Annual Project Report
August 2019 to June 2020

Project title	Monitoring of mycotoxins and other contaminants in UK cereals used in malting, milling and animal feed		
Project number	21130040		
Start date	August 2016	**End date**	August 2021

Project aim and objectives
To survey the incidence and levels of key contaminants in commercial samples of UK-grown and imported cereals and co-products, destined for milling, malt production, and animal feed to determine that they meet legal and guideline limits and that they are safe for consumption as food and feed.

Key messages emerging from the project

- During the period August 2019 to June 2020, the project focused on monitoring of harvest and stored grain samples for trichothecenes, zearalenone, ochratoxin A and pesticides. Subsets of samples were also analysed for ergot alkaloids and the Fusarium toxins beauvericin and enniatins. The samples included milling wheat, malting barley, food oats, food barley, feed wheat, wheatfeed, feed barley, feed oats, oatfeed and roasted barley malt. The data is not intended to provide a comprehensive monitoring of the UK grain harvest; the data represents levels likely to be found in each of the sample types within a given year of sampling. The results from some of the most commonly detected mycotoxins have been compared with the results from the previous 3 years of this study, these and selected results from 2019 are presented below.
- **Harvest Samples Mycotoxins** – The DON levels found were among the lowest that have been observed over the duration of the project. No sample exceeded the legal maximum level (ML). The maximum DON level found was 798 µg/kg in a milling wheat, 100% of oatfeed and wheatfeed contained DON above the reporting limit (RL), incidence above the RL ranged from 17% for food oats to 90% for feed wheat. DON was not measured above the RL in the single food barley sample analysed. Comparing mean results over the four years of the project, in general, DON levels were similar in 2018 and 2019 for milling wheat, wheatfeed, feed barley and malting barley although 2018 tended to have the lowest levels. Feed wheat mean results were the exception, where 76.9 µg/kg was higher than the 2018

result which was very low. However, only 9% of feed wheat samples in 2018 contained levels above the RL, whereas 90% of feed wheat samples in 2019 were above the RL. All oat products in 2019 were lower in terms of incidence and mean levels compared to 2018, except oatfeed which has had 100% incidence above the RL in every year of the study. The highest mean level in oat products in 2019 was 78.5 µg/kg in oatfeed, although the maximum level of 213 µg/kg found in 2019 was a factor of 10 times lower than the maximum level in 2018.

- Incidence of NIV above the RL ranged from 0% (feed wheat and food barley) to 100% (oatfeed). There are no MLs for this mycotoxin. The highest mean level (283 µg/kg) was found in oatfeed, this was very similar to the mean level in 2018 (297 µg/kg). The highest maximum level (815 µg/kg) was found in feed oats, and oatfeed had the second highest maximum level (449 µg/kg).
- A small number of samples (4) contained 3-acetyl DON the maximum level found was 17 µg/kg in oatfeed and one sample contained a very low level of 15-acetyl DON. All mean levels were below the RL. Neosolaniol was measured above the RL in food oats (48%) and oatfeed (100%), with mean levels of 15.6 and 42.6 µg/kg, respectively. None of the other trichothecenes analysed in the study were found above the RL in any of the samples.
- In 2019, T-2 and HT-2 toxins were detected most frequently in oats (food and feed) and oatfeed, 100% oatfeed, 93% food oats and 80% feed oats contained T-2 and HT-2 above the RL. The highest levels were also found in these products, with similar maximum levels found in all three products. The maximum levels were: 2391 µg/kg in food oats (vs 2745 µg/kg in 2018), oatfeed (2143 µg/kg compared to 4192 µg/kg in 2018) and 2077 µg/kg in feed oats (compared to 582 µg/kg in 2018). The mean level found in food oats was 458 µg/kg (similar to 2017 and 2018) and for feed oats was 246 µg/kg (similar to 2017 but approximately double the mean in 2018). There are no MLs in force for T-2 and HT-2, although limits are being discussed; the mean values for all products would comply with the levels under discussion. Over the four years of the study, there has been little incidence of T-2 and HT-2 toxins above the RL in wheat products, the highest incidence was 33% in wheatfeed in 2018. Mean levels in these products have generally been below the RL.
- Levels of zearalenone (ZEN) this year were the lowest found of any year of this study. Feed wheat was the only product that contained a mean level above the RL,

of 5.2 µg/kg. The highest level found in any sample was 19 µg/kg in a milling wheat sample. The highest incidence of ZEN was found in feed wheat, 70% of the samples contained ZEN above the RL, but the levels were low as the maximum level was 12.9 µg/kg.

- Masked forms of deoxynivalenol, T-2 toxin and zearalenone were also analysed. Deoxynivalenol 3-glucoside (DON3G) was found mainly in oatfeed and wheatfeed samples. The mean levels were low this year compared to previous years, the highest mean level of 21.9 µg/kg in oatfeed was much lower than the mean in 2018 of 142 µg/kg. The highest level found in 2019 was 72.9 µg/kg in a milling wheat, this compares to the highest level in 2018 of 557 µg/kg in a sample of oatfeed that also contained the highest level of DON. T-2 glucoside was detected in oats and oatfeed samples plus a small incidence in barley samples. The mean level found in oatfeed was 231 µg/kg and the maximum level found was 468 µg/kg (compared to 135 µg/kg and 698 µg/kg in 2018). The highest maximum level was found in a food oat sample (488 µg/kg, approximately half the 2018 value), although the mean value for food oats was 67 µg/kg was slightly higher than the mean in 2018 of 58 µg/kg. None of the modified forms of zearalenone and its derivatives were detected about the reporting limit in any samples this year.
- Over the 4 years of the study, the highest maximum levels for ergot alkaloids were found in 2016, except in feed barley which had the highest maximum level in 2019. Incidence of ergot alkaloids in 2019 was similar to previous years for most products, except feed barley where incidence was lower (50% cf 90% in 2018), but levels were higher. Feed barley had the highest maximum level of 777 µg/kg and also the highest mean level of 117 µg/kg. For several products, the maximum levels have decreased over the four years, but the mean and incidence are quite constant. Similar patterns were seen for milling wheat, malting barley, wheatfeed feed oats and oatfeed. Mean levels were slightly higher in 2019 than 2018, except for feed oats and oatfeed. For food oats the highest maximum level was found in 2016, and while the levels in 2019 were slightly higher than 2018 the maximum level of 59.1 µg/kg and mean of 10.1 µg/kg were significantly lower than the 2016 levels. Currently, there are no maximum levels for ergot alkaloids, but limits are under discussion within Europe.
- For the first time, milling wheat samples were analysed for the Fusarium mycotoxins beauvericin and enniatins A, A1, B and B1. There was a high incidence

of beauvericin (91%), but the mean level was 4.1 µg/kg. Of the four enniatins, the incidence ranged from 26 to 91%, the highest incidence, maximum level and mean level were measured for enniatin B1. The maximum level found was 145 µg/kg and the mean was 22.6 µg/kg. It should be noted that the reporting limit of 1 µg/kg is very low, leading to the high incidence reporting. There are no maximum levels for these mycotoxins.

- **Stored Samples Mycotoxins** - Wheatfeed (90%) and oatfeed (67%) most frequently contained ochratoxin A (OTA). The highest level, 22.5 µg/kg, was found in feed oats. Feed wheat, feed barley and milling wheat had the lowest incidence of OTA, but levels across all products were low. No samples exceeded the ML for ochratoxin A (OTA).
- Matched pairs of malting barley and malt were also analysed for Fusarium mycotoxins. DON and DON3G were found most frequently, 60% of malting barley and 65% of malt contained DON, and 35% of malting barley and 75% of malt contained DON3G. The maximum level was 156 µg/kg DON3G in a malt, mean levels of DON and DON3G were less than 40 µg/kg in all cases.

- **Pesticides** - One sample of malting barley contained a residue of chlorpropham at 0.10 mg/kg. The maximum residue level (MRL) is set at 0.01 mg/kg for chlorpropham in Barley.
- One sample of food oats contained a residue of pirimiphos-methyl at 10.3 mg/kg. The maximum residue level (MRL) is set at 5.0 mg/kg for pirimiphos-methyl in oats.
- 101 samples contained residues of plant growth regulators chlormequat and 44 samples contained mepiquat. None of these residues exceeded their corresponding MRLs.
- A high incidence of residues (48) was found for glyphosate, which is used as a desiccant. None of these residues exceeded their corresponding MRLs.
- Other most frequently found residues were for synergist piperonyl butoxide (65), fungicide tebuconazole (46) and insecticide deltamethrin (39). No MRL is set for piperonyl butoxide.
- Other than the two samples with chlorpropham and pirimiphos-methyl residues above, no other samples contained any residue above their corresponding MRLs.

- 86 residues were detected in feed or crops to be used for animal feed. No MRLs are currently applicable for “products or part of products exclusively used for animal feed production”.
- In total 425 residues were detected in the 370 samples tested. Overall, 159 samples (43%) contained no residues and 211 samples (57%) of the samples contained between 1 and 6 residues.

Summary of results from the reporting year

All analyses, except beauvericin and enniatins were carried out using UKAS ISO17025 accredited methods. Analysis for beauvericin and enniatins was carried out using a fully in-house validated method. All data calculations presented in the following tables are reported as ‘lower bound’ values, i.e. any result less than the reporting limit has been presumed to be zero.

Results for key mycotoxins are shown as summaries of four years for comparison.

In most cases, reporting limits in 2016 were higher than subsequent years due to improvements in the analytical method.

The Minimum level recorded in the tables is the reporting limit, or the lowest measured value where 100% of samples contained a measurable level of analyte.

Table 1. Deoxynivalenol Harvest Results 2016-2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Milling Wheat 2016	51	96%	<20	1006	129	54
Milling Wheat 2017	50	98%	<10	1540	214	108
Milling Wheat 2018	50	50%	<10	420	48.5	5.3
Milling Wheat 2019	50	76%	<10	798	66.7	25.4
Feed Wheat 2016	10	80%	<10	180	57	48
Feed Wheat 2017	11	100%	14.2	1127	250	171
Feed Wheat 2018	11	9%	<10	70.1	6.4	<10
Feed Wheat 2019	10	90%	<10	301	76.9	51
Wheatfeed 2016	20	100%	28	819	429	478
Wheatfeed 2017	22	100%	28.4	2016	676	426
Wheatfeed 2018	21	100%	19.9	502	157	124
Wheatfeed 2019	20	100%	53.2	459	172	133
Feed Barley 2016	9	33%	<10	85	20	<10
Feed Barley 2017	11	36%	<10	58.9	10.7	<10
Feed Barley 2018	10	60%	<10	45.1	15.1	13.8
Feed Barley 2019	10	70%	<10	99.7	18.8	12.4
Malting Barley 2016	40	60%	<25	117	36	29
Malting Barley 2017	40	48%	<10	109	13.3	<10
Malting Barley 2018	40	20%	<10	39.6	3.7	<10
Malting Barley 2019	40	60%	<10	76.5	15.2	13.5
Food Barley 2019	1	0%	<10	<10	<10	<10

Table 1 continued. Deoxynivalenol Harvest Results 2016-2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Food Oats 2016	30	23%	<10	132	15	<10
Food Oats 2017	29	7%	<10	11.8	0.8	<10
Food Oats 2018	29	66%	<10	160	23.4	17.9
Food Oats 2019	29	17%	<10	72.2	<10	<10
Feed Oats 2016	10	40%	<10	33	9	<10
Feed Oats 2017	11	27%	<10	38.8	6.5	<10
Feed Oats 2018	13	46%	<10	231	28.5	<10
Feed Oats 2019	10	40%	<10	101.7	19.5	<10
Oatfeed 2016	11	100%	16	332	64	37
Oatfeed 2017	10	100%	20.7	611	108	49.4
Oatfeed 2018	10	100%	33.4	2158	619	261
Oatfeed 2019	10	100%	35.2	213.3	78.5	66.1

Table 2. Nivalenol Harvest Results 2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Milling Wheat	50	4%	<50	55.6	<50	<50
Feed Wheat	10	0%	<50	<50	<50	<50
Wheatfeed	20	50%	<50	110	32.5	<50
Feed Barley	10	40%	<50	177	50	<50
Malting Barley	40	25%	<50	254.4	32.7	<50
Food Oats	29	38%	<50	237	<50	<50
Food Barley	1	0%	<50	<50	<50	<50
Feed Oats	10	40%	<50	815	116.3	<50
Oatfeed	10	100%	125.4	449	283	283

Table 3. 3Acetyl-Deoxynivalenol Harvest Results 2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Milling Wheat	50	2%	<10	12.2	<10	<10
Feed Wheat	10	0%	<10	<10	<10	<10
Wheatfeed	20	0%	<10	<10	<10	<10
Feed Barley	10	0%	<10	<10	<10	<10
Malting Barley	40	0%	<10	<10	<10	<10
Food Oats	29	0%	<10	<10	<10	<10
Food Barley	1	0%	<10	<10	<10	<10
Feed Oats	10	10%	<10	14.7	1.4	<10
Oatfeed	10	20	<10	17	2.9	<10

Table 4. Neosolaniol Harvest Results 2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Milling Wheat	50	0%	<10	<10	<10	<10
Feed Wheat	10	0%	<10	<10	<10	<10
Wheatfeed	20	0%	<10	<10	<10	<10
Feed Barley	10	0%	<10	<10	<10	<10
Malting Barley	40	0%	<10	<10	<10	<10
Food Oats	29	48%	<10	112	15.6	<10
Food Barley	1	0%	<10	<10	<10	<10
Feed Oats	10	0%	<10	<10	<10	<10
Oatfeed	10	100%	20.6	72.2	42.6	38.4

Table 5. HT-2 + T-2 Harvest Results 2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Milling Wheat 2016	51	0%	<20	<20	<20	<20
Milling Wheat 2017	50	8%	<20	64.0	2.9	<20
Milling Wheat 2018	50	10%	<20	139	4.7	<20
Milling Wheat 2019	50	6%	<20	43.0	<20	<20
Feed Wheat 2016	10	20%	<20	32	5	<20
Feed Wheat 2017	11	0%	<20	<20	<20	<20
Feed Wheat 2018	11	0%	<20	<20	<20	<20
Feed Wheat 2019	10	0%	<20	<20	<20	<20
Wheatfeed 2016	20	0%	<40	<40	<40	<40
Wheatfeed 2017	22	32%	<20	52.0	8.9	<20
Wheatfeed 2018	21	33%	<20	30.7	7.9	<20
Wheatfeed 2019	20	20%	<20	86.0	9.1	<20

Table 5 continued. HT-2 + T-2 Harvest Results 2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Feed Barley 2016	9	0%	<40	<40	<40	<40
Feed Barley 2017	11	27%	<20	69.7	18.2	<20
Feed Barley 2018	10	40%	<20	260	40.3	<20
Feed Barley 2019	10	20%	<20	62.6	9.4	<20
Malting Barley 2016	40	38%	<10	91	10	<10
Malting Barley 2017	40	3%	<20	30.0	0.8	<20
Malting Barley 2018	40	65%	<20	210	37.6	<20
Malting Barley 2019	40	45%	<20	63	12.1	<20
Food Barley 2019	1	0%	<20	<20	<20	<20
Food Oats 2016	30	70%	<20	1093	173	77
Food Oats 2017	29	97%	<20	1837	478	278
Food Oats 2018	29	100%	13.4	2745	443	188
Food Oats 2019	29	93%	<20	2391	458	224
Feed Oats 2016	10	60%	<40	437	115	65
Feed Oats 2017	11	82%	<20	716	225	81.7
Feed Oats 2018	13	92%	<20	582	114	48.6
Feed Oats 2019	10	80%	<20	2077	246	36.7
Oatfeed 2016	11	100%	532	5787	1761	1366
Oatfeed 2017	10	100%	434	2091	1038	981
Oatfeed 2018	10	100%	515	4192	1299	676
Oatfeed 2019	10	100%	328	2143	1237	1132

Table 6. Zearalenone Harvest Results 2016-2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg*	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Milling Wheat 2016	51	24%	<2.5	17	<2.5	<2.5
Milling Wheat 2017	50	70%	<3	327	18.6	7.4
Milling Wheat 2018	50	12%	<2.5	22.0	1.7	<2.5
Milling Wheat 2019	50	22%	<2.5	19.0	<2.5	<2.5
Feed Wheat 2016	10	50%	<5	23	7	4
Feed Wheat 2017	11	82%	<2.5	916	114	29.1
Feed Wheat 2018	11	0%	<2.5	<2.5	<2.5	<2.5
Feed Wheat 2019	10	70%	<2.5	12.9	5.2	5.5
Wheatfeed 2016	20	50%	<5	33	6	3
Wheatfeed 2017	22	95%	<2.5	94.7	32.9	25.5
Wheatfeed 2018	21	71%	<2.5	68.6	13.3	11.2
Wheatfeed 2019	20	0%	<2.5	<2.5	<2.5	<2.5
Feed Barley 2016	9	0%	<2.5	<25	<25	<25
Feed Barley 2017	11	9%	<2.5	5.5	0.5	<2.5
Feed Barley 2018	10	10%	<2.5	4.5	<2.5	<2.5
Feed Barley 2019	10	0%	<2.5	<2.5	<2.5	<2.5
Malting Barley 2016	40	3%	<2.5	6	<2.5	<2.5
Malting Barley 2017	40	3%	<2.5	3.0	0.1	<2.5
Malting Barley 2018	40	0%	<2.5	<2.5	<2.5	<2.5
Malting Barley 2019	40	13%	<2.5	9.1	0.6	<2.5
Food Barley 2019	1	0%	<5	<5	<5	<5

Table 6 continued. Zearalenone Harvest Results 2016-2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg*	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Food Oats 2016	30	3%	<2.5	4	<2.5	<2.5
Food Oats 2017	29	3%	<2.5	6.0	0.2	<2.5
Food Oats 2018	29	0%	<2.5	<2.5	<2.5	<2.5
Food Oats 2019	29	3%	<5	7.5	<5	<5
Feed Oats 2016	10	20%	<2.5	8	1	<2.5
Feed Oats 2017	11	0%	<2.5	<2.5	<2.5	<2.5
Feed Oats 2018	13	8%	<2.5	15.1	1.2	<2.5
Feed Oats 2019	10	0%	<2.5	<2.5	<2.5	<2.5
Oatfeed 2016	11	0%	<2.5	<25	<25	<25
Oatfeed 2017	10	50%	<2.5	63.5	9.5	1.3
Oatfeed 2018	10	60%	<2.5	269	71.8	11.3
Oatfeed 2019	10	0%	<2.5	<2.5	<2.5	<2.5

*Minimum level is the reporting limit for this analyte / matrix combination.

Table 7. Deoxynivalenol-3-Glucoside Harvest Results 2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Milling Wheat	50	26%	<10	72.9	<10	<10
Feed Wheat	10	50%	<10	34.9	11.2	6.1
Wheatfeed	20	95%	<10	39.7	18.9	16.9
Feed Barley	10	20%	<10	29.4	4.9	<10
Malting Barley	40	25%	<10	33.5	4.6	<10
Food Oats	29	3%	<10	23.7	<10	<10
Food Barley	1	0%	<10	<10	<10	<10
Feed Oats	10	0%	<10	<10	<10	<10
Oatfeed	10	100%	10.4	34.3	21.9	23

Table 8. T-2-b3-Glucoside Harvest Results 2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Milling Wheat	50	0%	<10	<10	<10	<10
Feed Wheat	10	0%	<10	<10	<10	<10
Wheatfeed	20	0%	<10	<10	<10	<10
Feed Barley	10	0%	<10	<10	<10	<10
Malting Barley	40	10%	<10	16.8	1.4	<10
Food Oats	29	59%	<10	488	67.4	16.0
Food Barley	1	0%	<10	<10	<10	<10
Feed Oats	10	30%	<10	261	28.9	<10
Oatfeed	10	100%	32.4	468	231	142

Table 9. Total Ergot Alkaloids (n=12) Harvest Results 2016-2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level** µg/kg	Maximum Level** µg/kg	Mean Level** µg/kg	Median Level** µg/kg
Milling Wheat 2016	51	71%	<6.0	1435	79	6
Milling Wheat 2017	50	52%	<6.0	862	79.4	5.1
Milling Wheat 2018	50	42%	<6.0	765	36.0	<6.0
Milling Wheat 2019	50	46%	<6.0	429	47.8	<6.0
Malting Barley 2016	40	70%	<6.0	275	32	3
Malting Barley 2017	40	30%	<6.0	63.1	7.4	<6.0
Malting Barley 2018	40	65%	<6.0	122	8.6	1.6
Malting Barley 2019	40	55%	<6.0	64	11.0	2.9
Feed Wheat 2016	10	60%	<6.0	148	33	3
Feed Wheat 2017	11	45%	<6.0	140	24.3	<6.0
Feed Wheat 2018	11	45%	<6.0	7.4	1.2	<6.0
Feed Wheat 2019	10	60%	<6.0	100	17.7	8.2

Table 9 continued. Total Ergot Alkaloids (n=12) Harvest Results 2016-2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level** µg/kg	Maximum Level** µg/kg	Mean Level** µg/kg	Median Level** µg/kg
Wheatfeed 2016	20	100%	50	1086	404	372
Wheatfeed 2017	22	95%	<6.0	633	243	205
Wheatfeed 2018	21	90%	<6.0	326	62.3	40.3
Wheatfeed 2019	20	100%	9.4	248	113	104
Feed Barley 2016	9	67%	<6.0	69	15	3
Feed Barley 2017	11	55%	<6.0	383	71.4	8.7
Feed Barley 2018	10	90%	<6.0	32.1	6.1	1.1
Feed Barley 2019	10	50%	<6.0	777	117	0.5
Food Barley 2019	1	100%	2.8	2.8	2.8	2.8
Food Oats 2016	30	60%	< 6	710	45	8
Food Oats 2017	29	48%	<6.0	97.8	8.6	<6.0
Food Oats 2018	29	38%	<6.0	47.2	3.9	<6.0
Food Oats 2019	29	38%	<6.0	59.1	10.1	<6.0
Feed Oats 2016	10	70%	< 6	171	44	2
Feed Oats 2017	11	18%	<6.0	407	43.6	<6.0
Feed Oats 2018	13	85%	<6.0	159	18.1	3.2
Feed Oats 2019	10	40%	<6.0	107	12.9	<6.0
Oatfeed 2016	11	100%	2	160	61	61
Oatfeed 2017	10	100%	16.3	111	48.4	43.1
Oatfeed 2018	10	100%	6.0	263	37.5	11.6
Oatfeed 2019	10	100%	4.8	43.9	20.3	9.4

** This is a combined value calculated from the sum of the individual 12 alkaloids. The LOQ of each alkaloid is 0.5 µg/kg. Where no residues are detected the LOQ values are combined to give a sum LOQ, of 6.0 µg/kg. Where individual alkaloids are quantified above the LOQ, the sum is calculated from those values with results below the LOQ presumed to be equal to zero (lower bound result), which can result in values of less than 6.0 µg/kg being reported.

Table 10. Beauvericin and Enniatins Harvest Milling Wheat 2019

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Beauvericin	35	91%	<1	30.6	4.1	2.1
Enniatin A	35	26%	<1	8.5	<1	<1
Enniatin A1	35	69%	<1	44.7	4.9	2.6
Enniatin B	35	89%	<1	84.6	16.2	7.0
Enniatin B1	35	91%	<1	145	22.6	11.4

Table 11. Ochratoxin A Stored Sample Results 2019-2020

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Malting Barley	20	10%	<0.2	2.3	<0.2	<0.2
Malt	20	25%	<0.2	2.6	0.2	<0.2

Table 12. Ochratoxin A Stored Sample Results 2020

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Milling Wheat (January)	25	12%	<0.2	4.1	<0.2	<0.2
Milling Wheat (March)	26	19%	<0.2	4.0	0.4	<0.2
Feed Wheat	40	5%	<0.2	0.6	<0.2	<0.2
Wheat Feed	10	90%	<0.2	0.7	0.5	0.6
Feed Barley	30	10%	<0.2	6.2	0.2	<0.2
Food Oats	30	20%	<0.2	0.6	<0.2	<0.2
Feed Oats	10	30%	<0.2	22.5	2.3	<0.2
Oatfeed	9	67%	<0.2	0.6	0.3	<0.2

Table 13. Field Mycotoxins Malting Barley & Malt Results 2019-2020

	No. of Samples Analysed	% > Reporting Limit	Minimum Level µg/kg***	Maximum Level µg/kg	Mean Level µg/kg	Median Level µg/kg
Deoxynivalenol						
Malting Barley	20	60%	<10	52.0	15.0	15.7
Malt	20	65%	<10	114	23.2	13.8
Deoxynivalenol-3-Glucoside						
Malting Barley	20	35%	<10	33.5	<10	<10
Malt	20	75%	<10	156	38.8	20.8
3-Acetyl Deoxynivalenol						
Malting Barley	20	0%	<10	<10	<10	<10
Malt	20	10%	<10	18.9	<10	<10
15-Acetyl Deoxynivalenol						
Malting Barley	20	0%	<20	<20	<20	<20
Malt	20	10%	<20	53.0	<20	<20
T-2-b3-Glucoside						
Malting Barley	20	5%	<10	11.9	<10	<10
Malt	20	0%	<10	<10	<10	<10
HT-2 +T2						
Malting Barley	20	10%	<20	41.3	<20	<20
Malt	20	0%	<20	<20	<20	<20
NIV						
Malting Barley	20	10%	<50	89.5	<50	<50
Malt	20	0%	<50	<50	<50	<50

*** Reporting limits vary by toxin due to individual response of each toxin.

Table 14. Pesticides Harvest Results 2019

	No. of Samples Analysed	% > Reporting Limit	Single Pesticide Incidence % > LOD	Multiple Pesticide Incidence % > LOD
Milling Wheat [1]	50	94%	38%	56%
Malting Barley [2]	40	15%	12.5%	2.5%
Food Oats [3]	29	93%	34%	59%
Barley [4]	1	100%	100%	0%
Feed Wheat [5]	10	20%	20%	0%
Feed Barley [6]	10	50%	50%	0%
Feed Oats [7]	10	70%	70%	0%

[1] boscalid (2) 0.010, 0.014mg/kg; fluxapyroxad (1) 0.012mg/kg; tebuconazole (18) 0.010-0.034mg/kg; chlormequat (46) 0.016-0.90mg/kg; mepiquat (7) 0.012-0.19mg/kg; Glyphosate (9) 0.11-2.2mg/kg.

[2] bixafen (2) 0.018, 0.023mg/kg; cyprodinil (1) 0.050mg/kg; fluxapyroxad (2) 0.017, 0.074mg/kg; prothioconazole (1) 0.011mg/kg; tebuconazole (1) 0.041mg/kg; chlorpropham (1) 0.10mg/kg exceeds the MRL set at 0.01 mg/kg

[3] azoxystrobin (2) 0.015-0.067mg/kg; cyproconazole (1) 0.030mg/kg; epoxiconazole (3) 0.021-0.13mg/kg; tebuconazole (7) 0.015-0.077mg/kg; chlormequat (20) 0.016-4.6mg/kg; mepiquat (10) 0.014-1.0mg/kg; glyphosate (15) 0.17-6.1mg/kg

[4] Chlormequat (1) 0.10mg/kg.

[5] Glyphosate (2) 0.36, 1.3mg/kg (not tested for other pesticides).

[6] Glyphosate (5) 0.26-3.9mg/kg (not tested for other pesticides).

[7] Glyphosate (7) 0.18-2.6mg/kg (not tested for other pesticides).

No MRLs are set for feed or crops meant for animal feed in UK or EU

Table 15. Pesticides Harvest Additional Compounds 2019

	No. of Samples Analysed	% > LOD	Single Pesticide Incidence % > LOD	Multiple Pesticide Incidence % > LOD
Milling Wheat [1]	50	26%	10%	16%
Malting Barley [2]	40	33%	15%	18%
Food Oats [3]	29	21%	21%	0%
Barley [4]	1	100%	0%	100%
Feed Wheat [5]	10	n/a	n/a	n/a
Feed Barely [6]	10	n/a	n/a	n/a
Feed Oats [7]	10	n/a	n/a	n/a

[1] 2,4-D (1) 0.013mg/kg; chlorpyrifos-methyl (1) 0.015mg/kg; cypermethrin (3) 0.019-0.18mg/kg; deltamethrin (7) 0.03-0.19mg/kg; fluroxypyr (2) 0.016, 0.06mg/kg; piperonyl butoxide (10) 0.012-1.8mg/kg; pirimiphos-methyl (3) 0.33-2.2; flonicamid metabolite (TFNG) (1) 0.013mg/kg.

[2] chlorpyrifos-methyl (2) 0.015, 0.016mg/kg; cypermethrin (1) 0.11 mg/kg; deltamethrin (7) 0.016-0.29mg/kg; fluroxypyr (1) 0.017mg/kg; piperonyl butoxide (11) 0.019-2.9mg/kg; pirimiphos-methyl (1) 0.020mg/kg.

[3] piperonyl butoxide (2) 0.011,0.049mg/kg; Pyraclostrobin (4) 0.012-0.044mg/kg.

[4] BAC 12 (1) 0.067mg/kg; DDAC (1) 0.094 mg/kg.

[5] Glyphosate only (Not tested for other pesticides).

[6] Glyphosate only (Not tested for other pesticides).

[7] Glyphosate only (Not tested for other pesticides).

No MRLs are set for feed or crops meant for animal feed in UK or EU

Table 16. Pesticides Malting Barley & Malt Stored Sample Results 2019-2020

	No. of Samples Analysed	% > LOD	Single Pesticide Incidence % > LOD	Multiple Pesticide Incidence % > LOD
Malting Barley [1]	20	85%	15%	70%
Malt [2]	20	95%	15%	80%

[1] deltamethrin (3) 0.021-0.13mg/kg; chlormequat (16) 0.015-0.76mg/kg; mepiquat (12) 0.013-0.13mg/kg; glyphosate (9) 0.14-2.0mg/kg.

[2] deltamethrin (5) 0.026, 0.10mg/kg; chlormequat (18) 0.012-0.61mg/kg; mepiquat (15) 0.013-0.13mg/kg; glyphosate (1) 0.14mg/kg.

Table 17. Pesticides Malting Barley & Malt Additional Compounds Results 2019-2020

	No. of Samples Analysed	% > LOD	Single Pesticide Incidence % > LOD	Multiple Pesticide Incidence % > LOD
Malting Barley [1]	20	35%	30%	5%
Malt [2]	20	35%	25%	10%

[1] cyprodinil (2) 0.015, 0.027mg/kg; piperonyl butoxide (6) 0.010-0.71mg/kg.

[2] bixafen (1) 0.011mg/kg; cyprodinil (1) 0.017mg/kg; piperonyl butoxide (7) 0.016-0.2mg/kg.

Table 18. Chlorpropham Stored Sample Results 2020

	No. of Samples Analysed	% > LOD	Single Pesticide Incidence % > LOD	Multiple Pesticide Incidence % > LOD
Milling Wheat	25	0%	0%	0%

Table 19. Pesticides Stored Additional Compounds 2020

	No. of Samples Analysed	% > Reporting Limit	Single Pesticide Incidence % > LOD	Multiple Pesticide Incidence % > LOD
Milling Wheat	25	8%	4%	4%

chlorpyrifos (1) 0.047mg/kg; deltamethrin (1) 0.030mg/kg; pirimiphos-methyl (1) 0.29.

Table 20. Pesticides Stored Sample Results 2020

	No. of Samples Analysed	% > LOD	Single Pesticide Incidence % > LOD	Multiple Pesticide Incidence % > LOD
Food Oats [1]	30	16%	13%	3%
Milling Wheat [2]	26	8%	8%	0%
Feed Wheat [3]	40	2.5%	2.5%	0%
Wheatfeed [4]	10	60%	30%	30%
Feed Barely [5]	30	17%	17%	0%
Feed Oats [6]	10	20%	20%	0%
Oatfeed [7]	9	22%	22%	0%

[1] chlorpyrifos (1) 0.030mg/kg; deltamethrin (2) 0.063, 0.31mg/kg; pirimiphos-methyl (3) 0.45-10.3 mg/kg (MRL set at 5.0 mg/kg)

[2] deltamethrin (1) 0.21mg/kg; pirimiphos-methyl (1) 0.034mg/kg.

[3] deltamethrin (1) 0.1mg/kg.

[4] Chlorpropham (1) 0.016mg/kg; cypermethrins (1) 0.012 mg/kg; deltamethrin (4) 0.022-0.063mg/kg; pirimiphos-methyl (4) 0.023-0.083mg/kg.

[5] deltamethrin (5) 0.011-0.18mg/kg.

[6] chlorpyrifos-methyl (1) 0.021mg/kg; deltamethrin (1) 0.099mg/kg.

[7] deltamethrin (2) 0.028, 0.031mg/kg.

No MRLs are set for feed or crops meant for animal feed in UK or EU

Table 21. Pesticides Stored Additional Compounds

	No. of Samples Analysed	% > LOD	Single Pesticide Incidence % > LOD	Multiple Pesticide Incidence % > LOD
Milling Wheat [1]	25	64%	36%	28%
Food Oats [2]	30	50%	27%	23%
Feed Wheat [3]	40	73%	45%	28%
Feed Barley [4]	30	30%	20%	10%
Wheatfeed [5]	10	100%	30%	70%
Feed Oats [6]	10	70%	30%	40%
Oatfeed [7]	10	50%	0%	50%

[1] 2,4-D (1) 0.02mg/kg; Boscalid (4) 0.02-0.06mg/kg; Piperonyl butoxide (4) 0.01-0.8mg/kg; Tebuconazole (14) 0.01-0.1mg/kg.

[2] Azoxystrobin (4) 0.02-0.1mg/kg; Epoxiconazole (8) 0.01-0.08mg/kg; Kresoxim-methyl (1) 0.01mg/kg; Prothioconazole-desthio (1) 0.01mg/kg; Tebuconazole (9) 0.01-0.1mg/kg.

[3] Azoxystrobin (3) 0.01mg/kg; BAC12 (1) 0.09mg/kg; Boscalid (2) 0.02-0.09mg/kg; Fluxapyroxad (3) 0.01-0.02mg/kg; Piperonyl butoxide (9) 0.01-1.7mg/kg; Tebuconazole (24) 0.01-0.1mg/kg.

[4] Azoxystrobin (1) 0.09mg/kg; Bixafen (1) 0.02mg/kg; Fluroxypyr (1) 0.05mg/kg; Fluxapyroxad (1) 0.04mg/kg; Piperonyl butoxide (5) 0.01-0.3mg/kg; Pyraclostrobin (1) 0.01mg/kg; Pyrimethanil (1) 0.01mg/kg; Tebuconazole (1) 0.03mg/kg.

[5] 2,4-D (1) 0.03mg/kg; Azoxystrobin (3) 0.01mg/kg; Epoxiconazole (1) 0.01mg/kg; Piperonyl butoxide (9) 0.03-3.7mg/kg; Tebuconazole (8) 0.02-0.07mg/kg.

[6] Azoxystrobin (2) 0.04mg/kg; Epoxiconazole (2) 0.01-0.08mg/kg; Kresoxim-methyl (1) 0.02mg/kg; Piperonyl butoxide (3) 0.09-0.3mg/kg; Tebuconazole (3) 0.01-0.07mg/kg.

[7] Azoxystrobin (5) 0.02-0.03mg/kg; Cyproconazole (3) 0.01-0.02mg/kg; Epoxiconazole (4) 0.01-0.02mg/kg; Piperonyl butoxide (5) 0.01-0.9mg/kg; Tebuconazole (3) 0.02-0.06mg/kg.

Figure 1. Incidence of Pesticides