

BRIEFING DOCUMENT

Pesticide residues in wheat and flour

Updated January 2023

Summary

Flour customers and consumers are increasingly aware of the potential for agrochemical (pesticide) residues to enter the food chain. Testing for pesticide residues covers the food chain from farm to fork, with milling wheat samples tested as part of the AHDB Contaminants Monitoring Project and flour and bread samples tested by the Defra Expert Committee on Pesticide Residues in food.

Residues of pesticides continue to remain well below statutory Maximum Residue Levels (MRLs) in UK wheat, flour and flour-based products.

Background

Prior to Brexit, the EU set the limit of agrochemicals (pesticides) that are legally allowed to remain in food in the UK. These are called maximum residue limits (MRLs). MRLs are based on good controls and practice during production and reflect the amount of pesticide that may reside in the product if it has been applied correctly. MRLs are not safety limits, they are usually well below the levels that could cause an unacceptable risk to human health. Now that the UK has left the EU, the responsibility to set MRLs is a UK competency and is carried out by the Chemicals Regulation Division (CRD) of the Health and Safety Executive (HSE). The limits set by the CRD will only apply to products sold in GB. Products sold in NI will continue to be subject to EU MRLs. The same applies to products exported to EU member states.

Farmers, importers, distributors and retailers are responsible for ensuring that food conforms to all statutory MRLs set. MRLs are set for each pesticide for a wide range of foodstuffs. The Food Standards Agency has a policy to reduce all pesticide levels as far as is practical and certainly below MRLs. This policy has been embraced by the wider agricultural industry. The Red Tractor Assurance Scheme continues with a successful initiative, directed at farmers, to minimise agrochemicals entering the food supply chain.

Agrochemical types

The agrochemicals most likely to leave residues are those that are applied late in the life of the growing crop, those that are applied to stored grain and those that have a long half-life (degrade slowly). Agrochemicals used on wheat can be categorised as follows:

Category	Uses and example active ingredients
Fungicides	Used to control fungal diseases, often applied relatively late in the life of the wheat crop.
Field insecticides	Used to control aphids or wheat blossom midge on wheat plants in the field.
Plant growth regulators (PGRs)	These are applied to reduce the height of the plant. There are three actives approved for use on wheat – chlormequat, mepiquat and trinexapac-ethyl.
Herbicides	Used to control weeds. In rare cases glyphosate is used to hasten crop senescence in wet years.
Storage insecticides	Applied to stored grain - (see agrochemicals for use on stored grain briefing document)
Synergists	Piperonyl butoxide is used as a synergist with pyrethroid insecticides to improve the 'knockdown' effect.

Residue data

Each year, as part of the AHDB Contaminants Monitoring Project, analyses are made on approximately 50 milling wheat samples for potential contaminants including pesticide residues. Results are sent to UK Flour Miller members and appear on the AHDB website. Results show that milling wheat is not a significant source of pesticide residues. The table below is a summary of the PGR, storage insecticide, chlorpropham and glyphosate results from the past three years. The relevant MRLs can be found in the Appendix. This document refers to active ingredient names, not product names.

Harvest Year	Active ingredient	% of samples containing residue	Mean level (mg/kg)*	Max level (mg/kg)	% samples exceeding MRL
2022	Chlormequat	92%	0.32	0.82	0%
	Mepiquat	12%	0.01	0.15	0%
	Glyphosate	18%	0.07	0.55	0%
	Imazaquin	0%	0.00	0.00	0%
	Chlorpropham	4%	0.00	0.03	2%
	Chlorpyrifos	tbc	tbc	tbc	tbc
	Chlorpyrifos-methyl	tbc	tbc	tbc	tbc
	Cypermethrin	tbc	tbc	tbc	tbc
	Deltamethrin	tbc	tbc	tbc	tbc
	Malathion	tbc	tbc	tbc	tbc
	Pirimiphos-methyl	tbc	tbc	tbc	tbc
2021	Chlormequat	88%	0.14	0.42	0%
	Mepiquat	16%	0.01	0.17	0%
	Glyphosate	41%	0.23	1.18	0%
	Imazaquin	0%	0.00	0.00	0%
	Chlorpropham	2%	0.00	0.03	2%
	Chlorpyrifos	0%	0.00	0.00	0%
	Chlorpyrifos-methyl	0%	0.00	0.00	0%
	Cypermethrin	0%	0.00	0.00	0%
	Deltamethrin	8%	0.00	0.04	0%
	Malathion	0%	0.00	0.00	0%
	Pirimiphos-methyl	0%	0.00	0.00	0%
2020	Chlormequat	90%	0.38	1.11	0%
	Mepiquat	14%	0.36	0.36	0%
	Glyphosate	37%	0.18	1.20	0%
	Imazaquin	0%	0.00	0.00	0%
	Chlorpropham	0%	0.00	0.00	0%
	Chlorpyrifos	0%	0.00	0.00	0%
	Chlorpyrifos-methyl	0%	0.00	0.00	0%
	Cypermethrin	4%	0.00	0.04	0%
	Deltamethrin	16%	0.02	0.31	0%
	Malathion	0%	0.00	0.00	0%
	Pirimiphos-methyl	8%	0.01	0.31	0%

* the mean is calculated using the lower bound for results <LOD, i.e a result below the LOD is assumed to be zero

Piperonyl butoxide

Samples from harvest 2014 were also analysed for the presence of piperonyl butoxide (PBO) residues. This material is added to some pyrethroid insecticides to improve their activity. It is not itself an insecticide or active ingredient but enhances the performance of some insecticides. In the USA there have been concerns about exposure in the home to this material (insecticide sprays and dusts), but the US Environmental Protection Agency (USEPA) determined that there were "no risks of concern" for householders mixing, loading, handling, or applying PBO-containing products. Some customers of UK flour have sought more information about this compound and may overestimate risks associated with it being applied to stored grain. In the sampling, 12 of the 50 samples tested contained low level residues. Samples have not been tested for piperonyl butoxide since. There are no MRLs for PBO.

Pesticide residues in flour and bread

The Defra Expert Committee on Pesticide Residues in Food (PRiF), previously the Pesticide Residues Committee (PRC), produces a report each quarter that looks at levels of pesticide residues in various food stuffs. They look at pesticide residue levels in staple foods, including bread, every year (flour is tested less regularly). All of their reports can be accessed on [their website](#). The monitoring (see table) shows that UK flour and bread has an excellent compliance record against agrochemical MRLs. 2022 results will be published later in 2023.

Year	Food	Samples analysed (n)	Samples free from residues (n)	% samples free from residues	Samples containing residues at or below MRL (n)	% samples containing residues at or below MRL	Samples containing residues above MRL (n)
2021	Bread	264	30	13%	228	86%	1
2021	Flour	42	13	31%	29	69%	0
2020	Bread	162	22	14%	140	86%	0
2019	Bread	180	12	7%	168	93%	1
2018	Bread	144	22	15%	122	85%	0
2017	Bread	216	16	7%	200	93%	0
2016	Bread	216	29	13%	187	87%	0
2015	Bread	140	62	44%	78	56%	0
2015	Bread (gluten free)	12	12	100%	0	0%	0
2015	Flour	66	3	5%	63	95%	0
2014	Bread	204	120	59%	84	41%	0
2014	Bread (part baked)	12	3	25%	9	75%	0
2014	Flour	67	65	97%	2	3%	0
2013	Bread	216	79	37%	137	63%	0

EU monitoring of pesticide residues

The European Food Safety Authority (EFSA) carries out an annual EU-wide monitoring programme of pesticide residues in a range of food stuffs, including flour ([reports available here](#)). The programme consistently finds that for wheat flour, the number of samples containing pesticide residues exceeding the MRL is very low.

Legislative levels

Customers sometimes seek MRL information for all of the agrochemicals likely to be used on milling wheat. A full list of these appears in the appendix.

Future actions

UK Flour Millers will continue to monitor and report on MRLs in milling wheat to provide its members with the latest data and information, and will continue to engage with Red Tractor to ensure agrochemical residues are as low as necessary.

APPENDIX – Maximum limits (MLs) for agrochemicals used on milling wheat

As outlined earlier, the UK now has responsibility for setting MRLs applying to products sold in GB. Products sold in NI continue to be subject to EU MRLs, as do product exported to EU member states. As such, there is the potential for divergence between the MRLs applying in GB and those applying in NI and the EU. The tables below now list both MRLs.

Fungicides (for the control of late foliar and/or ear diseases)

Many are applied either as formulated mixed products or in tank mixes made by the operator. They are applied relatively late in the life of the crop.

Active ingredient	MRLs (mg/kg)	
	GB	NI & EU
azoxystrobin	0.5	0.5
bixafen	0.05	0.05
boscalid	0.8	0.8
chlorothalonil* (no longer approved)	0.1	0.01
cyflufenamid	0.04	0.04
cyproconazole	0.1	0.1
cyprodinil	0.5	0.5
difenoconazole	0.1	0.1
dimoxystrobin	0.08	0.08
epoxiconazole	0.6	0.6
fenpropidin	0.1	0.1
fenpropimorph	0.15	0.15
fluoastrobilin	0.03	0.03
flutriafol	0.15	0.15
fluxapyroxad	0.4	0.4

Active ingredient	MRLs (mg/kg)	
	GB	NI & EU
kresoxim-methyl	0.08	0.08
metconazole	0.15	0.15
metrafenone	0.07	0.07
picoxystrobin (no longer approved)	0.01	0.01
prochloraz	0.2	0.2
propiconazole** (no longer approved)	0.09	0.01
proquinazid	0.02	0.02
prothioconazole	0.1	0.1
pyraclostrobin	0.2	0.2
spiroxamine	0.05	0.05
tebuconazole	0.3	0.3
thiophanate-methyl	0.05	0.05
triadimenol	0.1	0.1
trifloxystrobin	0.3	0.3

*chlorothalonil is no longer approved and the GB MRL is being lowered to the limit of detection (0.01mg/kg). This will apply from 05 March 2023. It is not expected the divergence between the GB and NI/EU MRL in the intervening months will pose a compliance issue as the use-by date for chlorothalonil was May 2020, so this active will not have been applied to the 2021 UK wheat crop or future UK wheat crops.

**propiconazole is no longer approved and the GB MRL is being lowered to the limit of detection (0.01mg/kg). This will apply from 24 April 2023. It is not expected the divergence between the GB and NI/EU MRL in the intervening months will pose a compliance issue as no fungicides containing propiconazole are approved for use on wheat in GB.

All the above agrochemicals are included in the PRiF multi-residue test screen with a few limited exceptions. All are included in the multi-residue test screen used in the AHDB Contaminants Monitoring Project. Very few samples contain fungicide residues above the LOD and if residues are present they are well below the MRLs. It is very unlikely that any residues (>LOD) would normally be found from these products unless a breach of good agricultural practice had occurred.

Insecticides (applied to control aphids or wheat blossom midge)

Active ingredient	MRLs (mg/kg)	
	GB	NI & EU
chlorpyrifos*** (no longer approved)	0.01	0.01
cypermethrin	2.0	2.0
deltamethrin	1.0	1.0
esfenvalerate	0.2	0.2

Active ingredient	MRLs (mg/kg)	
	GB	NI & EU
lambda-cyhalothrin	0.05	0.05
pirimicarb	0.05	0.05
tau-fluvalinate	0.05	0.05
thiacloprid	0.1	0.1

***chlorpyrifos is no longer approved for use on cereals and as such the MRL is set to the limit of detection (0.01mg/kg).

The insecticides listed are included in the PRiF multi-residue test screen and a review of PRiF results indicates that none are found above the limit of detection. Although usually used alone the full label rate may not be applied.

Plant Growth Regulators (PGRs)

Active ingredient	MRLs (mg/kg)	
	GB	NI & EU
chlormequat	7.0	7.0
imazaquin (no longer approved)	0.05	0.05
mepiquat	3.0	3.0
trinexapac-ethyl	3.0	3.0

Chlormequat continues to be found regularly despite efforts to reduce both levels and incidences. Mepiquat levels do seem to have significantly reduced in the last 5-6 years. This may be because it is now only used in co-formulated products. Imazaquin is a PGR that is no longer approved for use and as such its MRL is set to the limit of detection.

Herbicides

Active ingredient	MRLs (mg/kg)	
	GB	NI & EU
glyphosate	10.0	10.0

Glyphosate is the most commonly used agrochemical in the world and as such attracts media attention. A separate UK Flour Millers briefing document on glyphosate is available. Monitoring shows UK wheat, flour and bread has an excellent compliance record in relation to glyphosate MRLs.

Other agrochemicals

Active ingredient	MRLs (mg/kg)	
	GB	NI & EU
chlorpropham (potato sprout suppressant, not approved for wheat)	0.01	0.01
chlorpyrifos-methyl (stored product insecticide, no longer approved)	0.01	0.01
pirimiphos-methyl (stored product insecticide)	5.0	5.0
deltamethrin (stored product insecticide)	1.0	1.0
malathion (stored product insecticide - approved but no longer in use)	8.0	8.0

These are not applied to cereal crops growing in the field. The stored product insecticides are used only within stores, either applied to the fabric of the store or to the grain itself. Chlorpropham (also known as CIPC) is a sprout suppressant applied to potatoes in store. Its significance is that residues may then contaminate grain stored in the same facilities. Whilst this does not pose a health risk, the contamination is problematic as chlorpropham is not approved for use on wheat and so the MRL is set to the lowest level possible 0.01mg/kg (the limit of detection). There is a separate UK Flour Millers briefing document for pesticides applied to stored grain.