Umwelt Bundesamt

German Environment Agency

2. May 2023

Adjustments of to the HRI1 methodology (annex I, SUR draft regulation) as proposed by UBA

The HRI1 methodology according to annex I of the draft regulation on the sustainable use of plant protection products 2022/0196 (COD, SUR[1]) will be used to set national targets and to report the progress of the pesticide reduction goals. In this fact sheet, further reasoning and calculation examples are given to underline the two most important adjustments to correct to the HRI1 indicator methodology as proposed by the German Environment Agency (see Bär et al. 2022[2]; Chapter 2). The recommended adjustments comprise (1) the standardisation of sales data with substance specific application rates and (2) the reduced weighting factor for active substances with expired approval. Exemplary trends are calculated using sales data from Germany and recommended application dates from the EU approval procedure (EU review reports or EFSA conclusions).

1 Standardisation of sales data using recommended application rates

The sales volumes of pesticides have to be standardized by dividing them by substance-specific median application rates[3]. This standardisation of sales volumes is essential to present the use and risk of actives correctly in the given indicator trend.

How does the standardisation of sales volumes change the risk trend?

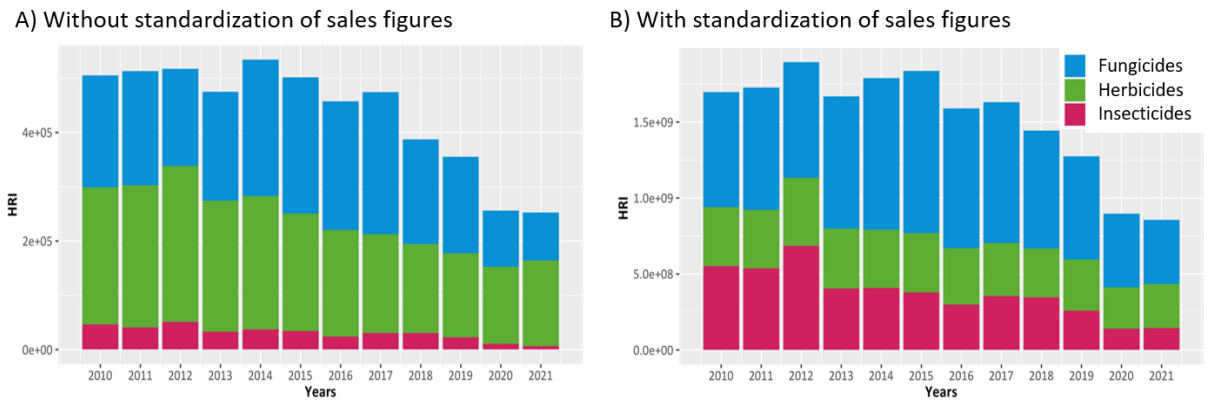
The German trend data show, that the currently proposed method with non-standardised sales volumes leads to a risk trend that is mainly dominated by herbicides and fungicides, while the share of insecticides is small (see Figure 1, left). This can be explained by the fact that insecticides are effective at comparatively low application rates. Therefore, insecticides also have a comparatively low sales volume in total, which leads to a low risk share of insecticides in the current non-standardized version. To adequately acknowledge the risk caused by highly effective substances, sales data need to be corrected by substance specific application rates. The trend with standardized sales data is for example shown in Figure 1 on the right: The shares of the different pesticide types (herbicides, fungicide, insecticides) are more evenly distributed. Even if the overall trend remains relatively unchanged in terms of the German data example, the standardisation is a prerequisite for a plausible trend. In addition, it enables a robust identification of the influence of single pesticides on the overall risk trend as required for the national action plans (Article 9[1]). By doing so, effective recommendations to reduce the overall pesticide risk to the environment and human health can be derived.

[1] Draft for the regulation on the sustainable use of plant protection products 2022/0196 (COD) by the European Commission, June 2022.

[2] Bär S., Knillmann S., Otto S., Müller A., Hess M., Kotschik P., Kuppe K., Foit K., Petzold N., Matezki S., Pieper S., Wogram J. (2022). Towards sustainable plant protection - Evaluation of the draft regulation on the sustainable use of plant protection products 2022/0196 (COD) with a focus on environmental protection.

[3] For each substance, a list of uses is defined, which results from the EU approval process and which is published by the Europ ean Commission in the "Review report for the active substance". Each use represents a fixed combination by aspects like crop, pest, or product formulation. Over all uses, the median application rate was calculated. In case of several application rates per use, the maximum approved rate is taken.

Figure 1: Overall HRI-Trend for Germany between 2010 and 2021 without standardization (A) and with standardization (B) of sales volumes by median application rates of actives 3. Data do not include plant growth regulators, non-chemical pesticide substances and pesticide substances intended for indoor uses. The risk factor for HRI Group 4 is set to 64 for graph A and B.



Source: own illustration, UBA

Can recommended application rates be used as a proxy for real application rates?

Yes, to our knowledge recommended application rates from the active substance approval are accurate enough to remove most of the unwanted bias from the current trend calculation. Thus, this leads to a significant improvement of the informative value of the indicator and its trend in time.

Depending on the substance-specific effectivity and toxicity, recommended mean application rates of PPPs differ by a **factor of up to 10.000** (see Table 1). Hence, if sales volumes are not standardised, the large variation of substance-specific efficacy and associated toxicity is not transferred to the trend calculation and reduces its meaningfulness. In comparison, the difference between recommended and real application rates is negligible and probably smaller than a **factor of 10.** This roughly estimated factor of 10 combines the two following aspects: The variance of recommended application rates per active[4] and the possible average deviation from recommended application rates in agricultural practice[5].

Considering the high level of variation between substance-specific application rates and the presumably small deviations from recommended to real application rates, we expect that both application data could be used interchangeably for the indicator. However, 'real' application rates are still not available EU-wide. Moreover, the added value of real recommended application rates would first need to be evaluated. Beside the fact that such data would complicate the trend calculation due to the given high complexity, the desired standardisation of sales data might be also distorted[6]. In any case, the current bias in HRI1 needs to be corrected

[4] As shown in Table 1, substance specific application rates extracted from the representative uses can vary depending on e.g. crop, pest or product formulation. The range between minimum and maximum application rate is for most chemical-synthetic active substances lower than the factor 3.5 (90% percentile).

[5] Dachbrodt-Saaydeh S., Sellmann J., Strassemeyer J., et al. (2021). Netz der Vergleichsbetriebe Pflanzenschutz: Jahresbericht 2017; Analyse der Ergebnisse der Jahre 2007 bis 2017. JKI, Braunschweig. The following information from the report was used for this factsheet: According to the agricultural monitoring of the JKI, farmers deviate from the recommended use rates by either using a reduced application rate or, to minor extent, by partial treatment. In 2007-2017, recommended application rates for winter cereals (wheat, barley, oilseed rape) were reduced on average by less than 50% (16-44% for fungicides, 22-30% for herbicides and 1-9% for insecticides; see JKI report, page 54, Table 22). To facilitate the comparison of factors in this factsheet, both aspects were combined and the mean reduction from the recommended application rate was evaluated with a factor of maximum 2.

[6] For example, if farmers would systematically halve the use rates in the field per hectare, e.g. due to an established practice of spot application versus field-wide application, a standardisation of the halved sales figures would lead to an overall unchanged indicator trend. We therefore assume that for the required standardisation step, recommended application rates are more suitable than real application rates. indicator trend.

immediately and the recommended application rates are appropriate and available for this purpose.

2 Reduced weighting factor for non-approved actives

In the current version of the HRI1 methodology (Annex I), all chemical pesticides are classified into four groups. Each group is weighted differently according to the assumed potential risk: Low risk actives (risk factor =1), approved actives (8), candidates for substitutions (16) and non-approved actives (64). Thus, risk factors increase from group 1 to group 4. It is assumed that this increase also correlates with an increasing risk for human health and the environment. Despite this rationale, the absolute setting of the risk factors is arbitrary and not scientifically or empirically proven.

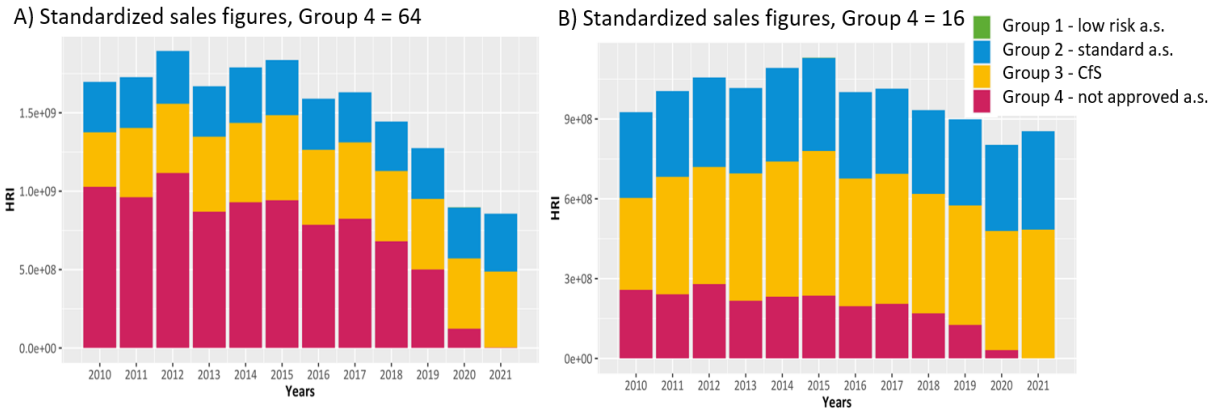
We argue that the main differences between the actives with regard to the environmental risk is already covered by the step of standardisation (for the rationale, see chapter 2 of the main text [2]). Following this approach, the currently suggested risk factors have to be revised to keep the trend calculation meaningful and transparent. In particular, the risk factor of 64 for non-approved actives (HRI-group 4) is disproportionately high and significantly distorts the trend of the indicator retrospectively. Compared to the other three HRI-groups, this risk factor is only connected to the status of approval and is, thus, not defined by hazard (or risk) characteristics. Therefore, and in absence of solid data to prove otherwise, we strongly advise to reduce the risk factor for non-approved substances (HRI-group 4) to a maximum of 16, which corresponds to the risk factor of candidates of substitution or to remove class 4 completely.

To which extent does the risk factor of 64 for non-approved actives influence the indicator result?

The visualization of German trend data shows that the currently used risk factor of 64 for non-approved actives results in a highly dominating share of actives with an expired approval since 2010 (HRI-group 4; see Figure 2A). In contrast, the share of HRI group 4 is notably lower, when the risk factor is reduced from 64 to 16 (see Figure 2B). In addition, there is no longer a significant decrease in the overall trend. Hence, the indicated trend reduction in Germany in the period 2010-2021 by approx. 50% is mainly driven by the risk factor of 64 for actives with expired approval. Moreover, the shares of HRI-group 2 (standard approved substances) remain constant over time or even increase as observed for HRI-group 3 (candidates for substitution, Figure 2A and B).

Considering the Farm-to-Fork-goals to reduce the use and risk of pesticides to the half, it is crucial to clarify whether an additional increased risk factor for the HRI group 4 is indeed necessary and justified.

Figure 2: Overall HRI-Trend for Germany between 2010 and 2021 to display the share of non-approved actives by the currently used risk factor of 64 (A) or the suggested reduced risk factor of 16 (B). Data do not include plant growth regulators, non-chemical pesticide substances and pesticide substances intended for indoor uses. Sales figures were standardized by the substance specific median application rates for both graphs A and B.



Source: own illustration, UBA

Is a steering of non-approved actives via risk factors necessary?

No, because the use of non-approved actives is strictly regulated by law[7]. The sales of expiring actives drop as a result of the phase-out, and the indicator trend decreases accordingly. Hence, a further steering of the process through a retrospective higher weighting of those actives is not needed.

Are non-approved actives guaranteed to be the most problematic substances?

No guarantee can be given that the HRI group 4 actually includes the most problematic substances. There is no harmonised and agreed approach to compare the overall hazard potential of the single actives to environment and human health. As described in more detail in chapter 2[2], attempts for such differentiating comparisons must be considered with caution. Existing approaches (e.g. Pesticide Load Index[8]) usually intend to provide a high level of precision and objectivity, while dealing with a complexity of potential effects and limited data availability or data quality. This leads to substance specific comparisons that are difficult to interpret and unable to cover all potential effects.

For several non-approved actives, the EU approval process was also either not initiated or not completed. The reasons for the non-approved status of actives can also be economic. For example, it is possible that companies have developed more economical alternatives to these active substances or alternatives to overcome emerging resistances in target organisms.

With regard to the missing scientific prove and non-risk related reasons for expiring approvals, it would be most appropriate to apply the same risk factor to non-approved active substances as to CfS (HRI group 3) and, thus, to distinguish them from the normally approved ones with factor 2. A higher weighting related to the state of approval would not be justified.

[7] According to Art. 32 and 46 of Regulation (EC) No 1107/2009, a regular sale of not approved actives as PPPs is limited to a time period of less than 1.5 years. According to Art. 53 of Regulation (EC) No 1107/2009, a sale of not approved actives for emergency situations in plant protection is only foreseen for a very limited and controlled use, and the corresponding risk is already indicated by the trend indicators HRI2 and HRI2a as described in annex VI.

[8] Kudsk P., Jørgensen L. N., & Ørum J. E. (2018). Pesticide Load—A new Danish pesticide risk indicator with multiple applications. Land Use Policy, 70, 384-393.

Table 1: The median, minimum and maximum application rates for each pesticide substance with relevant sales for Germany[9] is presented. The application rates for representative uses are extracted from EU review report or EFSA conclusions. Data do not include plant growth regulators, non-chemical pesticide substances and pesticide substances intended for indoor uses.

PPP active substance	CAS.Nr.	PPP type	Median g a.s./ha	Minimum g a.s./ha	Maximum g a.s./ha	Ratio Median vs. Maximum app. rate	Ratio Min vs. Maximum app. rate
2,4-D	94-75-7	H	750.00	750.00	750.00	1.00	1.00
8-Hydroxyquinoline incl. oxyquinoleine	148-24-3	F	1496.00	1496.00	1496.00	1.00	1.00
Abamectin (aka avermectin)	71751-41-2	I	21.60	9.00	21.60	1.00	2.40
Acequinocyl	57960-19-7	I	600.00	281.00	600.00	1.00	2.14
Acetamiprid	135410-20-7	I	50.00	50.00	50.00	1.00	1.00
Acetic acid	64-19-7	H	60000.00	40800.00	102000.00	1.70	2.50
Aclonifen	74070-46-5	H	2400.00	2400.00	2400.00	1.00	1.00
Alpha-Cypermethrin	67375-30-8	I	10.00	10.00	10.00	1.00	1.00
Ametoctradin	865318-97-4	F	240.00	240.00	240.00	1.00	1.00
Amidosulfuron	120923-37-7	H	45.00	45.00	45.00	1.00	1.00
Aminopyralid	150114-71-9	H	60.00	60.00	60.00	1.00	1.00
Amisulbrom	348635-87-0	F	87.50	75.00	100.00	1.14	1.33
Asulam sodium	2302-17-2	H	2400.00	2400.00	2400.00	1.00	1.00
Azoxystrobin	131860-33-8	F	250.00	250.00	250.00	1.00	1.00
Beflubutamid	113614-08-7	H	170.00	170.00	170.00	1.00	1.00
Benalaxyl	71626-11-4	F	200.00	200.00	240.00	1.20	1.20
Benalaxyl-M	71626-11-4	F	100.00	100.00	100.00	1.00	1.00
Bentazone	25057-89-0	H	960.00	345.60	960.00	1.00	2.78
Benthiavalicarb	177406-68-7	F	75.00	75.00	75.00	1.00	1.00

[9] https://www.bvl.bund.de/DE/Arbeitsbereiche/04_Pflanzenschutzmittel/01_Aufgaben/02_ZulassungPSM/03_PSMInlandsabsatzAusfuhr/psm_PSMInlandsabsatzAusfuhr_node.html

PPP active substance	CAS.Nr.	PPP type	Median g a.s./ha	Minimum g a.s./ha	Maximum g a.s./ha	Ratio Median vs. Maximum app. rate	Ratio Min vs. Maximum app. rate
Benzoic acid	65-85-0	F	14400.00	14400.00	28800.00	2.00	2.00
Benzovindiflupyr	1072957-71-1°	F	75.00	75.00	75.00	1.00	1.00
Beta-Cyfluthrin	68359-37-5	I	15.00	12.50	17.50	1.17	1.40
Bifenazate	149877-41-8	I	96.00	96.00	96.00	1.00	1.00
Bifenox	42576-02-3	H	750.00	750.00	750.00	1.00	1.00
Bifenthrin	82657-04-3	I	10.00	7.60	10.00	1.00	1.32
Bixafen	581809-46-3	F	125.00	125.00	125.00	1.00	1.00
Boscalid (formerly nicobifen)	188425-85-6	F	500.00	250.00	600.00	1.20	2.40
Bromoxynil	1689-84-5	H	400.00	300.00	450.00	1.13	1.50
Bromuconazole	116255-48-2	F	200.00	200.00	200.00	1.00	1.00
Bupirimate	41483-43-6	F	250.00	150.00	750.00	3.00	5.00
Captan	133-06-2°	F	1800.00	1800.00	1800.00	1.00	1.00
Carbendazim	10605-21-7	F	100.00	62.50	100.00	1.00	1.60
Carbetamide	16118-49-3	H	1800.00	1800.00	1800.00	1.00	1.00
Carfentrazone-ethyl	128621-72-7	H	52.50	20.00	60.00	1.14	3.00
Chlorantraniliprole	500008-45-7	I	47.08	42.00	63.00	1.34	1.50
Chloridazon (aka pyrazone)	1698-60-8	H	2600.00	2600.00	2600.00	1.00	1.00
Chlorothalonil	1897-45-6	F	1000.00	1000.00	1000.00	1.00	1.00
Chlorotoluron	15545-48-9	H	2500.00	2500.00	2500.00	1.00	1.00
Chlorpropham	101-21-3°	H	2400.00	2400.00	2400.00	1.00	1.00
Chlorpyrifos	2921-88-2	I	245.00	245.00	245.00	1.00	1.00
Chlorpyrifos-methyl	5598-13-0	I	225.00	225.00	225.00	1.00	1.00
Clethodim	99129-21-2	H	246.00	192.00	300.00	1.22	1.56
Clodinafop	114420-56-3	H	60.00	60.00	60.00	1.00	1.00
Clofentezine	74115-24-5	I	200.00	200.00	200.00	1.00	1.00
Clomazone	81777-89-1	H	105.00	90.00	120.00	1.14	1.33

PPP active substance	CAS.Nr.	PPP type	Median g a.s./ha	Minimum g a.s./ha	Maximum g a.s./ha	Ratio Median vs. Maximum app. rate	Ratio Min vs. Maximum app. rate
Clopyralid	1702-17-6	H	100.00	80.00	120.00	1.20	1.50
Clothianidin	210880-92-5	I	64.00	50.00	78.00	1.22	1.56
Copper compounds	20427-59-2	F	1250.00	800.00	1250.00	1.00	1.56
Copper compounds	1332-40-7	F	1250.00	800.00	1250.00	1.00	1.56
Copper compounds	12527-76-3	F	1250.00	800.00	1250.00	1.00	1.56
Cyantraniliprole	736994-63-1	I	100.00	12.50	100.00	1.00	8.00
Cyazofamid	120116-88-3	F	80.00	80.00	80.00	1.00	1.00
Cycloxydim	101205-02-1	H	525.00	400.00	600.00	1.14	1.50
Cyflufenamid	180409-60-3	F	25.00	25.00	25.00	1.00	1.00
Cyflumetofen	400882-07-7	I	200.00	200.00	300.00	1.50	1.50
Cymoxanil	57966-95-7	F	175.00	120.00	240.00	1.37	2.00
Cypermethrin	52315-07-8	I	25.00	25.00	25.00	1.00	1.00
Cyproconazole	94361-06-5	F	100.00	100.00	100.00	1.00	1.00
Cyprodinil	121552-61-2	F	487.50	225.00	750.00	1.54	3.33
Deltamethrin	52918-63-5	I	8.44	6.25	12.50	1.48	2.00
Desmedipham	13684-56-5	H	480.00	480.00	480.00	1.00	1.00
Dicamba	1918-00-9	H	420.00	360.00	480.00	1.14	1.33
Dichlorprop-P	15165-67-0	H	800.00	800.00	800.00	1.00	1.00
Difenoconazole	119446-68-3	F	12.00	12.00	125.00	10.42	10.42
Diflubenzuron	35367-38-5	I	180.00	180.00	180.00	1.00	1.00
Diflufenican	83164-33-4	H	120.00	120.00	120.00	1.00	1.00
Dimethachlor	50563-36-5	H	1000.00	1000.00	1000.00	1.00	1.00
Dimethenamid-P	163515-14-8	H	720.00	288.00	864.00	1.20	3.00
Dimethoate	60-51-5	I	120.00	120.00	120.00	1.00	1.00
Dimethomorph	110488-70-5	F	180.00	180.00	180.00	1.00	1.00

PPP active substance	CAS.Nr.	PPP type	Median g a.s./ha	Minimum g a.s./ha	Maximum g a.s./ha	Ratio Median vs. Maximum app. rate	Ratio Min vs. Maximum app. rate
Dimoxystrobin	149961-52-4	F	200.00	200.00	200.00	1.00	1.00
Diquat	85-00-7	H	600.00	200.00	1000.00	1.67	5.00
Disodium phosphonate	13708-85-5	F	1125.00	1125.00	1125.00	1.00	1.00
Dithianon	3347-22-6	F	542.50	525.00	560.00	1.03	1.07
Dodine	03.10.2439	F	900.00	900.00	900.00	1.00	1.00
Epoxiconazole	133855-98-8	F	125.00	125.00	125.00	1.00	1.00
Esfenvalerate	66230-04-4	I	15.00	15.00	15.00	1.00	1.00
Ethofumesate	26225-79-6	H	1000.00	1000.00	1000.00	1.00	1.00
Etofenprox	80844-07-1	I	150.00	60.00	210.00	1.40	3.50
Famoxadone	131807-57-3	F	95.00	90.00	100.00	1.05	1.11
Fatty acids C7 to C20 (Pelargonic acid (CAS 112-05-0))		I	31000.00	5520.00	73800.00	2.38	13.37
Fenamidone	161326-34-7	F	133.00	133.00	133.00	1.00	1.00
Fenazaquin	120928-09-8	I	300.00	300.00	300.00	1.00	1.00
Fenhexamid	126833-17-8	F	750.00	750.00	1000.00	1.33	1.33
Fenoxaprop-P	71283-80-2	H	83.00	83.00	83.00	1.00	1.00
Fenoxycarb	72490-01-8	I	187.50	150.00	225.00	1.20	1.50
Fenpropidin	67306-00-7	F	563.00	563.00	563.00	1.00	1.00
Fenpropimorph	67564-91-4	F	750.00	750.00	750.00	1.00	1.00
Fenpyrazamine	473798-59-3	F	600.00	600.00	600.00	1.00	1.00
Fenpyroximate	134098-61-6	I	102.40	102.40	102.40	1.00	1.00
Fipronil	120068-37-3	I	40.00	30.00	50.00	1.25	1.67
Flazasulfuron	104040-78-0	H	50.00	50.00	50.00	1.00	1.00
Flonicamid (IKI-220)	158062-67-0	I	70.00	70.00	80.00	1.14	1.14
Florasulam	145701-23-1	H	6.25	3.75	6.25	1.00	1.67
Fluazifop-P	79241-46-6	H	312.50	250.00	375.00	1.20	1.50

PPP active substance	CAS.Nr.	PPP type	Median g a.s./ha	Minimum g a.s./ha	Maximum g a.s./ha	Ratio Median vs. Maximum app. rate	Ratio Min vs. Maximum app. rate
Fluazinam	79622-59-6	F	200.00	200.00	200.00	1.00	1.00
Fludioxonil[10]	131341-86-1	F	8.75	8.75	8.75	1.00	1.00
Flufenacet (formerly fluthiamide)	142459-58-3	H	600.00	240.00	600.00	1.00	2.50
Flumioxazin	103361-09-7	H	40.00	30.00	50.00	1.25	1.67
Fluopicolide	239110-15-7	F	116.50	100.00	133.00	1.14	1.33
Fluopyram	658066-35-4	F	250.00	250.00	250.00	1.00	1.00
Fluoxastrobin	361377-29-9	F	200.00	200.00	200.00	1.00	1.00
Flupyradifurone	951659-40-8	I	125.00	125.00	150.00	1.20	1.20
Fluquinconazole	136426-54-5	F	125.00	125.00	125.00	1.00	1.00
Fluroxypyr	69377-81-7	H	200.00	180.00	200.00	1.00	1.11
Flurtamone	96525-23-4	H	125.00	125.00	125.00	1.00	1.00
Flusilazole	85509-19-9	F	200.00	150.00	200.00	1.00	1.33
Flutolanil	66332-96-5	F	225.00	225.00	225.00	1.00	1.00
Fluxapyroxad	907204-31-3	F	125.00	125.00	125.00	1.00	1.00
Folpet	133-07-3°	F	750.00	750.00	750.00	1.00	1.00
Foramsulfuron	173159-57-4	H	43.88	29.25	58.50	1.33	2.00
Formetanate	22259-30-9	I	500.00	500.00	500.00	1.00	1.00
Fosetyl	15845-66-6	F	3850.00	2000.00	7000.00	1.82	3.50
Fuberidazole	3878-19-1	F	8.35	7.70	10.35	1.24	1.34
Gamma-cyhalothrin	76703-62-3	I	4.50	4.50	4.50	1.00	1.00
Glufosinate	51276-47-2	H	750.00	750.00	750.00	1.00	1.00

[10] The application rate for the active substance fludioxonil is based on the representative use as a seed treatment in the EU-approval procedure. In Germany, the active is also authorized for spraying with notably higher application rates than for seed treatment. Therefore, the application rate of Fludioxonil has been set to the median of the authorized application rates in Germany (178.5 g/ha) for the exemplary trend calculations.

PPP active substance	CAS.Nr.	PPP type	Median g a.s./ha	Minimum g a.s./ha	Maximum g a.s./ha	Ratio Median vs. Maximum app. rate	Ratio Min vs. Maximum app. rate
Glyphosate	1071-83-6	H	2160.00	1080.00	2880.00	1.33	2.67
Halauxifen-methyl	943831-98-9	H	6.25	6.25	6.25	1.00	1.00
Halosulfuron-methyl	135397-30-7	H	37.50	37.50	37.50	1.00	1.00
Haloxyfop-P (Haloxyfop-R)	95977-29-0	H	83.00	83.00	83.00	1.00	1.00
Hexythiazox	78587-05-0	I	80.00	80.00	100.00	1.25	1.25
Hymexazol	10004-44-1	F	72.45	72.45	72.45	1.00	1.00
Imazalil (aka enilconazole)	35554-44-0	F	160.00	20.00	300.00	1.88	15.00
Imazamox	114311-32-9°	H	50.00	25.00	50.00	1.00	2.00
Imazosulfuron	122548-33-8	H	37.50	25.00	50.00	1.33	2.00
Imidacloprid	138261-41-3	I	150.00	150.00	150.00	1.00	1.00
Iodosulfuron	185119-76-0	H	8.75	7.50	10.00	1.14	1.33
Ioxynil	1689-83-4	H	375.00	300.00	450.00	1.20	1.50
Iprodione	36734-19-7	F	750.00	750.00	750.00	1.00	1.00
Iprovalicarb	140923-17-7	F	189.00	150.00	216.00	1.14	1.44
Iron sulphate	7720-78-7	H	71400.00	71400.00	71400.00	1.00	1.00
Isofetamid	875915-78-9	F	400.00	320.00	600.00	1.50	1.88
Isoproturon	34123-59-6	H	1500.00	1500.00	1500.00	1.00	1.00
Isopyrazam	881685-58-1°	F	125.00	125.00	125.00	1.00	1.00
Isoxaben	82558-50-7	H	125.00	125.00	125.00	1.00	1.00
Isoxaflutole	141112-29-0	H	100.00	100.00	100.00	1.00	1.00
Kresoxim-methyl	143390-89-0	F	125.00	125.00	150.00	1.20	1.20
lambda-Cyhalothrin	91465-08-6	I	7.50	7.50	20.00	2.67	2.67
Lenacil	01.08.2164	H	500.00	500.00	500.00	1.00	1.00

PPP active substance	CAS.Nr.	PPP type	Median g a.s./ha	Minimum g a.s./ha	Maximum g a.s./ha	Ratio Median vs. Maximum app. rate	Ratio Min vs. Maximum app. rate
Lime sulphur (calcium polysulphid)	1344-81-6	F	1000.00	800.00	1200.00	1.20	1.50
Linuron	330-55-2	H	950.00	950.00	950.00	1.00	1.00
Maltodextrin	9050-36-6	I	33700.00	33700.00	33700.00	1.00	1.00
Mancozeb	07.01.8018	F	1600.00	1400.00	2400.00	1.50	1.71
Mandestrobin	173662-97-0	F	200.00	200.00	200.00	1.00	1.00
Mandipropamid	374726-62-2	F	150.00	150.00	150.00	1.00	1.00
Maneb	12427-38-2	F	1800.00	1600.00	2000.00	1.11	1.25
MCPA	94-74-6	H	1800.00	1050.00	1800.00	1.00	1.71
Mecoprop-P	16484-77-8	H	1500.00	1500.00	1800.00	1.20	1.20
Mefentrifluconazole	1417782-03-6	F	150.00	150.00	150.00	1.00	1.00
Mepanipyrim	110235-47-7	F	400.00	400.00	600.00	1.50	1.50
Meptyldinocap	131-72-6°	F	210.00	210.00	210.00	1.00	1.00
Mesosulfuron	208465-21-8	H	10.50	6.00	15.00	1.43	2.50
Mesotrione	104206-82-8	H	150.00	150.00	150.00	1.00	1.00
Metaflumizone	139968-49-3	I	240.00	240.00	240.00	1.00	1.00
Metalaxyl	57837-19-1	F	250.00	200.00	300.00	1.20	1.50
Metalaxyl-M	70630-17-0	F	81.40	81.40	81.40	1.00	1.00
Metamitron	41394-05-2	H	1400.00	1400.00	1400.00	1.00	1.00
Metazachlor	67129-08-2	H	1000.00	750.00	1000.00	1.00	1.33
Metconazole	125116-23-6	F	90.00	90.00	90.00	1.00	1.00
Methiocarb (aka mercaptodimethur)	2032-65-7	I	150.00	150.00	150.00	1.00	1.00
Methoxyfenozide	161050-58-4	I	144.00	144.00	144.00	1.00	1.00
Metiram	9006-42-2	F	1180.00	1100.00	1260.00	1.07	1.15
Metobromuron	3060-89-7	H	2000.00	2000.00	2000.00	1.00	1.00

PPP active substance	CAS.Nr.	PPP type	Median g a.s./ha	Minimum g a.s./ha	Maximum g a.s./ha	Ratio Median vs. Maximum app. rate	Ratio Min vs. Maximum app. rate
Metosulam	139528-85-1	H	25.00	20.00	30.00	1.20	1.50
Metrafenone	220899-03-6	F	30.00	10.00	50.00	1.67	5.00
Metribuzin	21087-64-9	H	350.00	350.00	350.00	1.00	1.00
Metsulfuron-methyl	79510-48-8	H	6.00	3.00	6.00	1.00	2.00
Milbemectin	51596-10-2	I	18.10	17.40	27.90	1.54	1.60
Myclobutanil	88671-89-0	F	48.00	48.00	48.00	1.00	1.00
Napropamide	15299-99-7	H	1000.00	1000.00	1200.00	1.20	1.20
Nicosulfuron	111991-09-4	H	60.00	60.00	60.00	1.00	1.00
Oxathiapiprolin	1003318-67-9°	F	40.00	15.00	60.00	1.50	4.00
Paraffin oil/(CAS 72623-86-0)	8042-47-5	I	20000.00	10400.00	23700.00	1.19	2.28
Paraffin oil/(CAS 8042-47-5)	97862-82-3	I	14742.00	4368.00	29430.00	NA	2.00
Pelargonic acid (CAS 112-05-0)	66246-88-6	H	31000.00	5520.00	73800.00	2.38	13.37
Penconazole	66063-05-6	F	40.00	25.00	50.00	1.25	2.00
Pendimethalin	494793-67-8	H	1593.00	455.00	1600.00	1.00	3.52
Penflufen	219714-96-2	F	60.00	6.25	100.00	1.67	16.00
Penoxsulam	219714-96-2	H	40.00	40.00	40.00	1.00	1.00
Penthiopyrad	183675-82-3	F	500.00	400.00	600.00	1.20	1.50
Pethoxamid	106700-29-2	H	1200.00	1200.00	1200.00	1.00	1.00
Phenmedipham	13684-63-4	H	320.00	320.00	320.00	1.00	1.00
Phosphane	7803-51-2	I	3.70	3.70	3.70	1.00	1.00
Picloram	01.02.1918	H	23.45	23.45	23.45	1.00	1.00
Picolinafen	137641-05-5	H	100.00	100.00	100.00	1.00	1.00
Picoxystrobin	117428-22-5	F	250.00	250.00	250.00	1.00	1.00

PPP active substance	CAS.Nr.	PPP type	Median g a.s./ha	Minimum g a.s./ha	Maximum g a.s./ha	Ratio Median vs. Maximum app. rate	Ratio Min vs. Maximum app. rate
Pinoxaden	243973-20-8	H	60.00	45.00	60.00	1.00	1.33
Pirimicarb	23103-98-2	I	180.00	150.00	210.00	1.17	1.40
Potassium hydrogen carbonate	298-14-6°	F	6000.00	2550.00	15000.00	2.50	5.88
Potassium phosphonates		F	2904.00	2904.00	2904.00	1.00	1.00
Prochloraz	67747-09-5	F	241.50	33.00	450.00	1.86	13.64
Propamocarb	24579-73-5	F	2166.00	1083.00	72200.00	33.33	66.67
Propaquizafop	111479-05-1	H	200.00	200.00	200.00	1.00	1.00
Propiconazole	60207-90-1	F	125.00	125.00	125.00	1.00	1.00
Propoxycarbazone	181274-15-7	H	70.00	42.00	70.00	1.00	1.67
Propyzamide	23950-58-5	H	750.00	500.00	840.00	1.12	1.68
Proquinazid	189278-12-4	F	50.00	50.00	75.00	1.50	1.50
Prosulfocarb	52888-80-9	H	4000.00	4000.00	4000.00	1.00	1.00
Prosulfuron	94125-34-5	H	15.00	15.00	20.00	1.33	1.33
Prothioconazole	178928-70-6	F	200.00	175.00	200.00	1.00	1.14
Pymetrozine	123312-89-0	I	100.00	75.00	300.00	3.00	4.00
Pyraclostrobin	175013-18-0	F	100.00	100.00	100.00	1.00	1.00
Pyraflufen-ethyl	129630-17-7	H	21.20	21.20	21.20	1.00	1.00
Pyridate	55512-33-9	H	900.00	900.00	900.00	1.00	1.00
Pyrimethanil	53112-28-0	F	800.00	600.00	1000.00	1.25	1.67
Pyriofenone	688046-61-9	F	90.00	90.00	90.00	1.00	1.00
Pyroxsulam	422556-08-9	H	18.75	18.75	18.75	1.00	1.00
Quinmerac	90717-03-6	H	250.00	250.00	250.00	1.00	1.00
Quinoclamine	2797-51-5	H	3750.00	3750.00	3750.00	1.00	1.00
Quinoxyfen	124495-18-7	F	75.00	75.00	250.00	3.33	3.33

PPP active substance	CAS.Nr.	PPP type	Median g a.s./ha	Minimum g a.s./ha	Maximum g a.s./ha	Ratio Median vs. Maximum app. rate	Ratio Min vs. Maximum app. rate
Quizalofop-P	94051-08-8	H	162.50	125.00	200.00	1.23	1.60
Rimsulfuron	122931-48-0	H	20.00	15.00	20.00	1.00	1.33
Sedaxane	874967-67-6	F	25.00	25.00	25.00	1.00	1.00
Silthiofam	175217-20-6	F	50.00	50.00	50.00	1.00	1.00
S-Metolachlor	87392-12-9	H	1540.00	1500.00	1540.00	1.00	1.03
Spinetoram	187166-40-1	I	36.00	36.00	36.00	1.00	1.00
Spinosad	168316-95-8	I	144.00	96.00	720.00	5.00	7.50
Spirodiclofen	148477-71-8	I	144.00	96.00	144.00	1.00	1.50
Spirotetramat	203313-25-1	I	72.00	72.00	288.00	4.00	4.00
Spiroxamine	118134-30-8	F	375.00	375.00	375.00	1.00	1.00
Sulcotrion	99105-77-8	H	450.00	450.00	450.00	1.00	1.00
Sulfosulfuron	141776-32-1	H	10.00	10.00	20.00	2.00	2.00
Sulfoxaflor	946578-00-3	I	24.00	24.00	24.00	1.00	1.00
Sulphur	7704-34-9	F	6400.00	2560.00	29550.00	4.62	11.54
tau-Fluvalinate	102851-06-9	I	60.00	48.00	72.00	1.20	1.50
Tebuconazole	107534-96-3	F	250.00	6.00	250.00	1.00	41.67
Tebufenozide	112410-23-8	I	186.00	172.00	288.00	1.55	1.67
Tebufenpyrad	119168-77-3	I	100.00	100.00	100.00	1.00	1.00
Tefluthrin	79538-32-2	I	15.60	15.60	15.60	1.00	1.00
Tembotrione	335104-84-2	H	100.00	100.00	100.00	1.00	1.00
Tepraloxydim	149979-41-9	H	100.00	100.00	100.00	1.00	1.00
Terbuthylazine	5915-41-3	H	844.00	750.00	844.00	1.00	1.13

PPP active substance	CAS.Nr.	PPP type	Median g a.s./ha	Minimum g a.s./ha	Maximum g a.s./ha	Ratio Median vs. Maximum app. rate	Ratio Min vs. Maximum app. rate
Tetraconazole	112281-77-3	F	100.00	100.00	100.00	1.00	1.00
Thiacloprid	111988-49-9	I	216.00	144.00	216.00	1.00	1.50
Thiamethoxam	153719-23-4	I	95.50	20.00	150.00	1.57	7.50
Thiencarbazone-methyl	936331-72-5	H	45.00	45.00	45.00	1.00	1.00
Thifensulfuron-methyl	79277-67-1°	H	20.63	0.04	37.50	1.82	914.63
Thiophanate-methyl	23564-05-8	F	891.00	781.00	2810.00	3.15	3.60
Thiram	137-26-8°	F	2000.00	2000.00	2400.00	1.20	1.20
Tolclofos-methyl	57018-04-9	F	900.00	562.50	50000.00	55.56	88.89
Topramezone	210631-68-8	H	62.50	50.00	75.00	1.20	1.50
Triadimenol	55219-65-3	F	40.00	40.00	40.00	1.00	1.00
Triasulfuron	82097-50-5	H	7.50	7.50	7.50	1.00	1.00
Triazoxide	72459-58-6	F	6.00	6.00	6.00	1.00	1.00
Tribenuron (aka metometuron)	106040-48-6	H	15.00	5.50	24.00	1.60	4.36
Triclopyr	55335-06-3	H	480.00	480.00	480.00	1.00	1.00
Trifloxystrobin	141517-21-7	F	125.00	112.50	150.00	1.20	1.33
Triflusulfuron	126535-15-7	H	17.50	15.00	30.00	1.71	2.00
Triticonazole	131983-72-7	F	12.50	12.50	12.50	1.00	1.00
Tritosulfuron	142469-14-5	H	50.00	50.00	50.00	1.00	1.00
Valifenalate	283159-90-0	F	120.00	120.00	120.00	1.00	1.00
zeta-Cypermethrin	52315-07-8	I	26.25	15.00	37.50	1.43	2.50
Ziram	137-30-4	F	2280.00	2280.00	2280.00	1.00	1.00
Zoxamide	156052-68-5	F	180.00	180.00	180.00	1.00	1.00

Source: own illustration, UBA

Imprint

Publisher

Umweltbundesamt
Wörlitzer Platz 1
06844 Dessau-Roßlau
Tel: +49 340-2103-0
buergerservice@uba.de
Internet: www.umweltbundesamt.de
/umweltbundesamt.de
/umweltbundesamt

Completion: May/2023

Authors, Institutions

Saskia Knillmann, Kaarina Foit, Pia Kotschik Susanne Bär, Steffen Matezki

Section IV 1.3 Plant Protection Products, German Environment Agency