydrochloride)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Fosthiazate (RD)	P	Fosthiazate	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Glyphosate (RD)	PA	Glyphosate	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Haloxyfop (RD)	P	Haloxyfop (Sum of haloxyfop, its esters, salts and conjugates expressed as haloxyfop (sum of the R- and S- isomers at any ratio))	Hc, St
Heptachlor (RD)	A	Heptachlor (sum of heptachlor and heptachlor epoxide expressed as heptachlor)	Cm, Sf
Hexachlorobenzene (RD)	A	Hexachlorobenzene	Cm, Sf
		Hexachlorocyclohexane, alpha- (RD)	A
		Hexachlorocyclohexane (HCH), alpha-isomer	Cm, Sf
		Hexachlorocyclohexane, beta- (RD)	A
		Hexachlorocyclohexane (HCH), beta-isomer	Cm, Sf
Hexaconazole (RD)	P	Hexaconazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Hexythiazox (RD)	P	Hexythiazox	Ap, Hc, Le, Pe, Sp, St, To, Og
Imazalil (RD)	P	Imazalil	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Imidacloprid (RD)	P	Imidacloprid	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Indoxacarb (RD)	PA	Indoxacarb (sum of indoxacarb and its R enantiomer)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm
Iprodione (RD)	P	Iprodione	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Iprovalicarb (RD)	P	Iprovalicarb	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Isocarbophos (RD)	P	Isocarbophos	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Kresoxim-Methyl (RD)	P	Kresoxim-methyl	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Lambda-cyhalothrin (RD)	P	Lambda-cyhalothrin (includes gamma-cyhalothrin) (sum of R,S and S,R isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Lindane (RD)	A	Lindane (Gamma-isomer of hexachlorocyclohexane (HCH))	Cm, Sf
Linuron (RD)	P	Linuron	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Lufenuron (RD)	P	Lufenuron (any ratio of constituent isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Malathion (RD)	P	Malathion (sum of malathion and malaoxon expressed as malathion)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Mandipropamid (RD)	P	Mandipropamid	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Mepanipyrim (RD)	P	Mepanipyrim	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg

Pesticide	Type of food analysed[(a)]	Residue definition[(d)] according to Regulation (EC) No 396/2005 on EU MRLs[(b)]	Analysis mandatory for the following food products[(c)]
Mepiquat Chloride (RD)	P	Mepiquat (sum of mepiquat and its salts, expressed as mepiquat chloride)	Bg, Og
Metalaxyl and metalaxyl-M (RD)	P	Metalaxyl including other mixtures of constituent isomers including metalaxyl-M (sum of isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Methamidophos (RD)	P	Methamidophos	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Methidathion (RD)	P	Methidathion	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Methiocarb (RD)	P	Methiocarb (sum of methiocarb and methiocarb sulfoxide and sulfone, expressed as methiocarb)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Methomyl (RD)	P	Methomyl	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Methoxychlor (RD)	A	Methoxychlor	Cm, Sf
Methoxyfenozide (RD)	P	Methoxyfenozide	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Metrafenone (RD)	P	Metrafenone	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Monocrotophos (RD)	P	Monocrotophos	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Myclobutanyl (RD)	P	Myclobutanil	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Oxadixyl (RD)	P	Oxadixyl	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Oxamyl (RD)	P	Oxamyl	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Oxydemeton-Methyl (RD)	P	Oxydemeton-methyl (sum of oxydemeton-methyl and demeton-S-methylsulfone expressed as oxydemeton-methyl)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Paclobutrazol (RD)	P	Paclobutrazol	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Parathion (RD)	PA	Parathion	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Parathion-Methyl (RD)	P	Parathion-methyl (sum of Parathion-methyl and paraoxon-methyl expressed as Parathion-methyl)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Penconazole (RD)	P	Penconazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Pencycuron (RD)	P	Pencycuron	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Pendimethalin (RD)	P	Pendimethalin	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Permethrin (RD)	PA	Permethrin (sum of isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Phosmet (RD)	P	Phosmet (phosmet and phosmet oxon expressed as phosmet)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Pirimicarb (RD)	P	Pirimicarb	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Pirimiphos-Methyl (RD)	PA	Pirimiphos-methyl	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg, Cm, Sf
Procymidone (RD)	P	Procymidone	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Profenofos (RD)	P	Profenofos	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Propamocarb (RD)	P	Propamocarb (Sum of propamocarb and its salt expressed as propamocarb)	Hc, Le, Sp, St, To, Bg
Propargite (RD)	P	Propargite	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Propiconazole (RD)	P	Propiconazole (sum of isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Propyzamide (RD)	P	Propyzamide	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Prosulfocarb (RD)	P	Prosulfocarb	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg

Pesticide	Type of food analysed[(a)]	Residue definition[(d)] according to Regulation (EC) No 396/2005 on EU MRLs[(b)]	Analysis mandatory for the following food products[(c)]
Prothioconazole (RD)	P	Prothioconazole: prothioconazole-desthio (sum of isomers)	Hc, Le, To, Bg, Og
Pymetrozine (RD)	P	Pymetrozine	Hc, Le, Sp, St, To
Pyraclostrobin (RD)	P	Pyraclostrobin	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Pyridaben (RD)	P	Pyridaben	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Pyrimethanil (RD)	P	Pyrimethanil	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Pyriproxyfen (RD)	P	Pyriproxyfen	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Quinoxyfen (RD)	P	Quinoxyfen	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Spinosad (RD)	P	Spinosad (spinosad, sum of spinosyn A and spinosyn D)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Spirodiclofen (RD)	P	Spirodiclofen	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Spiromesifen (RD)	P	Spiromesifen	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Spiroxamine (RD)	P	Spiroxamine (sum of isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Spirotetramat (RD)	P	Spirotetramat and its 4 metabolites BYI08330-enol, BYI08330-ketohydroxy, BYI08330-monohydroxy and BYI08330 enol-glucoside, expressed as spirotetramat	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Tau-Fluvalinate (RD)	P	Fluvalinate, tau-	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Tebuconazole (RD)	P	Tebuconazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Tebufenozide (RD)	P	Tebufenozide	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Tebufenpyrad (RD)	P	Tebufenpyrad	Ap, Hc, Le, Pe, Sp, St, To, Og
Teflubenzuron (RD)	P	Teflubenzuron	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Tefluthrin (RD)	P	Tefluthrin	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Terbuthylazine (RD)	P	Terbuthylazine	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Tetraconazole (RD)	P	Tetraconazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Tetradifon (RD)	P	Tetradifon	Ap, Hc, Le, Pe, Sp, St, To, Og
Thiabendazole (RD)	P	Thiabendazole	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Thiacloprid (RD)	P	Thiacloprid	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Thiamethoxam (RD)	P	Thiamethoxam	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Thiodicarb (RD)	P	Thiodicarb	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Thiofanate-Methyl (RD)	P	Thiophanate-methyl	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Tolclofos-Methyl (RD)	P	Tolclofos-methyl	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Triadimefon (RD)	P	Triadimefon	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Triadimenol (RD)	P	Triadimenol (any ratio of constituent isomers)	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Triazophos (RD)	P	Triazophos	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Trifloxystrobin (RD)	P	Trifloxystrobin	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Triflumuron (RD)	P	Triflumuron	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg
Vinclozolin (RD)	P	Vinclozolin	Ap, Hc, Le, Pe, Sp, St, To, Og, Bg, Wg

(a): P: to be analysed in plant products; A: to be analysed in animal products.
(b): Legal residue definition applicable in 2019 for the relevant food products covered by the EUCP; if not specifically mentioned, the residue definition comprises the parent compound only.
(c): Ap: apples; Hc: head cabbages; Le: lettuce; Pe: peaches, Sp: spinach, St: strawberries, To: tomatoes, Og: oat grain; Bg: barley grain, Wg: wine grapes, Cm: cow's milk and Sf: swine fat.
(d): The term 'residue definition (RD)' in this report refers to all substances generated from the presence of a pesticide in the crop, food or/and feed. A residue definition may be a simple (i.e. one substance only) or a complex one (i.e. more than one substance). However, the acronym '(RD)' has been used constantly in all pesticide names. Moreover, considering that the substances used for the estimation of the dietary exposure to a pesticide residue may not coincide with the ones used for

setting and enforcing Maximum Residue Limits (MRLs), different residue definitions may be implemented at EU level for risk assessment and enforcement purposes. In this report, dealing with pesticide monitoring, the 'RD' refers to the enforcement one.

Appendix C – Food to be analysed in 2019 according to Regulation (EC) No 669/2009 on import controls

Country of origin	Food	Food name (code) in food classification under Reg. (EC) No 396/2005[(a)]
Benin	Pineapples	
Cambodia	Chinese celery (*Apium graveolens*)	Celery leaves (0256030)
	Yardlong beans (*Vigna unguiculata* spp. *sesquipedalis*)	Beans with pods (0260010)
China	Goji berries (wolfberries) (*Lycium barbarum L.*)	Tomatoes
	Tea leaves, dry and/or fermented and similar	
Dominican Republic	Aubergines (*Solanum melongena*) and Ethiopian eggplant (*Solanum aethiopicum*)	Aubergines/eggplants
	Peppers (other than sweet)	Chilli peppers
	Sweet peppers (*Capsicum annuum*) and peppers (other than sweet)	Sweet peppers/bell peppers
	Yardlong beans (*Vigna unguiculata* spp. *sesquipedalis*)	Beans with pods (0260010)
Egypt	Sweet peppers (*Capsicum annuum*) and peppers (other than sweet)	Sweet peppers/bell peppers
India	Curry leaves (bergera/Murraya koenigii)	Laurel/bay leaves
	Okra	Okra, lady's fingers
	Peppers (other than sweet)	
Kenya	Yardlong beans (Vigna unguiculata spp. sesquipedalis)	Beans (with pods) and similar
Malaysia	Jackfruits	
Pakistan	Peppers (other than sweet)	
Thailand	Peppers (other than sweet)	
Turkey	Lemons	
	Pomegranates	
	Sweet peppers (*Capsicum annuum*)	Sweet peppers/bell peppers
	Vine leaves	Grape leaves and similar species
Uganda	Peppers (other than sweet)	
Vietnam	Basil (holy, sweet)	
	Coriander leaves	Celery leaves (0256030)
	Dragon fruit (Pitahaya)	Prickly pears/cactus fruits (0162040)
	Mint	Basil (0256080)
	Okra	Okra/lady's finger
	Parsley	
	Peppers (other than sweet)	

(a): Corresponding name in the food classification under Regulation (EC) No 396/2005 (only if the food product to be analysed under Regulation (EC) No 669/2009 is not listed in Annex I, Part A of Regulation (EU) No 62/2018).

Appendix D – Health-based guidance values for compounds included in the 2019 EUCP and detailed results on risk assessment

Pesticide	ADI (mg/kg bw per d)	Year	Source	ARfD (mg/kg bw)	Year	Source
2,4-D (RD)	0.02	2018	EFSA	0.3	2018	EFSA
2-phenylphenol	0.4	2008	EFSA	n.n.	2008	EFSA
Abamectin (RD)	0.0025	2008	EFSA	0.005	2008	COM
Acephate	0.03	2005	JMPR	0.1	2005	JMPR
Acetamiprid (RD)	0.025	2013	EFSA	0.025	2013	EFSA
Acrinathrin	0.01	2013	EFSA	0.01	2013	EFSA
Aldicarb (RD)	0.003	2001	JMPR	0.003	2001	JMPR
Azinphos-methyl	0.005	2006	COM	0.01	2006	COM
Azoxystrobin	0.2	2011	COM	n.n.	2011	COM
Bifenthrin	0.015	2011	EFSA	0.03	2011	EFSA
Biphenyl	0.038	1999	WHO	n.n.	2010	EFSA
Bitertanol	0.003	2011	COM	0.01	2011	COM
Boscalid (RD)	0.04	2008	COM	n.n.	2008	COM
Bromide ion*	1	1988	JMPR	n.n	2013	EFSA
Bromopropylate	0.03	1993	JMPR	0.03		
Bupirimate	0.05	2011	COM	n.n.	2011	COM
Buprofezin	0.01	2010	COM	0.5	2010	COM
Captan (RD)	0.1	2007	COM	0.3	2008	COM
Carbaryl	0.0075	2006	EFSA	0.01	2006	EFSA
Carbendazim (RD)	0.02	2010	COM	0.02	2010	COM
Carbofuran (RD)	0.00015	2009	EFSA	0.00015	2009	EFSA
Chlorantraniliprole	1.56	2013	EFSA	n.n.	2013	EFSA
Chlordane (RD)	0.0005	1994	JMPR	0.0005		
Chlorfenapyr	0.015	1999	ECCO	0.015	2006	EFSA
Chlormequat	0.04	2008	EFSA	0.09	2008	EFSA
Chlorothalonil (RD)	0.015	2006	COM	0.6	2006	COM
Chlorpropham (RD)	0.05	2004	COM	0.5	2004	COM
Chlorpyrifos	0.001	2015	EFSA	0.005	2015	EFSA
Chlorpyrifos-methyl	0.01	2005	COM	0.1	2005	COM
Clofentezine (RD)	0.02	2010	COM	n.n.	2010	COM
Clothianidin	0.097	2006	COM	0.1	2006	COM
Cyfluthrin	0.003	2003	COM	0.02	2003	COM
Cymoxanil	0.013	2008	EFSA	0.08	2008	EFSA
Cypermethrin	0.05	2005	COM	0.2	2005	COM
Cyproconazole	0.02	2011	COM	0.02	2011	COM
Cyprodinil (RD)	0.03	2006	COM	n.n.	2006	COM
Cyromazine	0.06	2006	JMPR	0.1	2006	JMPR
DDT (RD)	0.01	2000	JMPR	n.n.	2000	JMPR
Deltamethrin	0.01	2003	COM	0.01	2003	COM
Diazinon	0.0002	2006	EFSA	0.025	2006	EFSA
Dichlorvos	0.00008	2006	EFSA	0.002	2006	EFSA
Dicloran	0.005	2010	EFSA	0.025	2010	EFSA
Dicofol (RD)	0.002	1992	JMPR	0.2	2011	JMPR
Dieldrin (RD)	0.0001	1994	JMPR	0.003	2007	EFSA
Diethofencarb	0.43	2010	EFSA	n.n.	2010	EFSA
Difenoconazole	0.01	2008	COM	0.16	2008	COM
Diflubenzuron (RD)	0.1	2009	EFSA	n.n.	2009	EFSA

Pesticide	ADI (mg/kg bw per d)	Year	Source	ARfD (mg/kg bw)	Year	Source
Dimethoate	0.001	2013	EFSA	0.01	2013	EFSA
Dimethomorph	0.05	2007	COM	0.6	2007	COM
Diniconazole	0.02	2007	France	0.02	2007	France
Diphenylamine	0.075	2008	EFSA	n.n.	2008	EFSA
Dithianon	0.01	2011	COM	0.12	2011	COM
Dithiocarbamates (RD) – mancozeb sc.	0.028	2005	COM	0.337	2005	COM
Dithiocarbamates (RD) – maneb sc.	0.029	2005	COM	0.11	2005	COM
Dithiocarbamates (RD) – metiram sc.	0.004	2005	COM	n.n.	2005	COM
Dithiocarbamates (RD) – propineb sc.	0.004	2003	COM	0.053	2003	COM
Dithiocarbamates (RD) – thiram sc.	0.01	2003	COM	0.025	2003	COM
Dithiocarbamates (RD) – ziram sc.	0.003	2004	COM	0.04	2004	COM
Dodine	0.1	2010	EFSA	0.1	2010	EFSA
Endosulfan (RD)	0.006	2006	JMPR	0.02	2006	JMPR
EPN						
Epoxiconazole	0.008	2008	COM	0.023	2008	COM
Ethephon	0.03	2006	COM	0.05	2008	COM
Ethion	0.002	1990	JMPR	0.015	1999	UK ACP
Ethirimol	0.035	2010	EFSA	n.n.	2010	EFSA
Etofenprox	0.03	2009	COM	1	2009	COM
Famoxadone	0.006	2015	EFSA	0.1	2015	EFSA
Fenamidone		2017	EFSA		2017	EFSA
Fenamiphos (RD)	0.0008	2006	COM	0.0025	2006	COM
Fenarimol	0.01	2006	COM	0.02	2006	COM
Fenazaquin	0.005	2013	EFSA	0.1	2013	EFSA
Fenbuconazole	0.006	2010	COM	0.3	2010	COM
Fenbutatin oxide	0.05	2011	COM	0.1	2011	COM
Fenhexamid	0.2	2015	EFSA	n.n.	2015	EFSA
Fenitrothion	0.005	2006	EFSA	0.013	2006	EFSA
Fenoxycarb	0.053	2011	COM	2	2011	COM
Fenpropathrin	0.03	1993	JMPR	0.03	2012	JMPR
Fenpropidin (RD)	0.02	2012	COM	0.02	2012	COM
Fenpropimorph (RD)	0.003	2008	COM	0.03	2008	COM
Fenpyroximate (RD)	0.01	2013	EFSA	0.02	2013	EFSA
Fenthion (RD)	0.007	2000	JMPR	0.01	2000	JMPR
Fenvalerate (RD)	0.0175	2015	EFSA	0.0175	2015	EFSA
Fipronil (RD)	0.0002	2007	COM	0.009	2007	COM
Flonicamid (RD)	0.025	2010	COM	0.025	2010	COM
Fluazifop-P (RD)	0.01	2010	EFSA	0.017	2010	EFSA
Flubendiamide	0.017	2013	EFSA	0.1	2013	EFSA
Fludioxonil (RD)	0.37	2007	COM	n.n.	2007	COM
Flufenoxuron	0.01	2011	EFSA	n.n.	2011	EFSA
Fluopicolide	0.08	2010	COM	0.18	2010	COM
Fluopyram (RD)	0.012	2013	EFSA	0.5	2013	EFSA
Fluquinconazole	0.002	2011	COM	0.02	2011	COM
Flusilazole (RD)	0.002	2007	COM	0.005	2007	COM
Flutriafol	0.01	2011	COM	0.05	2011	COM

Pesticide	ADI (mg/kg bw per d)	Year	Source	ARfD (mg/kg bw)	Year	Source
Folpet (RD)	0.1	2013	EFSA	0.2	2013	EFSA
Formetanate	0.004	2007	COM	0.005	2007	COM
Fosthiazate	0.004	2003	COM	0.005	2003	COM
Glyphosate	0.5	2015	EFSA	0.5	2015	EFSA
Haloxyfop (RD)	0.00065	2015	COM	0.075	2015	COM
Heptachlor (RD)	0.0001	1994	JMPR			
Hexachlorobenzene						
Hexachlorocyclohexane (alpha)						
Hexachlorocyclohexane (beta)						
Hexaconazole	0.005	1990	JMPR	0.005		
Hexythiazox	0.03	2011	COM	n.n.	2011	COM
Imazalil	0.025	2011	COM	0.05	2011	COM
Imidacloprid	0.06	2013	EFSA	0.08	2013	EFSA
Indoxacarb	0.006	2005	COM	0.125	2005	COM
Iprodione (RD)	0.02	2018	EFSA	0.06	2018	EFSA
Iprovalicarb	0.015	2015	EFSA	n.n.	2015	EFSA
Isocarbophos						
Isoprothiolane	0.1	2012	EFSA	0.12	2012	EFSA
Kresoxim-methyl (RD)	0.4	2011	COM	n.n.	2011	COM
Lambda-cyhalothrin (RD)	0.0025	2015	EFSA	0.005	2015	EFSA
Lindane	0.005	2000	COM	0.06	2000	COM
Linuron	0.003	2002	COM	0.03	2002	COM
Lufenuron	0.015	2009	COM	n.n.	2009	COM
Malathion (RD)	0.03	2010	COM	0.3	2010	COM
Mandipropamid	0.15	2012	EFSA	n.n.	2012	EFSA
Mepanipyrim	0.012	2018	EFSA	0.1	2018	EFSA
Mepiquat	0.2	2008	COM	0.3	2008	COM
Metalaxyl	0.08	2015	EFSA	0.5	2015	EFSA
Methamidophos	0.001	2007	COM	0.003	2007	COM
Methidathion	0.001	1997	JMPR	0.01	1997	JMPR
Methiocarb (RD)	0.013	2007	COM	0.013	2007	COM
Methomyl	0.0025	2009	COM	0.0025	2009	COM
Methoxychlor	0.005	2011	ATSDR	0.005		
Methoxyfenozide	0.1	2018	EFSA	0.1	2018	EFSA
Monocrotophos	0.0006	1995	JMPR	0.002	1995	JMPR
Myclobutanil (RD)	0.025	2010	COM	0.31	2010	COM
Omethoate	0.0003	2013	EFSA	0.002	2013	EFSA
Oxadixyl	0.01	1984	FR	0.01	1984	FR
Oxamyl	0.001	2006	COM	0.001	2006	COM
Oxydemeton-methyl (RD)	0.0003	2006	COM	0.0015	2006	COM
Paclobutrazol	0.022	2011	COM	0.1	2011	COM
Parathion	0.0006	2001	ECCO 100	0.005	2001	ECCO 100
Parathion-methyl (RD)	0.003	2002	COM	0.03	2001	COM
Penconazole	0.03	2009	COM	0.5	2009	COM
Pencycuron	0.2	2011	COM	n.n.	2011	COM
Pendimethalin	0.125	2015	EFSA	0.3	2015	EFSA
Permethrin	0.05	2000	COM	1.5	2000	COM
Phosmet (RD)	0.01	2007	COM	0.045	2007	COM
Pirimicarb (RD)	0.035	2006	COM	0.1	2006	COM

Pesticide	ADI (mg/kg bw per d)	Year	Source	ARfD (mg/kg bw)	Year	Source
Pirimiphos-methyl	0.004	2007	COM	0.15	2007	COM
Procymidone (RD)	0.0028	2007	DAR FR	0.012	2007	DAR FR
Profenofos	0.03	2007	JMPR	1	2007	JMPR
Propamocarb (RD)	0.29	2007	COM	1	2007	COM
Propargite	0.03	2018	EFSA	0.06	2018	EFSA
Propiconazole	0.04	2018	EFSA	0.1	2018	EFSA
Propyzamide (RD)	0.05	2017	EFSA	0.13	2017	EFSA
Prosulfocarb	0.005	2007	COM	0.1	2007	COM
Prothioconazole (RD)	0.01	2008	COM	0.01	2008	COM
Pymetrozine (RD)	0.03	2018	COM	0.1	2018	COM
Pyraclostrobin	0.03	2004	COM	0.03	2004	COM
Pyridaben	0.01	2010	COM	0.05	2010	COM
Pyrimethanil (RD)	0.17	2006	COM	n.n.	2006	EFSA
Pyriproxyfen	0.1	2008	COM	n.n.	2008	COM
Quinoxyfen	0.2	2004	COM	n.n.	2003	COM
Spinosad	0.024	2007	COM	n.n.	2006	COM
Spirodiclofen	0.015	2009	EFSA	n.n.	2009	EFSA
Spiromesifen	0.03	2007	EFSA	2	2007	EFSA
Spiroxamine (RD)	0.025	1999	COM	0.1	2011	COM
tau-Fluvalinate	0.005	2010	COM	0.05	2010	COM
Tebuconazole (RD)	0.03	2013	EFSA	0.03	2013	EFSA
Tebufenozide	0.02	2011	COM	n.n.	2011	COM
Tebufenpyrad	0.01	2009	COM	0.02	2009	COM
Teflubenzuron	0.01	2008	COM	n.n.	2008	COM
Tefluthrin	0.005	2010	COM	0.005	2010	COM
Terbuthylazine	0.004	2018	EFSA	0.008	2018	EFSA
Tetraconazole	0.004	2008	COM	0.05	2008	COM
Tetradifon	0.015	2001	DE	n.n.	2002	DE
Thiabendazole (RD)	0.1	2015	EFSA	0.1	2015	EFSA
Thiacloprid	0.01	2004	COM	0.03	2004	COM
Thiamethoxam	0.026	2007	COM	0.5	2007	COM
Thiodicarb	0.01	2005	EFSA	0.01	2005	EFSA
Thiophanate-methyl	0.08	2005	COM	0.2	2005	COM
Tolclofos-methyl	0.064	2006	COM	n.n.	2006	COM
Tolylfluanid (RD)	0.1	2006	COM	0.25	2006	COM
Triadimenol (RD)	0.05	2008	COM	0.05	2008	COM
Triadimefon	0.03	2004	JMPR	0.08	2004	JMPR
Triazophos	0.001	2002	JMPR	0.001	2002	JMPR
Trifloxystrobin (RD)	0.1	2018	EFSA	0.5	2018	EFSA
Triflumuron	0.014	2011	COM	n.n.	2011	COM
Vinclozolin	0.005	2006	COM	0.06	2006	COM

n.n.: ARfD not necessary.
*: For tentative risk assessment only.

Results of acute risk assessment for food products in focus of the EUCP, expressed as percentage of the ARfD

In the following figures,[97] the acute exposure calculated for each sample with residues above the LOQ is presented individually, expressing the result as a percentage of the ARfD. The blue dots refer to results reported under the EU-coordinated programme, whereas the orange dots refer to findings in samples that were analysed in the framework of the national control programmes. The figures in brackets next to the name of the pesticides represent the number of samples with residues below the LOQ, number of samples with quantified residues below or at the MRL and the number of samples with residues above the MRL.[98]

[97] In the following figures there are some cases where the ARfD was exceeded due to recent lowering in the ARfD value, while the samples were still within the MRL. In other cases, the exceedance of the ARfD is due to the IESTI equation and the gap between the highest residue derived under residue trials and the calculation of the MRL.

[98] Samples with residues above the MRL in the context of this report refers to samples with one or several pesticides exceeding the legal limit, as reported by the Member States.

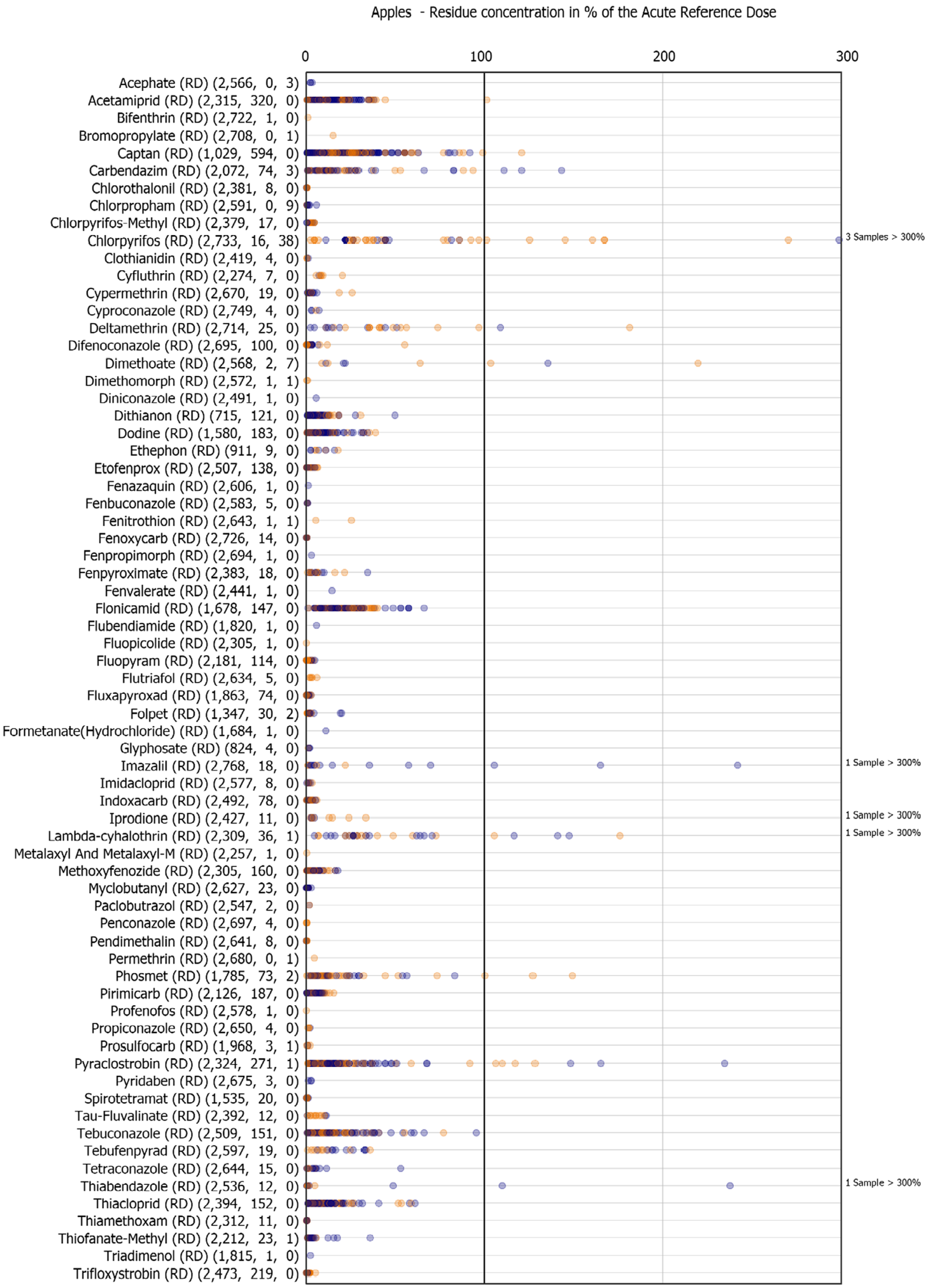

Figure D.1: Acute dietary exposure assessment – apples

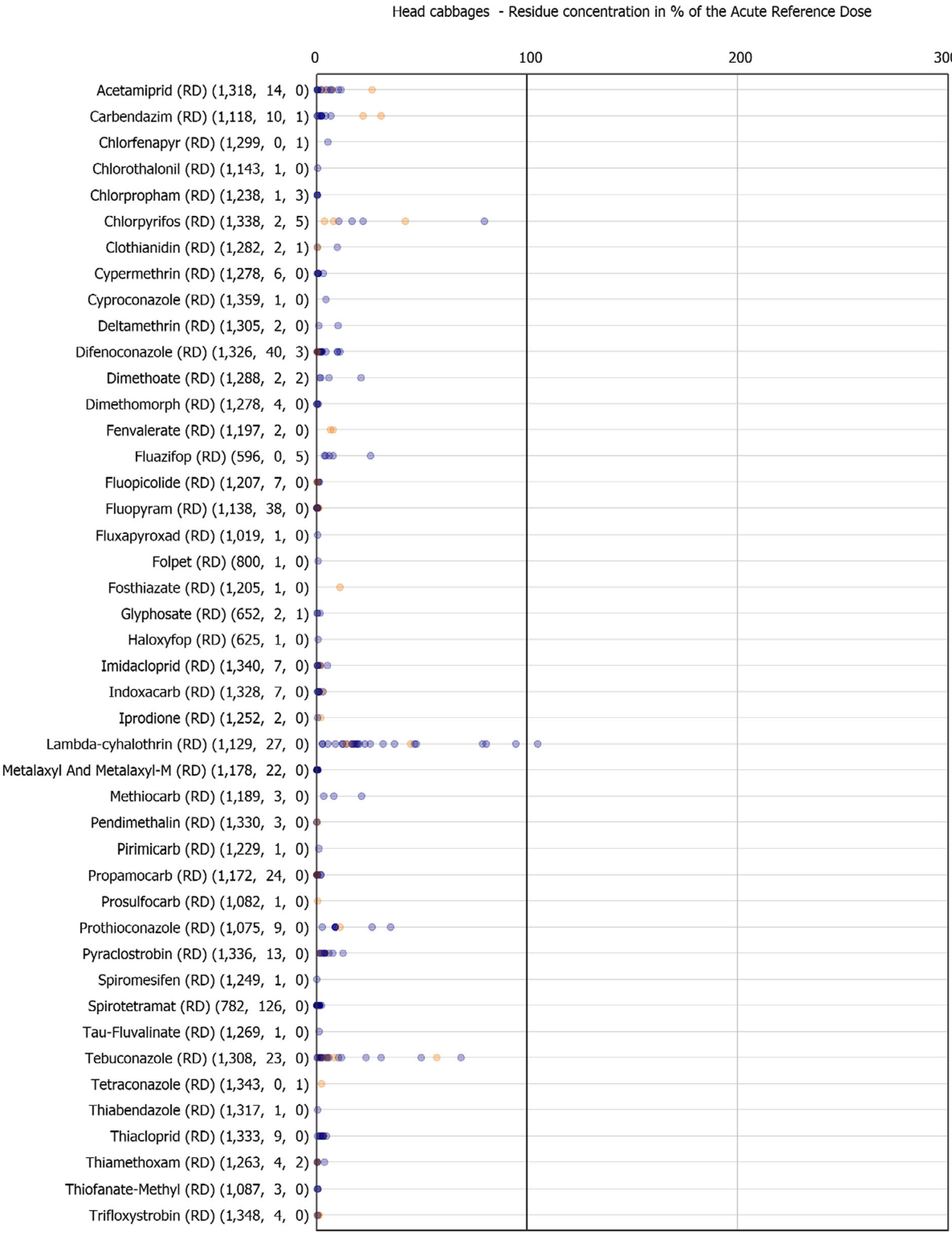

Figure D.2: Acute dietary exposure assessment – head cabbage

Figure D.3: Acute dietary exposure assessment – lettuce

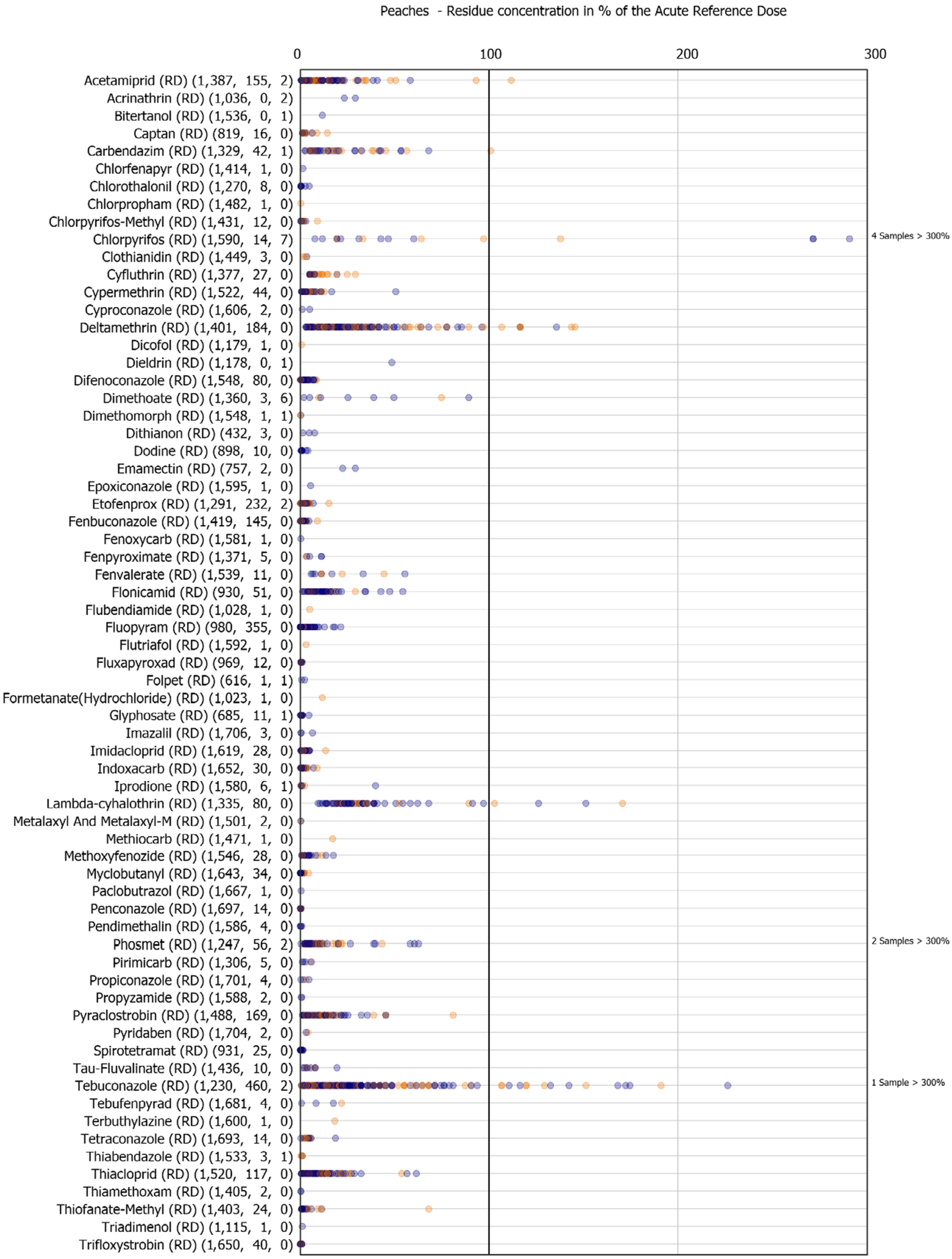

Figure D.4: Acute dietary exposure assessment – peaches

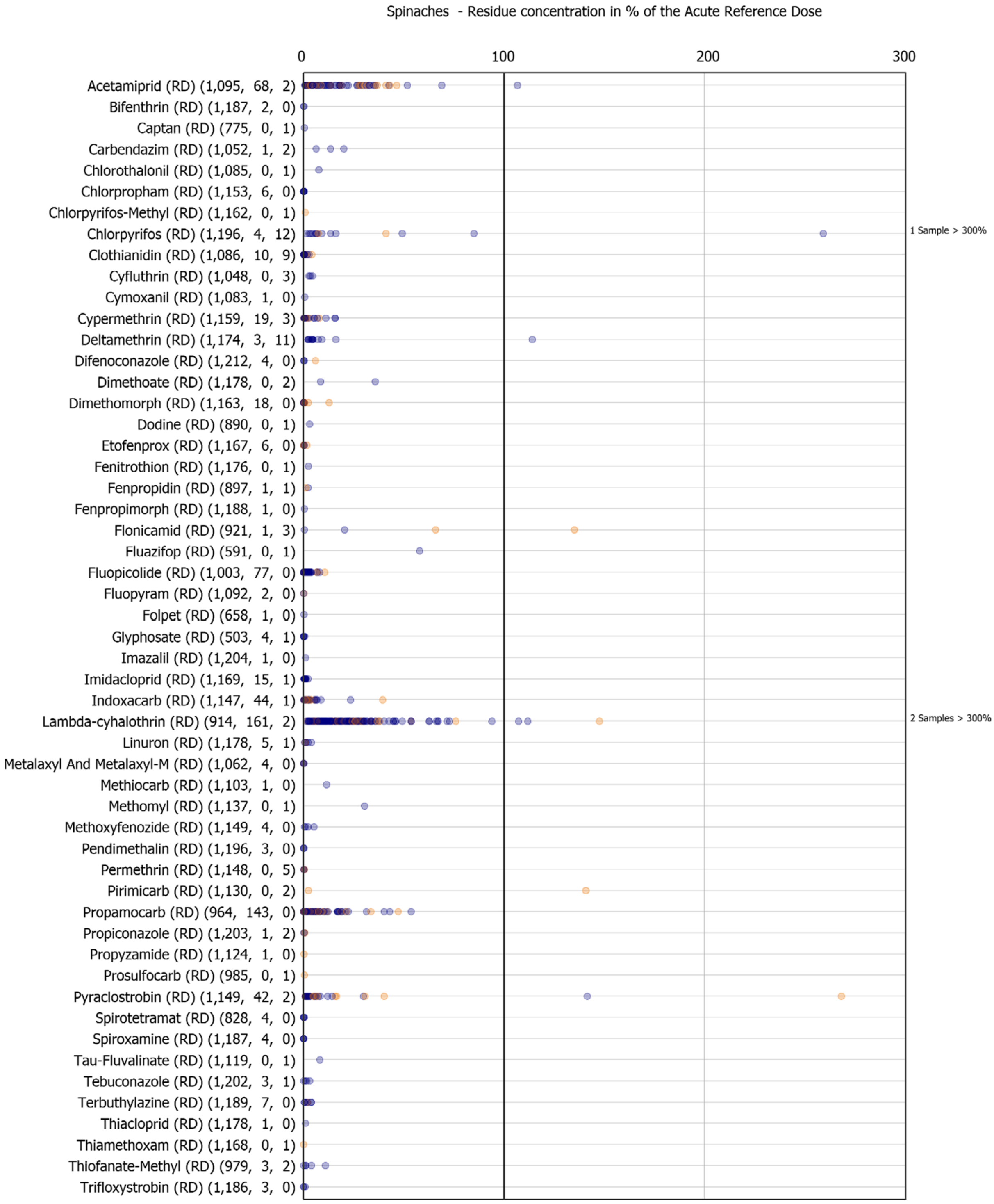

Figure D.5: Acute dietary exposure assessment – spinach

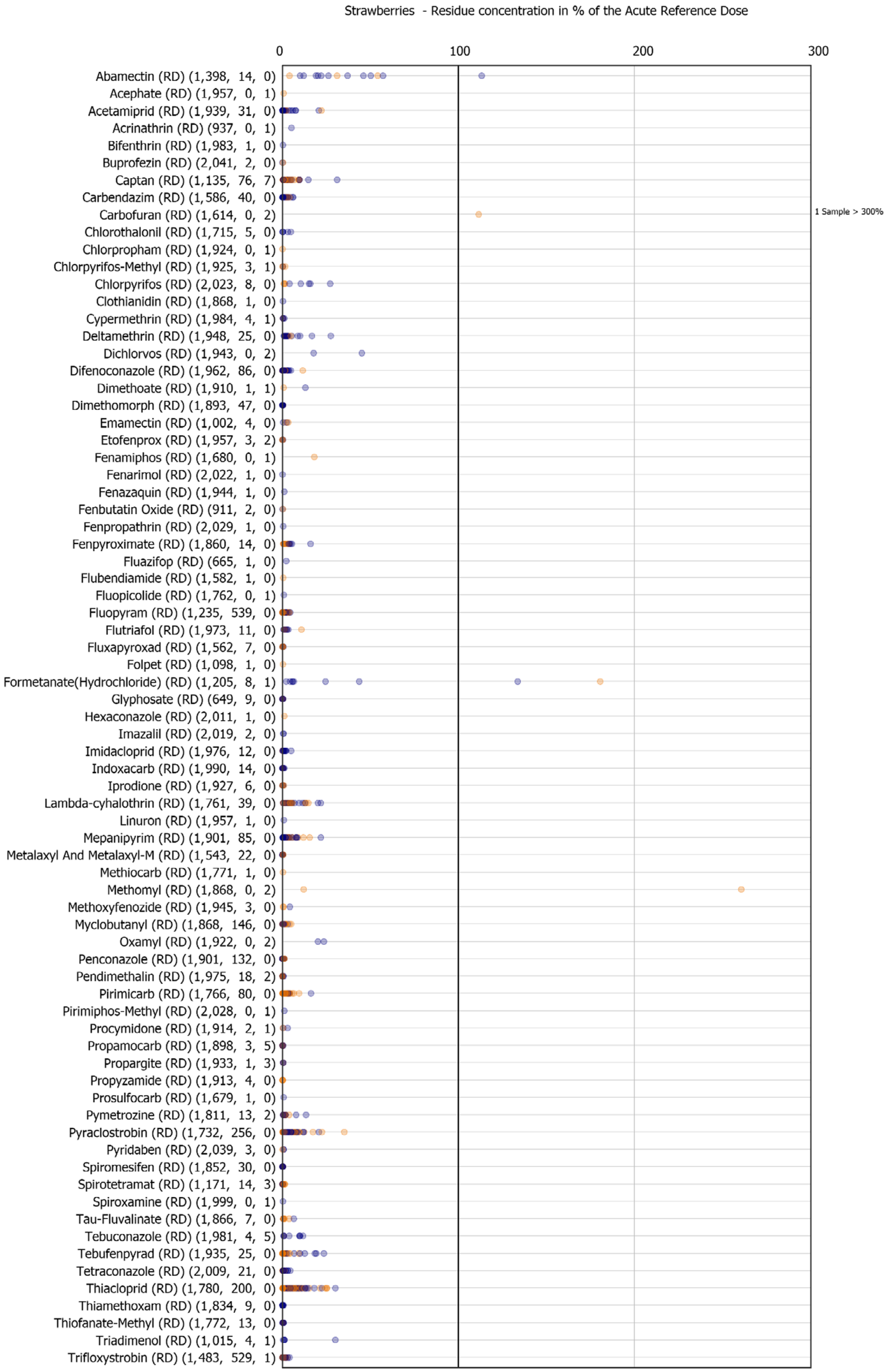

Figure D.6: Acute dietary exposure assessment – strawberries

Figure D.7: Acute dietary exposure assessment – tomatoes

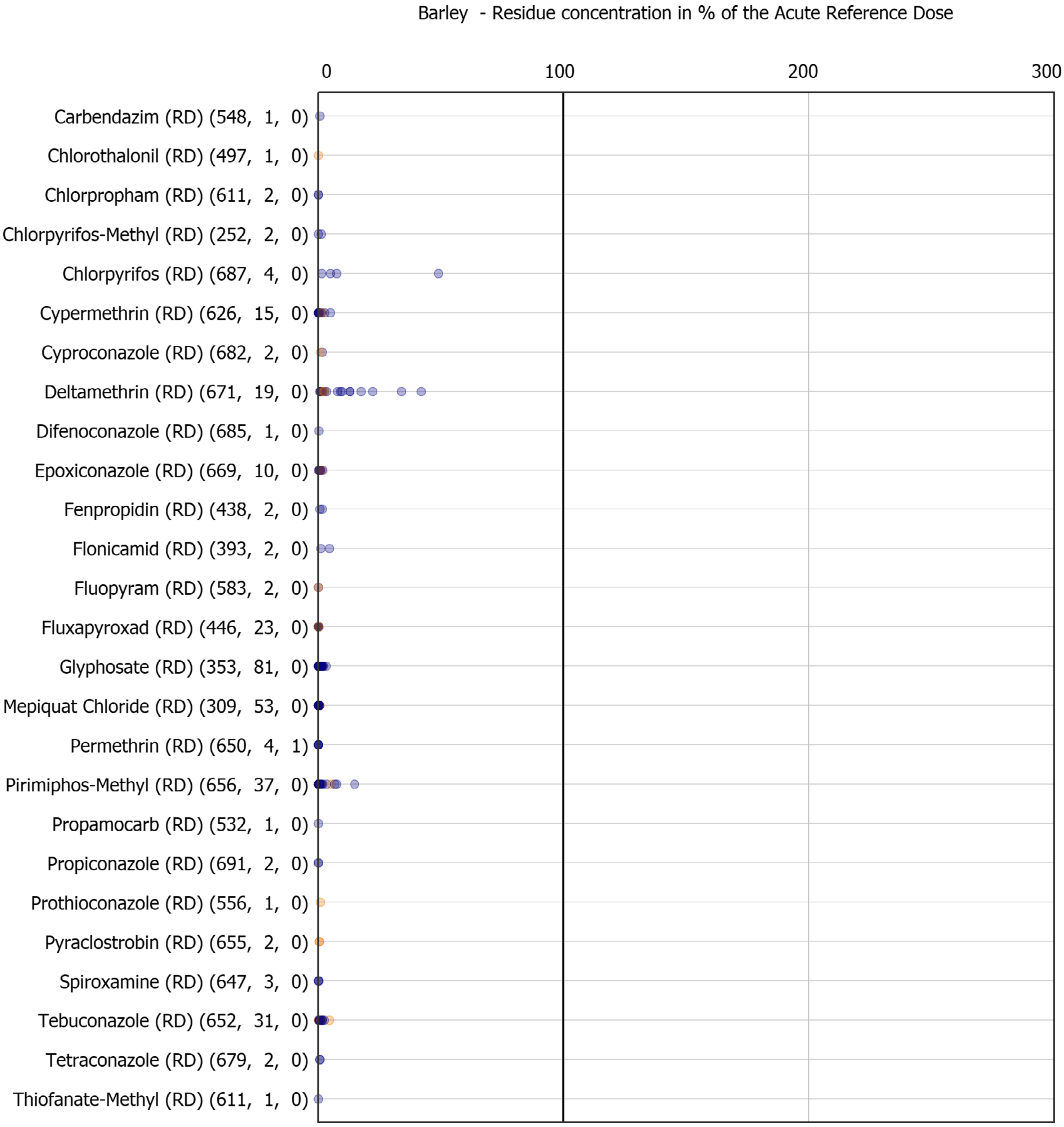

Figure D.8: Acute dietary exposure assessment – barley

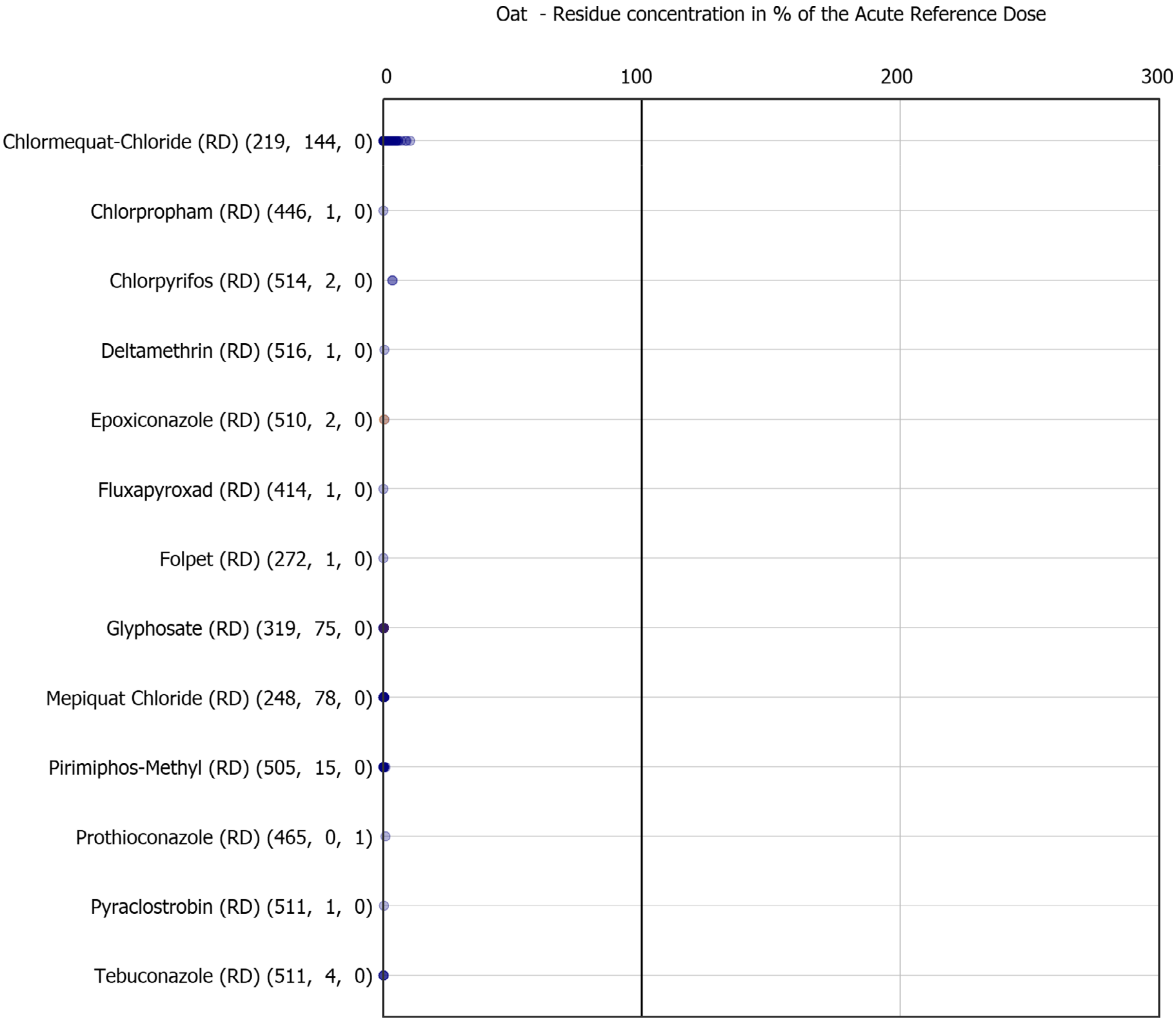

Figure D.9: Acute dietary exposure assessment – oats

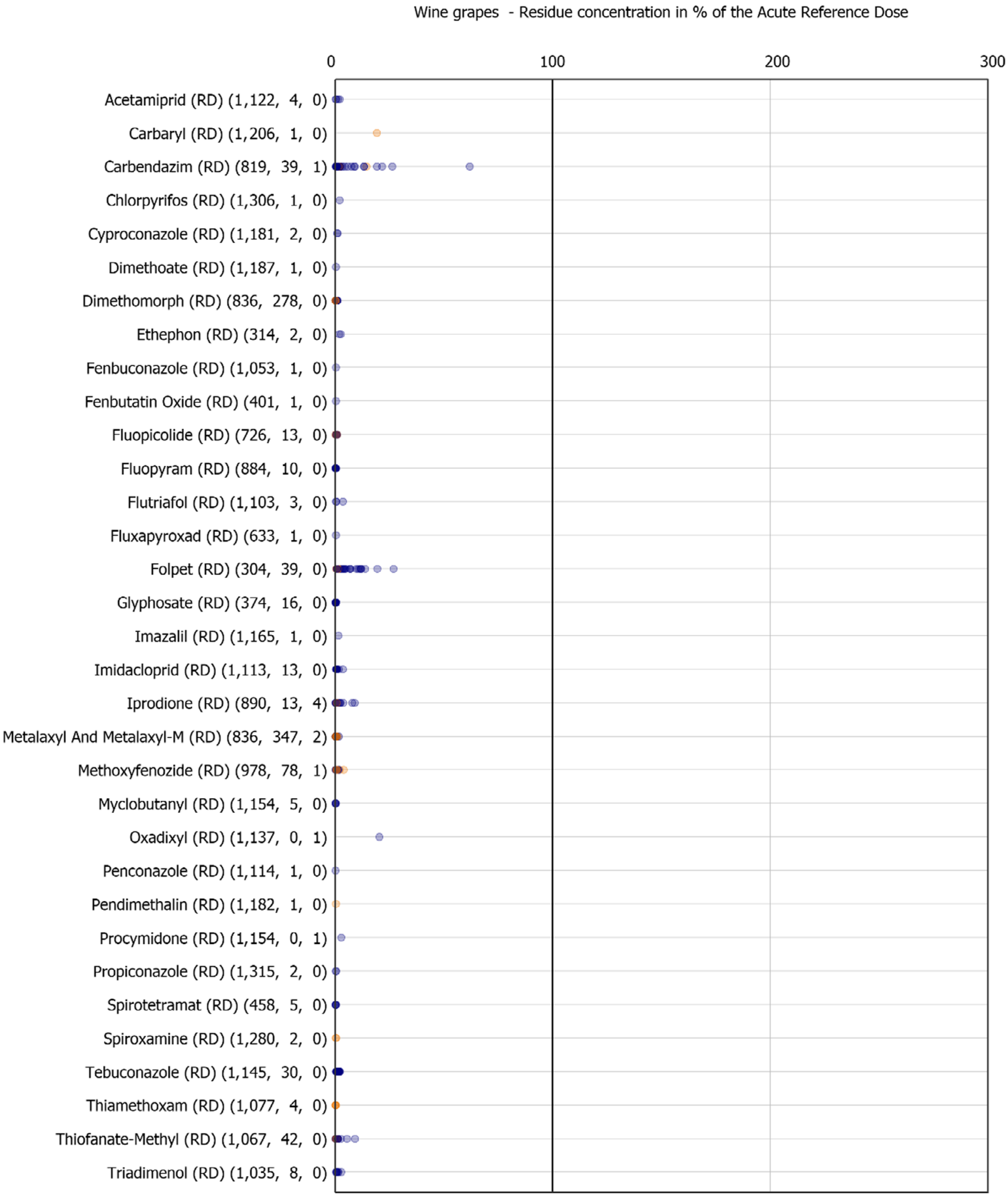

Figure D.10: Acute dietary exposure assessment – wine grapes

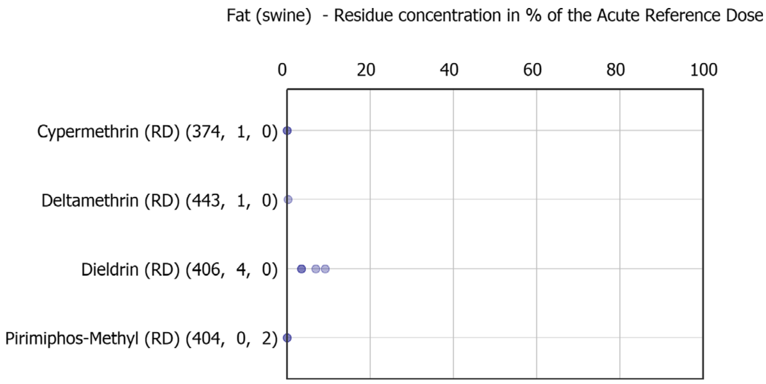

Figure D.11: Acute dietary exposure assessment – swine fat

Annexes

- Annex I – The EU-coordinated programme data visualisation
- Annex II – The MRL exceedances on the 2019 annual report on pesticide residues
- Annex III – The PRIMo exposure model on the 2019 annual report on pesticide residue results
- Annex IV – The pesticides analysed on the 2019 annual report on pesticide residues