Mycotoxin monitoring results

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Original thinking... applied

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AHDB Contaminants Consortium

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Original thinking... applied

Partners

AHDB
AGRICULTURE & HORTICULTURE DEVELOPMENT BOARD

AIC – Agricultural Industries Confederation

BOBMA – British Oats and Barley Millers' Association

MAGB – Maltsters' Association of Great Britain

UKFM – UK Flour Millers

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Background

For the UK grain supply chain to remain competitive, it needs to maintain its reputation for compliance and quality

- Agrochemical residues, mycotoxins and other major contaminants in cereals and co-products have been monitored independently since the mid-1980s
- A five-year (2016–2021) AHDB monitoring contract (21130040) is led by Fera, this was extended for 1 year to include 2021-2022
- Commercial grain samples* from each harvest are tested for key contaminants
- Sampling & sample preparation is key consideration, sample sizes up to 10kg
- The results presented show harvest 2021 data for mycotoxins**

*Commercial intake samples have been provided by member companies of AIC, BOBMA, MAGB and UKFM

**Full monitoring results are published on the AHDB project page: ahdb.org.uk/monitoring-of-contaminants-in -uk-cereals-used-for-processing-food-and-animal-feed

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Data Treatment

- Mycotoxin results are all corrected for recovery determined with each analytical batch
- For statistical summaries (from Fera) all results are calculated using 'lower bound' values
- This means anything <RL is presumed = 0.
- This is why some mean values can be calculated as a 'value/number' which is lower than the RL

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Sampling plan – harvest samples 2021

Sample type	Trade Association	Sample number	Core and additional analytes
Milling Wheat	nabim	50	Trichothecenes, ZON, fungicides, PGRs & glyphosate, 6+6 ergot alkaloids, 10 samples for aflatoxins, 25 samples for 7 metals
Malting Barley	MAGB	40	Trichothecenes, ZON, fungicides, 6+6 ergot alkaloids, 10 samples for 7 metals
Food Oats	BOBMA	29	Trichothecenes, ZON, fungicides, PGRs & glyphosate, 6+6 ergot alkaloids, 10 samples for 7 metals
Barley		1	Trichothecenes, ZON, fungicides, PGRs & glyphosate, 6+6 ergot alkaloids,
Feed Wheat	AIC	14	Trichothecenes, ZON, glyphosate, 6+6 ergot alkaloids
Wheatfeed		20	Trichothecenes, ZON, 6+6 ergot alkaloids
Feed Barley		14	Trichothecenes, ZON, glyphosate, 6+6 ergot alkaloids
Feed Oats		6	Trichothecenes, ZON, glyphosate, 6+6 ergot alkaloids
Oatfeed		6	Trichothecenes, ZON, 6+6 ergot alkaloids

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Analytical Method

- In-house method developed at Fera, for analysis of 17 Fusarium mycotoxins
- Method uses solvent extraction, followed by SPE clean-up and LC-MS/MS analysis
- Analytes are:
  Deoxynivalenol, fusarenon X, 3-acetyl DON, 15-acetyl DON, nivalenol, diacetoxyscirpenol, neosolaniol, T-2 toxin, HT-2 toxin, DON-3-glucoside, T-2 b3 glucoside, zearalenone, α-zearalenol, β-zearalenol, α-zearalenol glucoside, β-zearalenol glucoside and zearalenone glucoside
- Method is accredited to ISO17025 – originally by Flexible Scope

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Deoxynivalenol Results Harvest 2020 Samples

DON Harvest (September 2021)

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	2021 Mean Level µg/kg	2020 Mean Level µg/kg	2019 Mean Level µg/kg
Milling Wheat	51	90%	<10	620	102	57.7	66.7
Feed Wheat	15	80%	<10	1414	251	293.0	76.9
Wheatfeed	18	100%	185	1485	378	203.6	172
Feed Barley	15	67%	<10	790	95.5	91.7	18.8
Malting Barley	25*	88%	<10	201	43.6	36.7	15.2
Food Oats	29	55%	<10	746	76.0	97.1	<10
Food Barley	1	100%	150	150	150	105.4	<10
Feed Oats	6	100%	15.0	120	43.0	29.2	19.5
Oatfeed	6	100%	21.3	2581	638	364.7	79

*Partial data set

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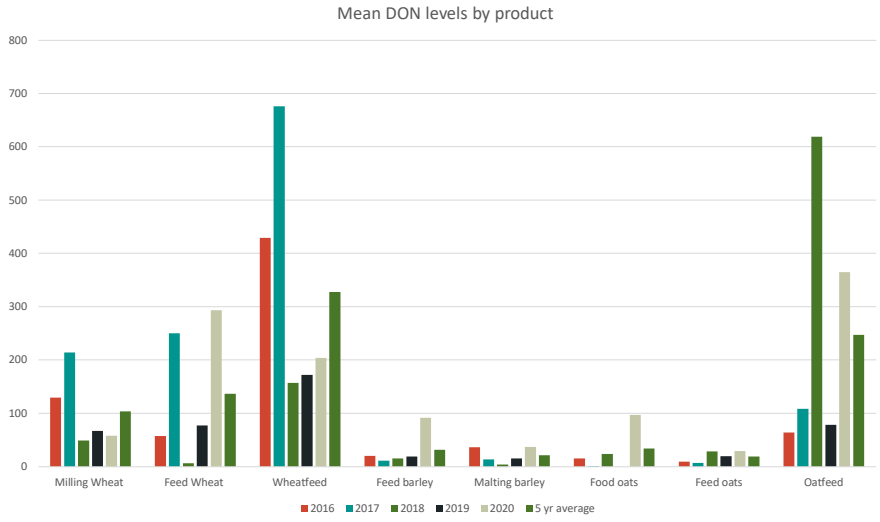
Collated Mean DON results by product 2016-2020



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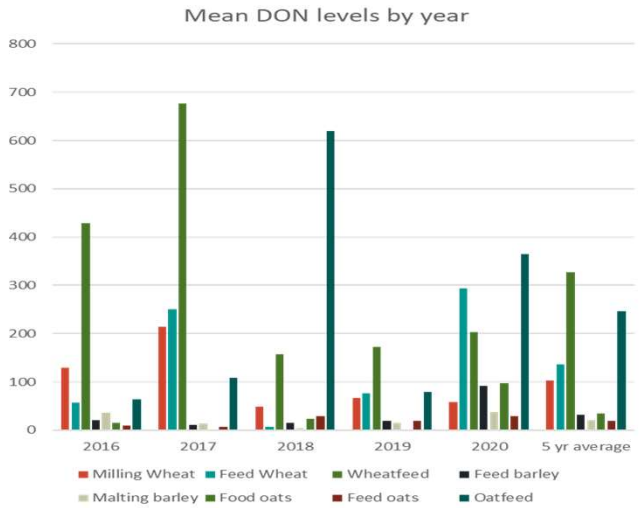
Collated Mean DON results by year 2016-2020



	2021 Mean Level µg/kg
Milling Wheat	102
Feed Wheat	251
Wheatfeed	378
Feed Barley	95.5
Malting Barley	43.6
Food Oats	76.0
Food Barley	150
Feed Oats	43.0
Oatfeed	638

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DON-3 Glucoside Harvest 2021 samples

DON-3-Glc Harvest (September 2021)

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	2021 Mean Level µg/kg	2020 Mean Level µg/kg	2019 Mean Level µg/kg
Milling Wheat	51	53%	<10	59.1	11.7	13.3	<10
Feed Wheat	15	53%	<10	195	34.4	36.4	11.2
Wheatfeed	18	100%	17.0	219	41.0	29.6	18.9
Feed Barley	15	60%	<10	218	28.8	64.7	4.9
Malting Barley	25*	40%	<10	72.2	10.6	14.6	4.6
Food Oats	29	34%	<20	72	11.9	33.1	<10
Food Barley	1	100%	46.0	46.0	46.0	42.5	<10
Feed Oats	6	33%	<10	22.9	5.9	12.1	<10
Oatfeed	6	67%	<10	285	66	117.7	22

*Partial data set

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Zearalenone Harvest 2021 samples

ZEN Harvest (September 2021)

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	2021 Mean Level µg/kg	2020 Mean Level µg/kg	2019 Mean Level µg/kg
Milling Wheat	51	35%	<2.5	119**	5.9	<2.5	<2.5
Feed Wheat	15	53%	<2.5	353	36.6	29.0	5.2
Wheatfeed	18	94%	<2.5	60	19.4	23.5	<2.5
Feed Barley	15	33%	<2.5	22	3.5	25.8	<2.5
Malting Barley	25*	12%	<2.5	10.7	0.9	3.1	0.6
Food Oats	29	28%	<2.5	33	2.4	33.8	<5
Food Barley	1	0%	<2.5	<2.5	<2.5	<2.5	<5
Feed Oats	6	33%	<10	7.4	1.8	1.0	<2.5
Oatfeed	6	67%	<2.5	134	29.2	40.3	<2.5

*Partial data set
**pending confirmation by duplicate analysis

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Sum HT-2 and T-2 Toxins Harvest 2021 samples

HT-2 + T-2 Harvest (September 2021)

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	2021 Mean Level µg/kg	2020 Mean Level µg/kg	2019 Mean Level µg/kg
Milling Wheat	51	4%	<20	43.4	1.2	<20	<20
Feed Wheat	15	0%	<20	<20	<20	<20	<20
Wheatfeed	18	83%	<20	38.0	15.8	10.5	9.1
Feed Barley	15	53%	<20	143.0	24.9	2.1	9.4
Malting Barley	25*	60%	<20	290	29.1	6.0	12.1
Food Oats	29	100%	60.0	1195**	357	313	458
Food Barley	1	100%	30.5	30.5	30.5	<20	<20
Feed Oats	6	100%	20.0	337	213	183	246
Oatfeed	6	100%	814	4734	1722	1132	1237

*Partial data set
**pending confirmation by duplicate analysis

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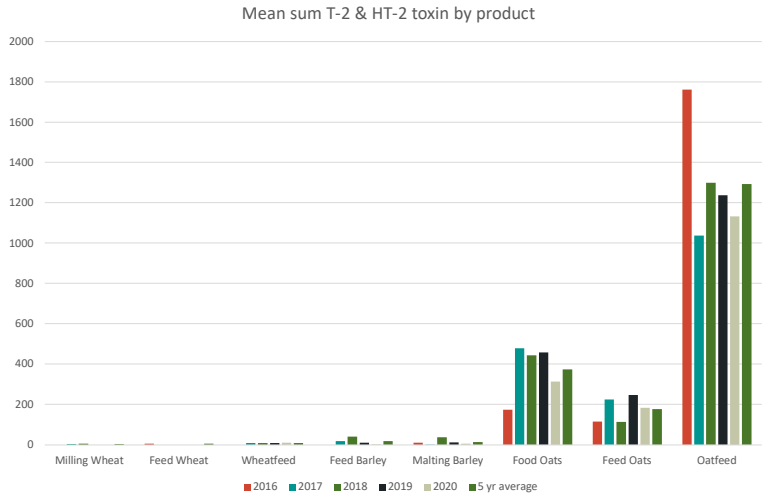
Collated results sum T-2 & HT-2 toxin 2016-2020



	2021 Mean Level µg/kg
Milling Wheat	1.2
Feed Wheat	<20
Wheatfeed	15.8
Feed Barley	24.9
Malting Barley	29.1
Food Oats	357
Food Barley	30.5
Feed Oats	213
Oatfeed	1722

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T2-B3-Glucoside Harvest 2021 samples

T2-B3-Glc Harvest (September 2021)

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	2021 Mean Level µg/kg	2020 Mean Level µg/kg	2019 Mean Level µg/kg
Milling Wheat	51	0%	<10	<10	<10	<10	<10
Feed Wheat	15	0%	<10	<10	<10	1.0	<10
Wheatfeed	18	0%	<10	<10	<10	<10	<10
Feed Barley	15	13%	<10	21.2	2.1	3.1	<10
Malting Barley	25*	12%	<10	25.8	2.3	1.6	1.4
Food Oats	29	79%	<10	232	53.5	37.1	67.4
Food Barley	1	0%	<10	<10	<10	<10	<10
Feed Oats	6	83%	<10	77	37.7	61.5	28.9
Oatfeed	6	100%	131	424	188	118	231

*Partial data set

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Nivalenol Harvest 2021 samples

NIV Harvest (September 2021)

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	2021 Mean Level µg/kg	2020 Mean Level µg/kg	2019 Mean Level µg/kg
Milling Wheat	51	2%	<50	123	2.4	<50	<50
Feed Wheat	15	20%	<50	68.2	12.1	13.5	<50
Wheatfeed	18	72%	<50	250	59.9	43.1	32.5
Feed Barley	15	60%	<50	450	165	131	50
Malting Barley	25*	64%	<50	888	98.4	17.7	32.7
Food Oats	29	72%	<50	841	136	101	<50
Food Barley	1	100%	850	850	850	<50	<50
Feed Oats	6	83%	<50	341	182	406	116
Oatfeed	6	100%	140	225	169	215	283

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Other results

- Very little occurrence of 3 acetyl and 15 acetyl DON (ca 5 samples, max mean level 50 µg/kg in oatfeed)
- Fusarenon X and diacetoxyscirpenol not detected
- Neosolaniol only found in oat products, 48% occurrence in food oats (max level 40 µg/kg), 100% incidence in oatfeed (max level 110 µg/kg)
- Alpha-zearalenol and its glucoside not detected
- Beta-zearalenol and its glucoside detected in small number of samples
- Zearalenone glucoside not detected.
- Very low level of aflatoxin B1 detected in one milling wheat.

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Total Ergot alkaloids Harvest 2020

Total Ergot Alkaloids (n=12) [Sum of quantified residues] Harvest (September 2020)							
	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg (*)	Median Level µg/kg	5 year average µg/kg
Milling Wheat	51	39%	<6.0	468	**31.1** (47.8)	<6.0	54.7
Feed Wheat	10	90%	<6.0	1542	**182** (17.7)	31.1	51.6
Wheatfeed	20	100%	54.2	420	**193** (113)	162	203
Feed Barley	10	70%	<6.0	213	**37.6** (117)	4.6	49.4
Malting Barley	35	54%	<6.0	251	**13.5** (11)	0.7	14.5
Food Oats	29	48%	<6.0	242	**18.1** (10.1)	<6.0	17.1
Food Barley	1	0%	<6.0	<6.0	**<6.0** (2.8)	<6.0	-
Feed Oats	10	60%	<6.0	258	**37** (12.9)	7.4	31.1
Oatfeed	10	80%	<6.0	43.0	**13.2** (20.3)	4.6	36.1

(*) 2019 mean level in brackets

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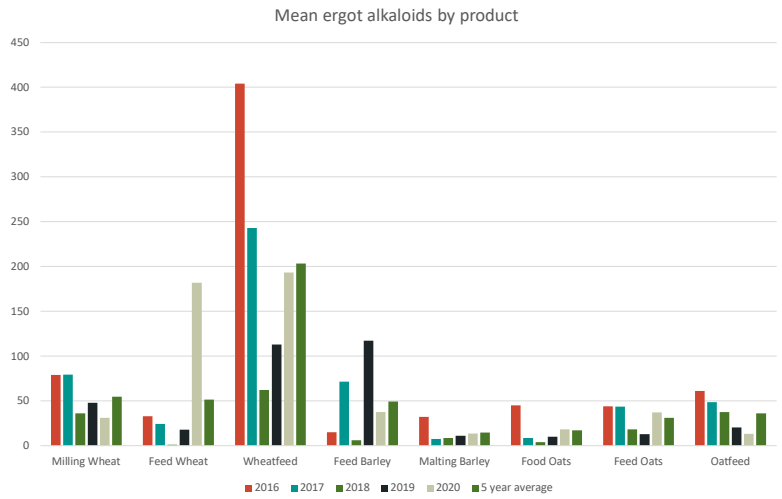
Collated ergot alkaloid results - 5 years



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Partners results 2021

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BOBMA: Field Mycotoxins – Intake Oats

	DON	T-2 + HT-2
Reporting Limit	10	20
Mean	37	191
Median	10	109
Max	327	775
95th Percentile	184	740

N = 33. All results are upper bound and in µg/kg

- 10 detections > reporting limit for DON (10µg/kg). Modified forms:
  - **3Ac DON** - None
  - **15Ac DON** – None
  - **DON-3-Glc** – No available data
- 11 detections > reporting limit (50µg/kg) for Nivalenol (NIV) – range 32 to 104µg/kg.
- T2/HT2 – No results > Indicative Level (1000µg/kg)
- 30 detections > reporting limit (10/kg) for T-2 + HT-2

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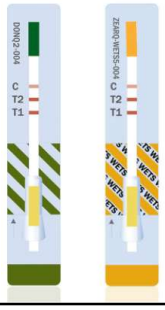
UKFM and AIC harvest mycotoxin monitoring

- Survey of rapid test kit results for deoxynivalenol (DON) and zearalenone (ZON). Testing wheat.
- Merchants and millers participate.
- Merchants testing grain in store (central stores and on-farm).
- Millers testing grain arriving at intake.
- Usually runs for 7-8 weeks from start of UK wheat harvest.
- Comprehensive monitoring of DON and ZON in UK wheat crop.



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2021 DON results

		2021 DON Results (ppb)					
	Samples (n)	<250	≥250 to <500	≥500 to <750	≥750 to <1000	≥1000 to ≤1250	>1250
UKFM	2,111	81.0%	11.2%	4.0%	2.2%	0.7%	0.8%
AIC	1,554	85.3%	9.1%	3.7%	0.7%	0.5%	0.7%

UKFM RESULTS		DON result (ppb)					
Year	(n)	<250	≥250 to <500	≥500 to <750	≥750 to <1000	≥1000 to ≤1250	>1250
2012	2,909	47.3%	26.4%	14.0%	7.1%	2.3%	2.9%
2013	1,887	53.9%	27.5%	9.9%	5.1%	1.8%	1.9%
2014	1,587	73.9%	20.3%	2.8%	2.0%	0.8%	0.3%
2015	2,065	96.9%	2.2%	0.5%	0.2%	0.1%	0.0%
2016	1,268	77.2%	18.1%	3.0%	0.7%	0.5%	0.5%
2017	1,956	70.7%	16.0%	7.5%	3.4%	1.4%	1.1%
2018	1,642	97.9%	1.9%	0.1%	0.0%	0.1%	0.0%
2019	1,789	96.9%	2.1%	0.4%	0.3%	0.1%	0.2%
2020	1,538	92.6%	6.2%	0.7%	0.3%	0.0%	0.2%
2021	2,111	81.1%	11.2%	4.0%	2.2%	0.7%	0.8%

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2021 ZON results

		2021 ZON Results (ppb)				
	Samples (n)	<25	≥25 to <50	≥50 to <75	≥75 to ≤100	>100
UKFM	1,460	67.3%	22.3%	8.5%	1.8%	0.1%
AIC	1,595	73.0%	23.6%	2.3%	0.4%	0.8%

UKFM results		ZON result (ppb)				
YEAR	(n)	<25	≥25 to <50	≥50 to <75	≥75 to ≤100	>100
2012	594	81.5%	14.3%	2.2%	0.7%	1.3%
2013	627	67.5%	27.9%	3.8%	0.6%	0.2%
2014	570	65.4%	30.5%	2.6%	1.4%	0.0%
2015	805	85.6%	12.3%	2.1%	0.0%	0.0%
2016	748	85.7%	12.8%	0.9%	0.3%	0.3%
2017	1,862	83.7%	8.8%	3.7%	2.4%	1.4%
2018	1,091	92.1%	7.0%	0.7%	0.2%	0.0%
2019	1,206	90.4%	7.4%	1.5%	0.7%	0.1%
2020	1,271	92.6%	4.4%	1.8%	0.6%	0.6%
2021	1,460	67.3%	22.3%	8.5%	1.8%	0.1%

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