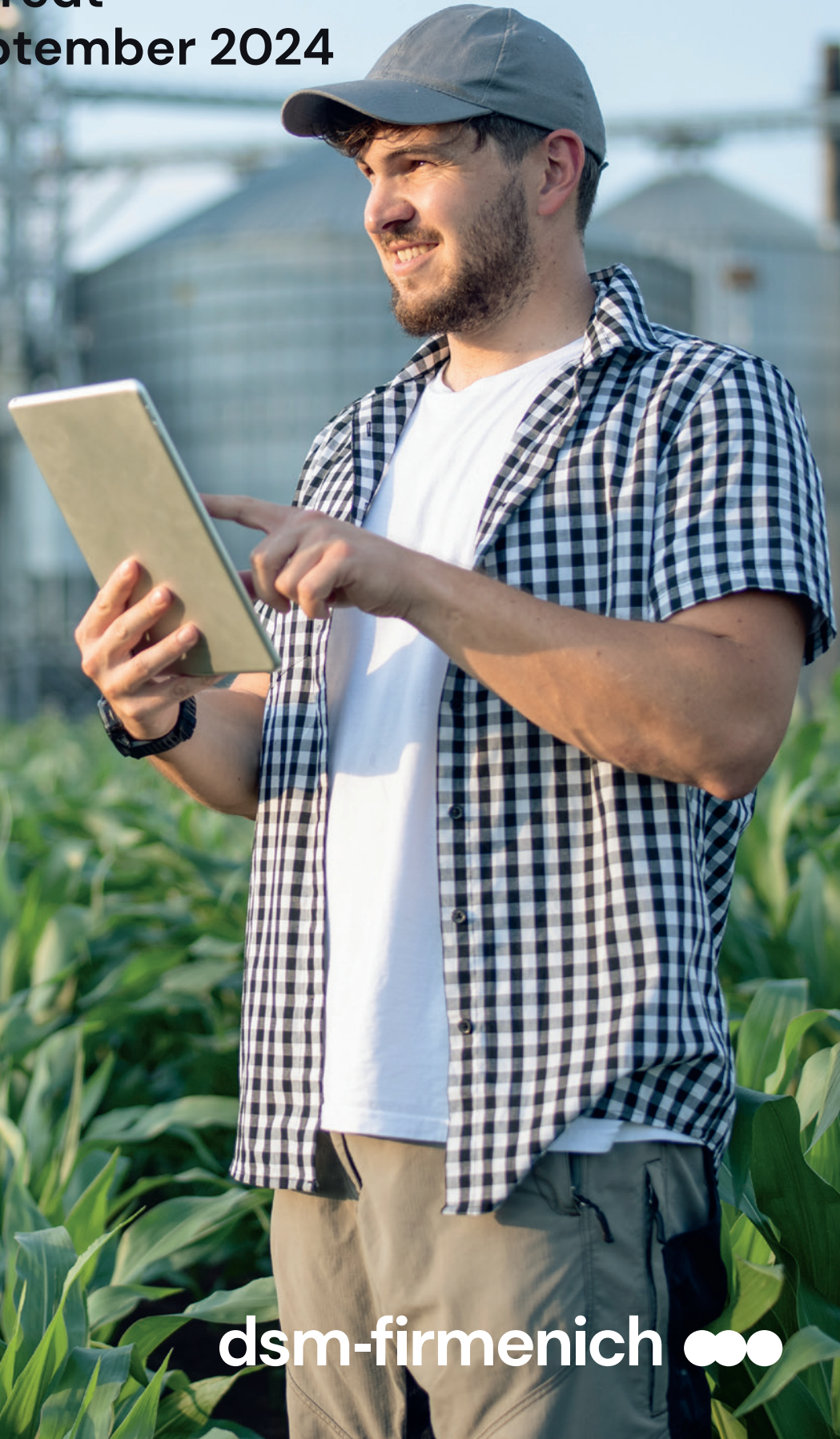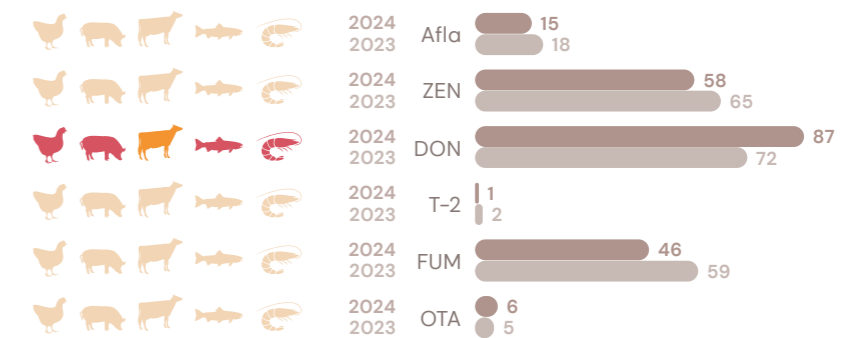# dsm-firmenich

World Mycotoxin Survey

The Global Threat
January – September 2024

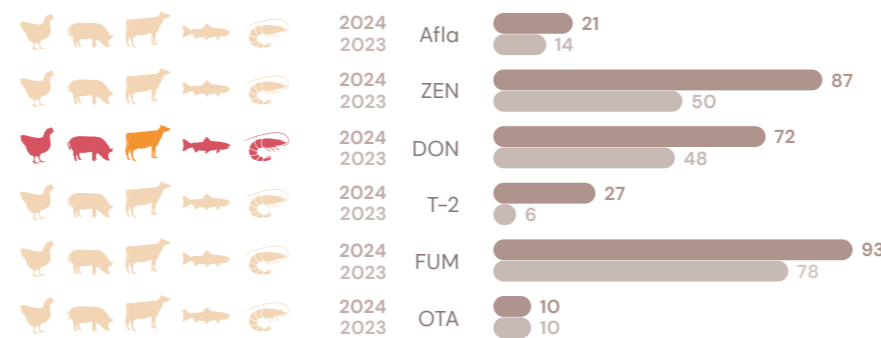dsm-firmenich

dsm-firmenich
World Mycotoxin Survey

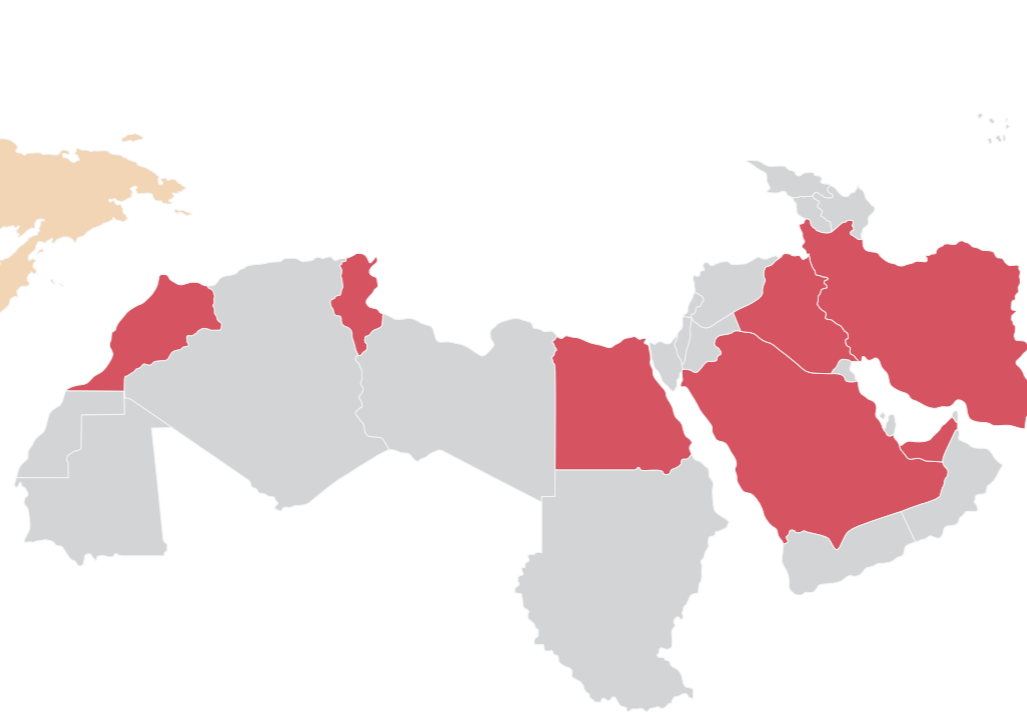## World Overview

17 675
Samples

87 746
Analyses

91
Countries

Co-contamination

<limit of detection	1 mycotoxin	more than 1 mycotoxin
9%	20%	71%

Number of mycotoxins per sample based on samples tested for 3 or more mycotoxins.

Risk Level
The risk level expresses the percentage of samples testing positive for at least one mycotoxin above the threshold level in parts per billion (ppb).

Recommended risk threshold of major mycotoxins in ppb

Afla	ZEN	DON	T2	FUM	OTA
2	50	150	50	500	10

Figure 1. Global map of mycotoxin prevalence and risk in different regions.

0 – 25%	26 – 50%	51 – 75%	76 – 100%	

of samples above risk threshold   No samples tested

Moderate risk   Extreme risk

North America — Total Risk 75%
Prevalence:
Afla	19%
ZEN	75%
DON	71%
T2	13%
FUM	49%
OTA	4%

Central America — Total Risk 80%
Prevalence:
Afla	31%
ZEN	82%
DON	69%
T2	11%
FUM	78%
OTA	2%

South America — Total Risk 65%
Prevalence:
Afla	34%
ZEN	57%
DON	34%
T2	20%
FUM	68%
OTA	4%

Central Europe — Total Risk 51%
Prevalence:
Afla	10%
ZEN	52%
DON	72%
T2	24%
FUM	53%
OTA	13%

Northern Europe — Total Risk 47%
Prevalence:
Afla	1%
ZEN	55%
DON	76%
T2	21%
FUM	16%
OTA	8%

Eastern Europe — Total Risk 22%
Prevalence:
Afla	2%
ZEN	42%
DON	50%
T2	31%
FUM	19%
OTA	22%

Southern Europe — Total Risk 64%
Prevalence:
Afla	47%
ZEN	69%
DON	67%
T2	19%
FUM	68%
OTA	16%

Middle East North Africa — Total Risk 70%
Prevalence:
Afla	21%
ZEN	87%
DON	72%
T2	27%
FUM	93%
OTA	10%

Central Asia — Total Risk 14%
Prevalence:
Afla	14%
ZEN	0%
DON	86%
T2	0%
FUM	14%
OTA	14%

China / Taiwan — Total Risk 90%
Prevalence:
Afla	17%
ZEN	76%
DON	84%
T2	3%
FUM	93%
OTA	7%

East Asia — Total Risk 43%
Prevalence:
Afla	3%
ZEN	42%
DON	50%
T2	7%
FUM	99%
OTA	1%

South Asia — Total Risk 83%
Prevalence:
Afla	73%
ZEN	31%
DON	8%
T2	65%
FUM	57%
OTA	63%

South-East Asia — Total Risk 66%
Prevalence:
Afla	46%
ZEN	48%
DON	56%
T2	1%
FUM	90%
OTA	17%

Subsaharan Africa — Total Risk 67%
Prevalence:
Afla	40%
ZEN	66%
DON	83%
T2	0%
FUM	55%
OTA	14%

South Africa — Total Risk 66%
Prevalence:
Afla	5%
ZEN	55%
DON	89%
T2	1%
FUM	42%
OTA	3%

Oceania — Total Risk 8%
Prevalence:
Afla	6%
ZEN	9%
DON	19%
T2	1%
FUM	91%
OTA	4%

Europe

2024 / 2023		
Afla	24	19
ZEN	57	55
DON	68	58
T–2	23	37
FUM	48	46
OTA	15	14

Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – September 2024 ■ and January – September 2023 ■

Total samples: 7 733	Afla	ZEN	DON	T–2	FUM	OTA
Number of samples tested	5 543	7 308	7 409	5 272	5 082	4 922
% Contaminated samples	24%	57%	68%	23%	48%	15%
Average of positive (ppb)	8	81	519	30	288	9
Median of positive (ppb)	4	20	200	14	89	3
Maximum (ppb)	741	5000	43 891	1 731	12 368	928

Middle East & North Africa

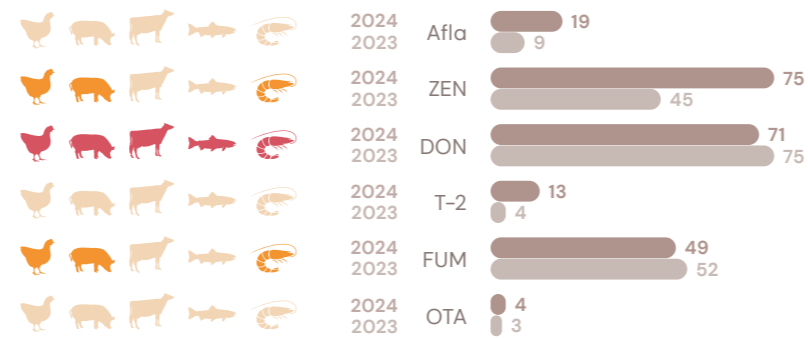| 2024 / 2023		
Afla	21	14
ZEN	87	50
DON	72	48
T–2	27	6
FUM	93	78
OTA	10	10

Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – September 2024 ■ and January – September 2023 ■

Total samples: 149	Afla	ZEN	DON	T–2	FUM	OTA
Number of samples tested	149	149	149	145	149	145
% Contaminated samples	21%	87%	72%	27%	93%	10%
Average of positive (ppb)	3	40	399	15	526	3
Median of positive (ppb)	1	14	296	10	187	2
Maximum (ppb)	13	863	4 028	95	22 030	7

Sub-saharan Africa

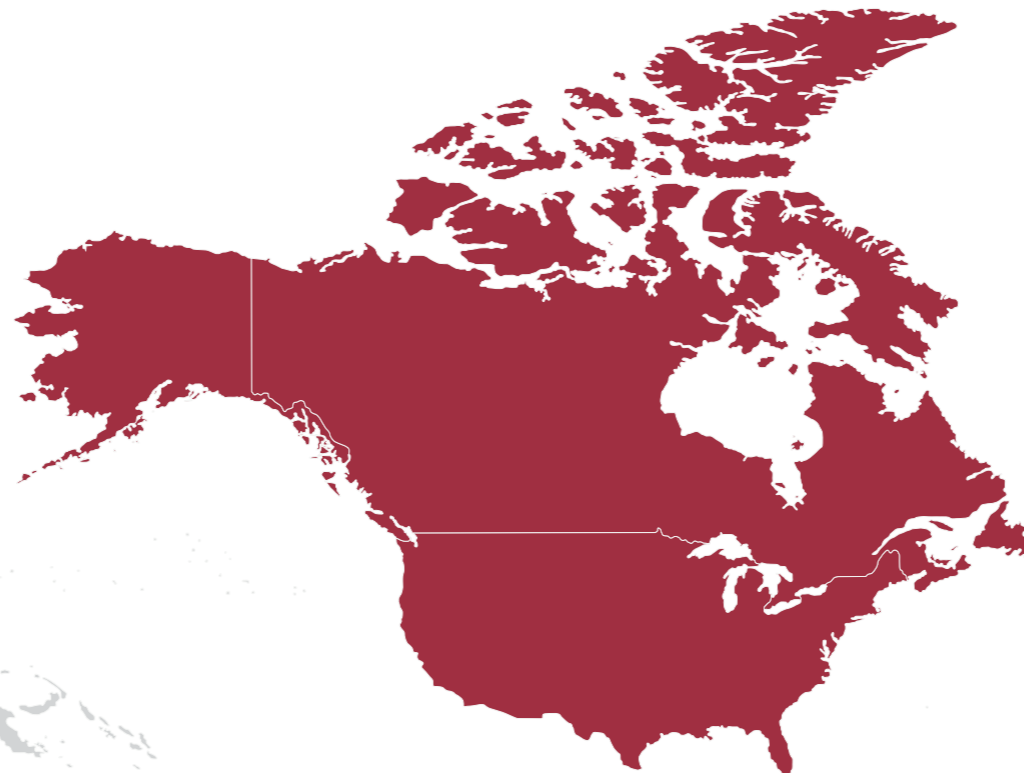| 2024 / 2023		
Afla	15	18
ZEN	58	65
DON	87	72
T–2	1	2
FUM	46	59
OTA	6	5

Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – September 2024 ■ and January – September 2023 ■

Total samples: 852	Afla	ZEN	DON	T–2	FUM	OTA
Number of samples tested	852	852	852	852	852	851
% Contaminated samples	15%	58%	87%	1%	46%	6%
Average of positive (ppb)	50	31	481	40	261	6
Median of positive (ppb)	6	10	234	46	84	2
Maximum (ppb)	708	1 058	18 341	89	3 252	85

Asia

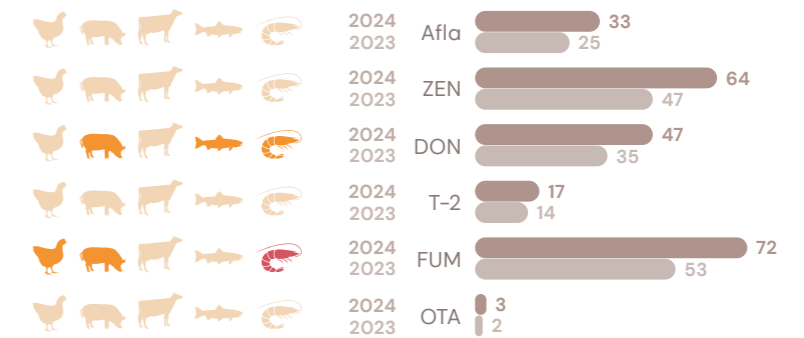| 2024 2023			
Afla	42 / 44		
ZEN	49 / 56		
DON	47 / 61		
T-2	32 / 22		
FUM	78 / 81		
OTA	38 / 28		
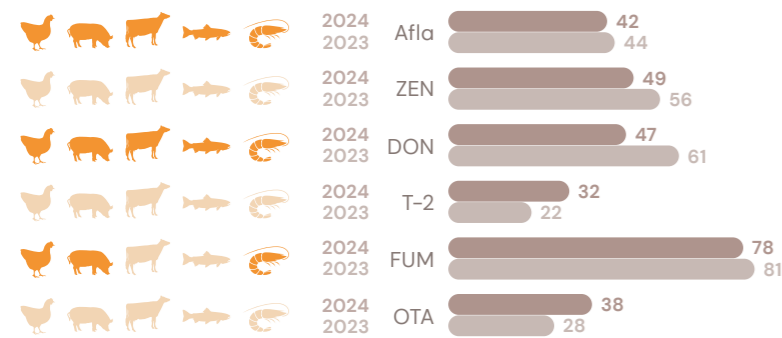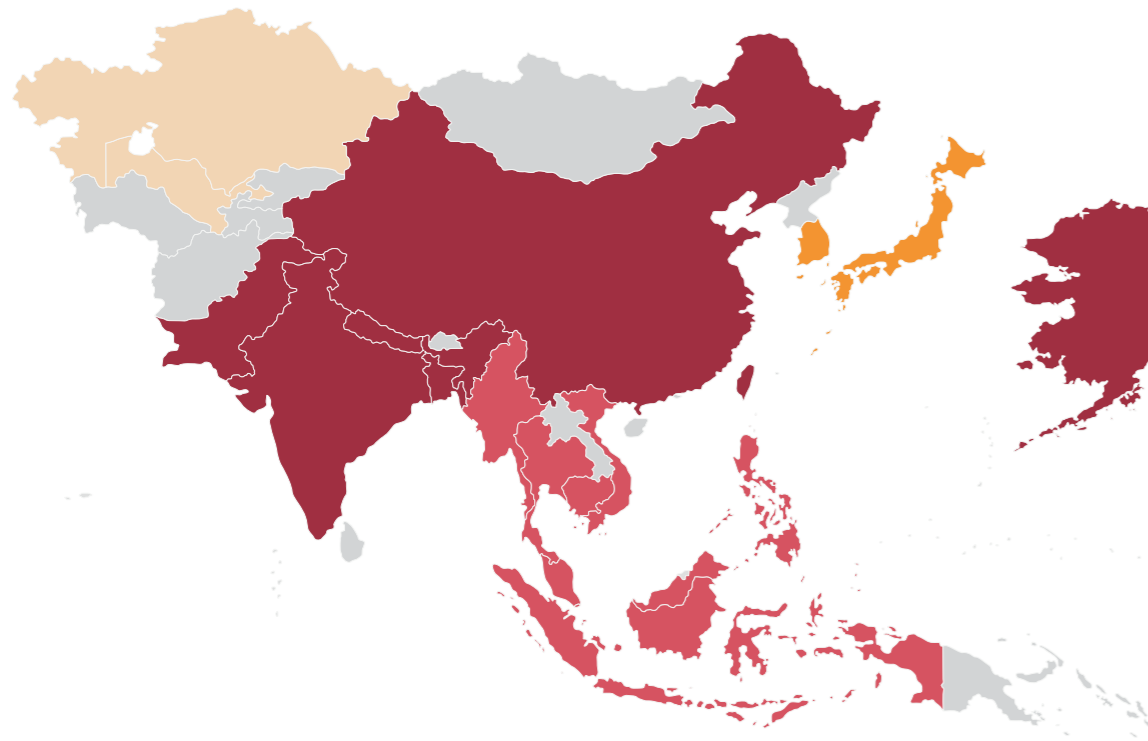
Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – September 2024 ■ and January – September 2023 ■

Total samples: 3 233	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	3 013	3 110	3 218	2 527	3 000	2 271
% Contaminated samples	42%	49%	47%	32%	78%	38%
Average of positive (ppb)	34	148	1 407	28	1 667	14
Median of positive (ppb)	15	47	372	24	686	5
Maximum (ppb)	517	25 373	476 954	385	489 698	579

North America

2024 2023			
Afla	19 / 9		
ZEN	75 / 45		
DON	71 / 75		
T-2	13 / 4		
FUM	49 / 52		
OTA	4 / 3		

Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – September 2024 ■ and January – September 2023 ■

Total samples: 1 495	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	1 458	1 468	1 424	1 424	1 423	1 421
% Contaminated samples	19%	75%	71%	13%	49%	4%
Average of positive (ppb)	56	128	1 534	33	2 997	5
Median of positive (ppb)	1	34	650	11	1 000	3
Maximum (ppb)	1 767	6 513	32 220	481	96 316	62

Latin America

2024 2023			
Afla	33 / 25		
ZEN	64 / 47		
DON	47 / 35		
T-2	17 / 14		
FUM	72 / 53		
OTA	3 / 2		

Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – September 2024 ■ and January – September 2023 ■

Total samples: 4 213	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	4 091	4 058	2 963	3 596	3 292	2 456
% Contaminated samples	33%	64%	47%	17%	72%	3%
Average of positive (ppb)	5	73	566	33	2 340	3
Median of positive (ppb)	2	37	316	29	1 349	2
Maximum (ppb)	306	2 599	11 190	200	244 701	15

Spectrum 380® and Spectrum Top®50

Only analyzing for single mycotoxins can lead to underestimation of the detrimental effects of mycotoxins on animal health and performance. Our long-term monitoring of mycotoxins in different commodities shows that co-occurrence of mycotoxins is the rule and not the exception. Here we need support of state-of the art analytical methods based on LC-MS/MS. These allow to detect multiple mycotoxins in one run. The high sensitivity of the method is important, as already moderate levels of mycotoxins can have a detrimental effect. This is especially true in case of co-contamination.

Romer Labs®

iFA TULLN   **BOKU**

Spectrum 380®:

The most advanced and comprehensive mycotoxin analysis available
It detects > 800 different mycotoxins (including masked and modified forms and emerging mycotoxins), fungal metabolites as well as plant and bacterial toxins and metabolites.
This is not a routine analysis but it is done in special cases and/or also of course as part of research of future objectives.
Spectrum 380® is developed and conducted by the world's leading independent mycotoxin research lab at the Department of Agrobiotechnology (IFA-Tulln) at the University of Natural Resources and Life Sciences Vienna and offered through cooperation with Performance Solutions plus Biomin.
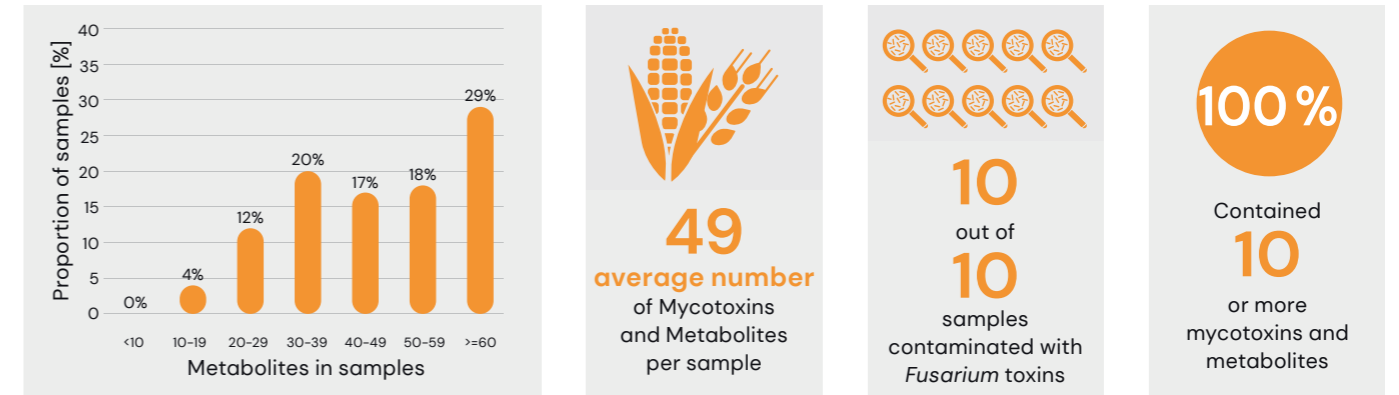
Spectrum Top®50:

The most comprehensive mycotoxin analysis commercially available
It detects > 50 different mycotoxins (including masked and modified forms), emerging mycotoxins and fungal metabolites.
The Spectrum Top® 50 method was developed by scientists of Romer Labs, a leading global supplier of diagnostic solutions for food and feed safety.

Multiple mycotoxin occurrence

Spectrum 380® results January to September 2024: the most comprehensive mycotoxin analysis available

Proportion of samples [%] vs Metabolites in samples:
<10: 0%; 10-19: 4%; 20-29: 12%; 30-39: 20%; 40-49: 17%; 50-59: 18%; >=60: 29%

49 average number of Mycotoxins and Metabolites per sample

10 out of **10** samples contaminated with *Fusarium* toxins

100 % Contained **10** or more mycotoxins and metabolites

Total 829 samples from 34 countries; 663 200 points of analysis

Mycotoxins & metabolites

Metabolite	Prevalence		Average	Maximum
Tryptophol		91%	435	78 200
Aurofusarin		82%	390	17 329
Moniliformin		77%	75	1 233
Abscisic acid		76%	254	7 685
Enniatin B		75%	85	2 871
Infectopyron		73%	9 913	631 680
Equisetin		73%	83	10 603
Culmorin		72%	111	2 581
Beauvericin		68%	17	568
Enniatin B1		68%	44	1 283
Asperglaucide		68%	155	25 781
Asperphenamate		66%	174	12 557
Brevianamid F		66%	64	1 663
Siccanol		66%	271	8 688
Flavoglaucin		65%	427	95 136
Bikaverin		63%	27	605
Fellutanine A		62%	53	1 288
Emodin		61%	43	2 197
Daidzin		59%	30 079	237 100
Daidzein		59%	3 824	26 110
Genistein		58%	3 017	22 649
Deoxynivalenol		58%	506	8 335
Genistin		57%	44 715	317 400
Tenuazonic acid		57%	327	9 188
Neoechinulin A		56%	259	79 008
Altersetin		56%	54	5 052
15-Hydroxyculmorin		56%	491	14 770

Positive Samples [%] for metabolites present in >55% of samples (orange bars indicate regulated or guideline mycotoxins; red bar indicates a masked mycotoxin). Cut off for all metabolites 1 ppb (except for aflatoxins 0.5 ppb). Average of positives and Maximum are presented in ppb.

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World Mycotoxin Survey

## The Global Threat – January to September 2024

Overview of the most frequently found mycotoxins, their masked and modified forms as well as emerging mycotoxins in all samples and finished feed

ALL samples (n=4 586)

Metabolite	Prevalence	Average	Maximum
Deoxynivalenol	77%	536	43 891
Beauvericin	68%	48	2 390
Enniatin B	66%	70	8 355
Enniatin B1	63%	27	3 262
Fumonisin B1	60%	485	335 053
Fumonisin B2	59%	171	114 907
Zearalenone	58%	77	9 099
Moniliformin	55%	108	3 440
Alternariol	45%	32	4 723
Enniatin A1	43%	15	1 307
Fumonisin B3	38%	95	39 738
Deoxynivalenol-3-Glucoside	30%	100	3 906
Enniatin A	29%	6	377
Aflatoxin B1	20%	10	305
Ochratoxin A	18%	6	579
15-Acetyl-Deoxynivalenol	15%	177	4 335
Sterigmatocystin	13%	7	142
HT-2 Toxin	13%	81	3 081
T-2 Toxin	10%	33	1 255
Nivalenol	9%	268	6 359
Mycophenolic Acid	9%	309	26 974
Ergometrine	6%	29	521
3-Acetyl-Deoxynivalenol	6%	1711	31 607
Ergosine	5%	24	505
beta-Zearalenol	5%	77	8 381

Positive Samples (%) — 0%, 50%, 100%

Top25 metabolites are presented according to their prevalence (orange bars indicate regulated or guideline mycotoxins; red bar indicates a masked mycotoxin). Cut off for all metabolites 1 ppb (except for aflatoxins 0.5 ppb). Average of positive samples and maximum levels found are reported in ppb.

FINISHED FEED (n=1 896)

Metabolite	Prevalence	Average	Maximum
Deoxynivalenol	82%	348	14 532
Fumonisin B1	75%	184	7 853
Enniatin B	74%	34	2 654
Enniatin B1	74%	13	499
Fumonisin B2	71%	68	2 862
Zearalenone	70%	28	1 207
Beauvericin	69%	22	264
Moniliformin	67%	64	1 348
Alternariol	57%	21	936
Enniatin A1	48%	7	152
Fumonisin B3	44%	44	1 204
Enniatin A	31%	3	69
Aflatoxin B1	30%	7	150
Deoxynivalenol-3-Glucoside	28%	67	2 379
Ochratoxin A	26%	4	579
Sterigmatocystin	13%	5	43
15-Acetyl-Deoxynivalenol	10%	89	2 061
Ergometrine	8%	26	144
Mycophenolic Acid	7%	113	9 083
T-2 Toxin	7%	25	892
HT-2 Toxin	6%	48	973
Nivalenol	5%	113	2 436
Aflatoxin G1	5%	22	234
Aflatoxin B2	4%	3	16
3-Acetyl-Deoxynivalenol	4%	1 829	13 438

Positive Samples (%) — 0%, 50%, 100%

Top25 metabolites are presented according to their prevalence (orange bars indicate regulated or guideline mycotoxins; red bar indicates a masked mycotoxin). Cut off for all metabolites 1 ppb (except for aflatoxins 0.5 ppb). Average of positive samples and maximum levels found are reported in ppb.

Legend

Ergot alkaloids

Regulated or guideline mycotoxins

Masked and modified myoctoxins

3-Acetyldeoxynivalenol and **15-Acetyldeoxynivalenol** are metabolites of the mycotoxin Deoxynivalenol. They can be converted to Deoxynivalenol in the intestinal tract.

DON-3-glucoside: plant metabolite of DON (masked DON); less toxic than DON, but it converted back to DON in the gastrointestinal tract of mammals.

Beta-zearalenol: Metabolite of ZEN

Aflatoxin B2 and G1: Aflatoxins, less toxic than Aflatoxin B1, not regulated

Nivalenol: Type B trichothecene, more cytotoxic than DON in intestinal cells of pigs and ruminants (in vitro)

4 586	243 058	77
Samples	Analysis points	Countries
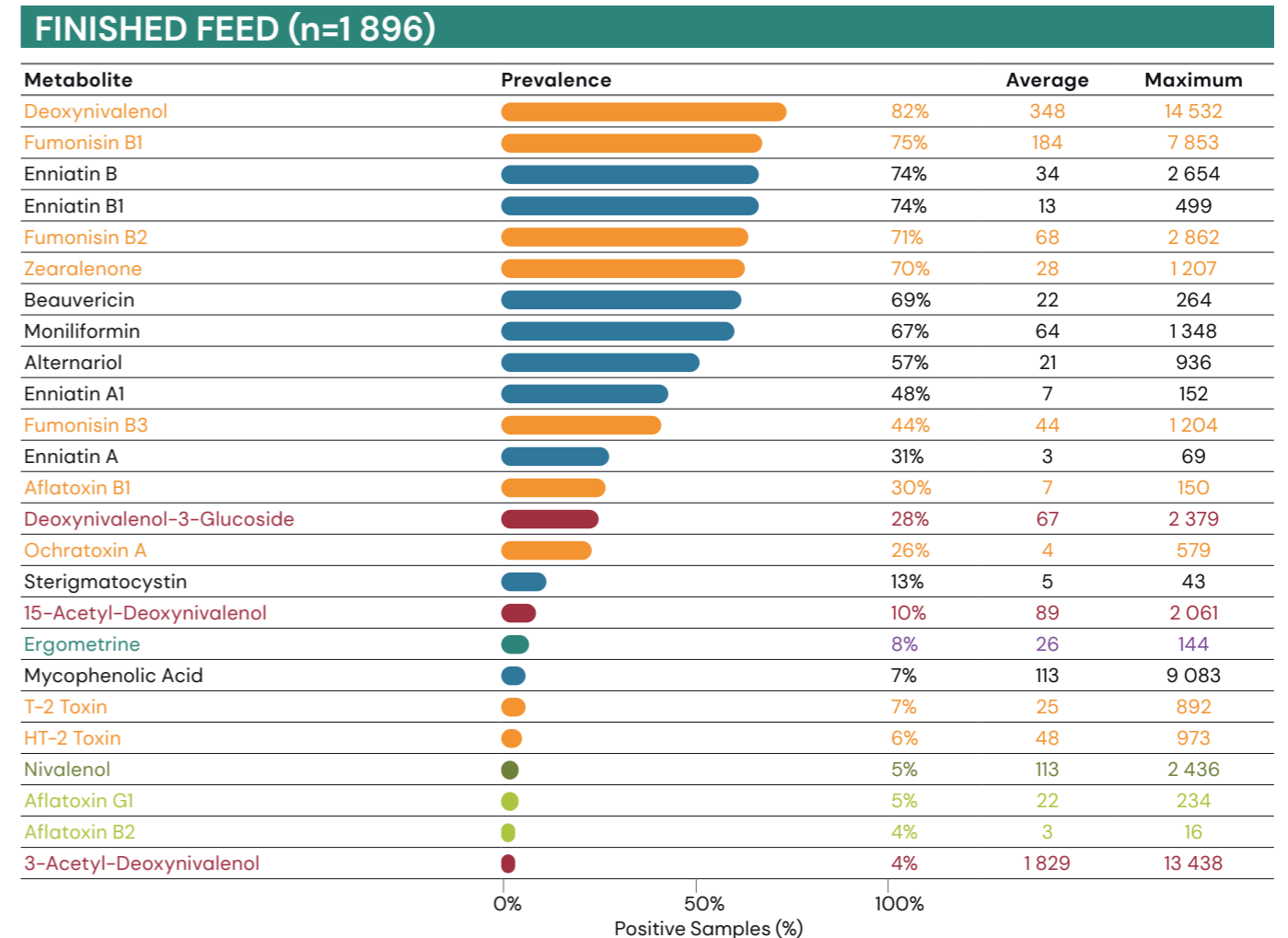
Emerging myotoxins: frequently found on agricultural commodities, not regulated; toxicity is under investigation, but toxic effects suggested in some scientific literature; EFSA started to publish reports to do a risk assessment for these toxins.

Moniliformin: broiler very susceptible, genotoxic, immunosuppressive; causes heart damage, muscular weakness, respiratory distress

Mycophenolic acid: Mycophenolic Acid shows a low acute toxicity in animals but may cause immunosuppression.

Alternariol: no acute toxicity, cytotoxic and mutagenic in vitro, effects on reproductive & immune system in vitro.

Beauvericin and Enniatins: effects on immune system: accumulation in fat-rich tissue.

Sterigmatocystin: precursor of aflatoxins; causes similar effects as aflatoxin B_1 in animals, but lower acute toxicity; negative effects incl. bloody diarrhea, less milk production, less feed intake, hepatotoxicity, nephrotoxicity

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