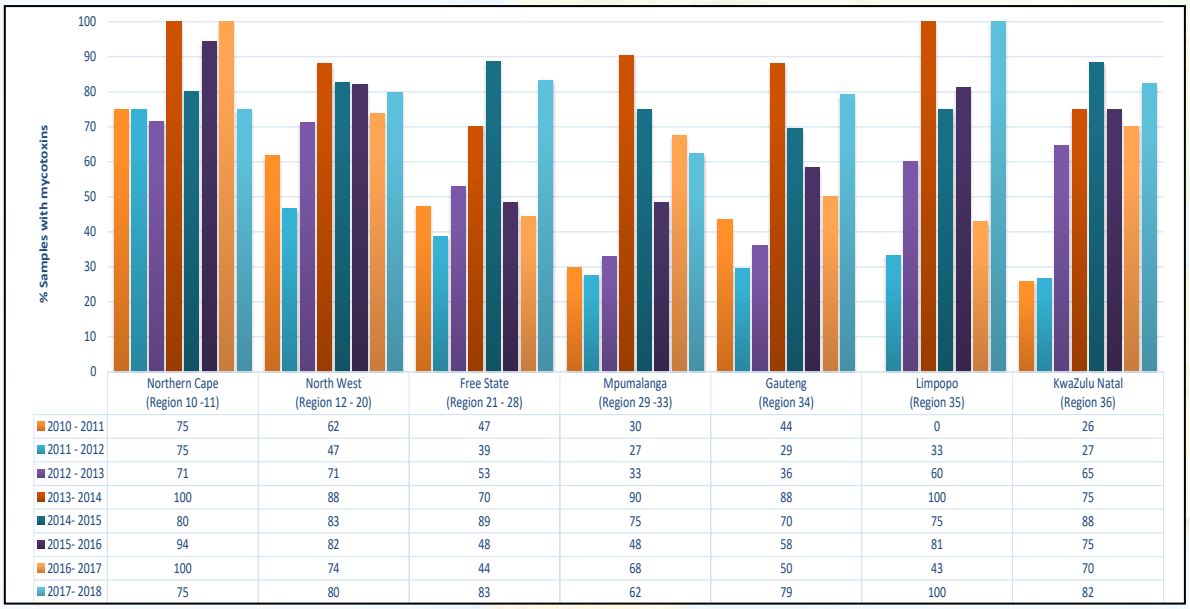
MYCOTOXINS

Annual survey results of mycotoxin contamination in the main staple foods are world-wide critically important for developing sound practices to reduce the mycotoxin contamination along the value chain. The results of the 13 mycotoxins monitored in the SA commercial maize over the past eight seasons, provide insight to producers, traders and processors on the occurrence trends in white and yellow maize over all the production regions. Approximately 35% of the maize crop samples were selected every season for multi-mycotoxin analyses to proportionally represent all the production regions as well as both white and yellow maize.

The 13 mycotoxins (listed in the Methods Section) analysed with the LC-MS/MS instrument include the SA regulated mycotoxins, aflatoxin B_1 (and Aflatoxin total), fumonisin (FUM) $B_1 + B_2$ and deoxynivalenol (DON) as well as the mycotoxins listed for grains in the Codex General Standard.

In the 2017/2018 season, 75% of the tested samples contained one or more mycotoxin. This is a 13% increase compared to the 62% of the 2016/2017 season's tested maize samples. The percentage samples with mycotoxins in the Free State and Limpopo increased 2-fold when compared with the previous season. The percentage samples containing one or more mycotoxins in the different provinces showed notable differences and the trends in occurrence confirmed that mycotoxin risk varies significantly between production regions, seasons and maize class (white/yellow). A summary of % occurrence per region is provided in graph 41.

Graph 41: Mycotoxin occurance per province of selected samples over eight seasons



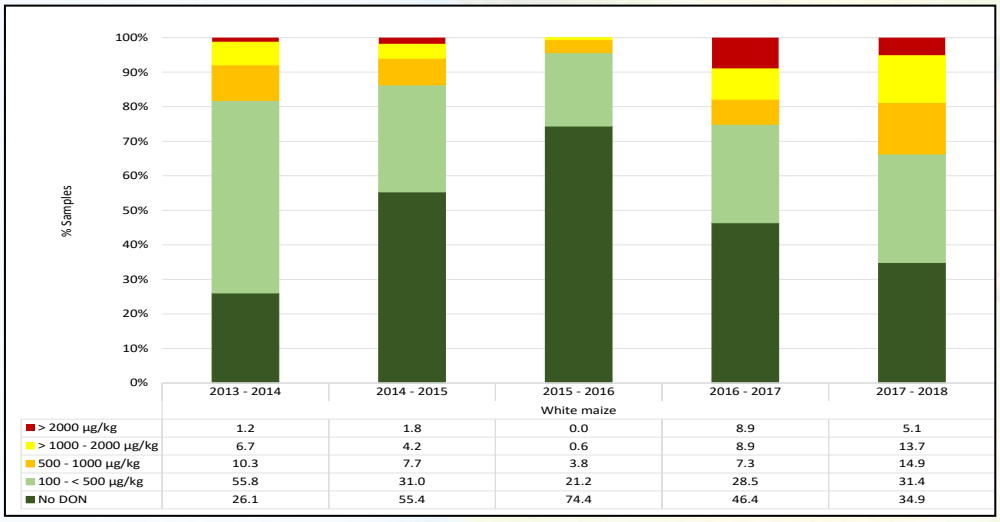
	Northern Cape (Region 10 -11)	North West (Region 12 - 20)	Free State (Region 21 - 28)	Mpumalanga (Region 29 -33)	Gauteng (Region 34)	Limpopo (Region 35)	KwaZulu Natal (Region 36)
2010 - 2011	75	62	47	30	44	0	26
2011 - 2012	75	47	39	27	29	33	27
2012 - 2013	71	71	53	33	36	60	65
2013- 2014	100	88	70	90	88	100	75
2014- 2015	80	83	89	75	70	75	88
2015- 2016	94	82	48	48	58	81	75
2016- 2017	100	74	44	68	50	43	70
2017- 2018	75	80	83	62	79	100	82

The survey confirmed the absence of aflatoxin B_1 (classified as a cancer-causing hazard), B_2, G_1 and G_2, T2-toxin, HT-2 toxin and ochratoxin A in commercial maize produced in all the regions over the past eight seasons. Zearalenone (ZON) was detected in only 9% of the white maize samples and 7% of the yellow maize samples. The highest ZON concentration, (361 µg/kg) was found in a white maize sample. The most predominant mycotoxins observed in all the seasons in most regions on both white and yellow maize are FUM B_1, B_2, B_3 (in 44% of the samples) and DON (in 58% of the samples).

The number of samples containing DON this season increased with 21%; from 37% in 2016/2017 to 58% in the 2017/2018 season. In contrast to the previous season, the highest increase in % samples with DON was observed in yellow maize; from 19% in the previous season to 51% of the samples this season. With the amendment of the SA Regulation in 2016 to include maximum allowable levels for human consumption, it is important to focus on the % samples with FUM and DON concentrations just below and above the maximum allowable levels; namely 4 000 µg/kg FUM $B_1 + B_2$ and 2 000 µg/kg DON in unprocessed maize.

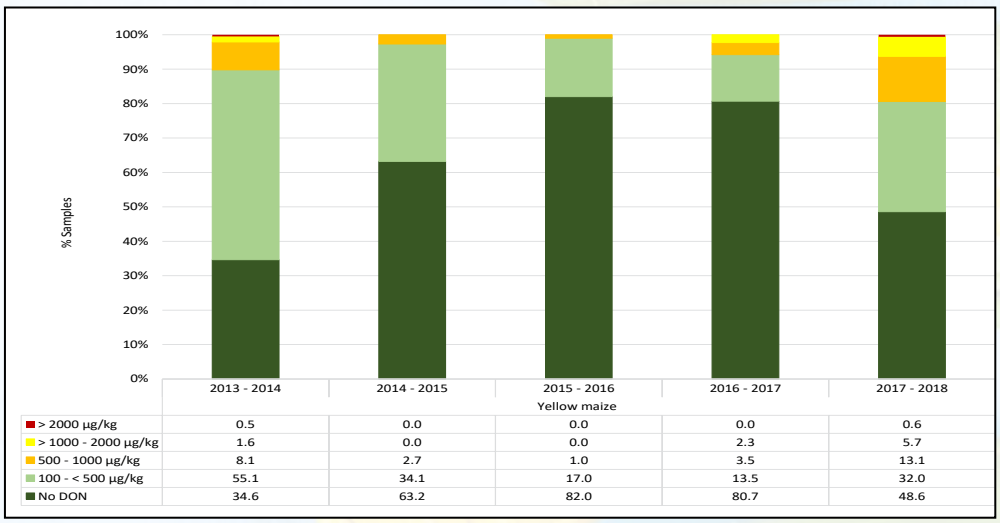
The % samples with DON at different concentration levels in the past five seasons for both white and yellow maize, are summarised in graphs 42 and 43. This season, only 34.9% of white maize samples contained no DON and a notable increase was observed in the % samples with DON concentrations larger than (>) 1 000 µg/kg over the last three consecutive seasons. Five percent of the white maize samples (9 samples) were contaminated with DON concentrations above the regulated maximum allowable level of 2 000 µg/kg, as illustrated in graph 42. The highest DON concentration of 3 510 µg/kg was also observed on a white maize sample. In contrast to the 81% yellow maize samples containing no DON in 2016/2017, only 49% yellow maize samples this season contained no DON and the percentage yellow maize with DON > 1 000 µg/kg increased from 2% in 2016/2017 to 6% in 2017/2018, see graph 43.

Graph 42: 2017/2018 White maize crop - DON occurance



	2013 - 2014	2014 - 2015	2015 - 2016	2016 - 2017	2017 - 2018
> 2000 µg/kg	1.2	1.8	0.0	8.9	5.1
> 1000 - 2000 µg/kg	6.7	4.2	0.6	8.9	13.7
500 - 1000 µg/kg	10.3	7.7	3.8	7.3	14.9
100 - < 500 µg/kg	55.8	31.0	21.2	28.5	31.4
No DON	26.1	55.4	74.4	46.4	34.9

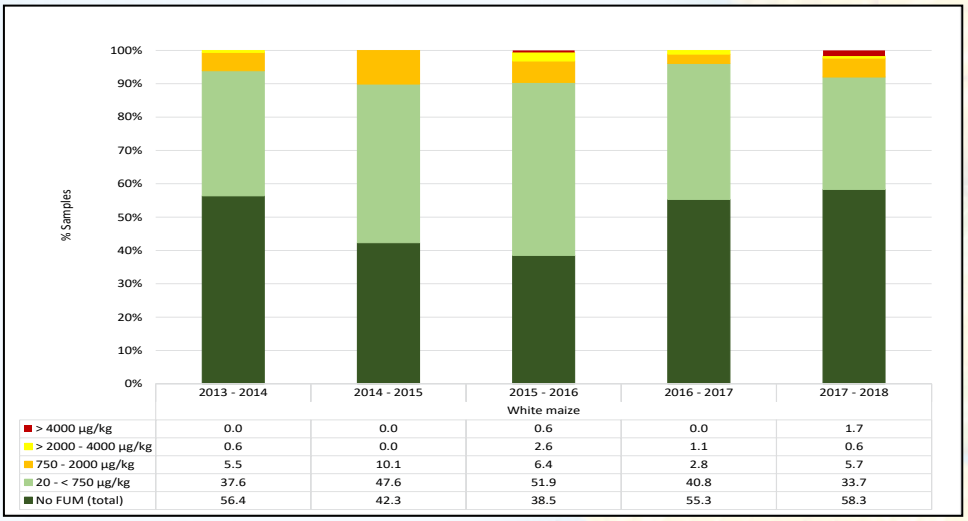
Graph 43: 2017/2018 Yellow maize crop - DON occurance



	2013 - 2014	2014 - 2015	2015 - 2016	2016 - 2017	2017 - 2018
> 2000 µg/kg	0.5	0.0	0.0	0.0	0.6
> 1000 - 2000 µg/kg	1.6	0.0	0.0	2.3	5.7
500 - 1000 µg/kg	8.1	2.7	1.0	3.5	13.1
100 - < 500 µg/kg	55.1	34.1	17.0	13.5	32.0
No DON	34.6	63.2	82.0	80.7	48.6

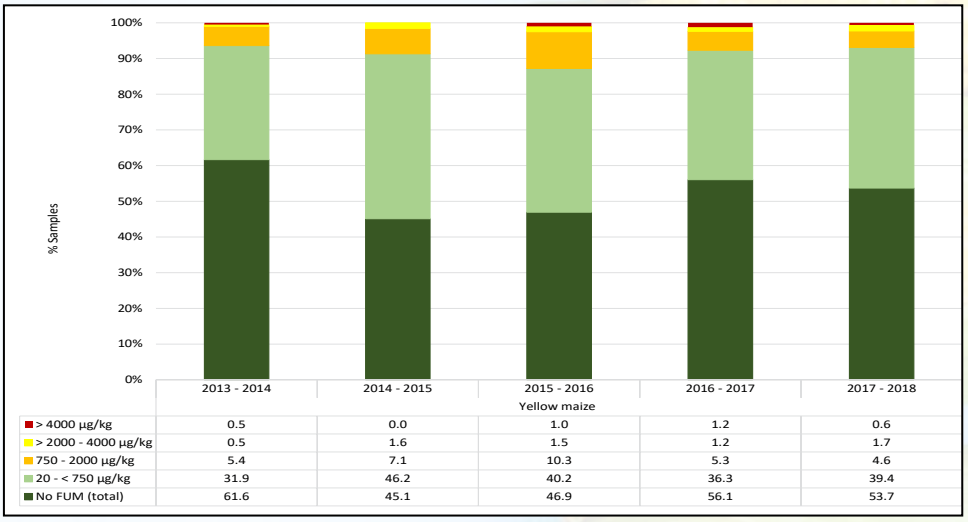
Fumonisins were found in 44% of the samples, similar to the eight-year average, while white and yellow maize also had almost the same incidence rates every season. However, in contrast to the 2016/2017 season, white maize samples containing FUM above 4 000 µg/kg were found this season, concentrations as high as 8 356, 7 328 and 4 505 µg/kg were reported in three different provinces. The following two graphs are summaries of the % white and yellow maize with different FUM concentration levels over the past five seasons.

Graphs 44: 2017/2018 White Maize crop - Fumonisin occurance



White maize	2013 - 2014	2014 - 2015	2015 - 2016	2016 - 2017	2017 - 2018
> 4000 µg/kg	0.0	0.0	0.6	0.0	1.7
> 2000 - 4000 µg/kg	0.6	0.0	2.6	1.1	0.6
750 - 2000 µg/kg	5.5	10.1	6.4	2.8	5.7
20 - < 750 µg/kg	37.6	47.6	51.9	40.8	33.7
No FUM (total)	56.4	42.3	38.5	55.3	58.3

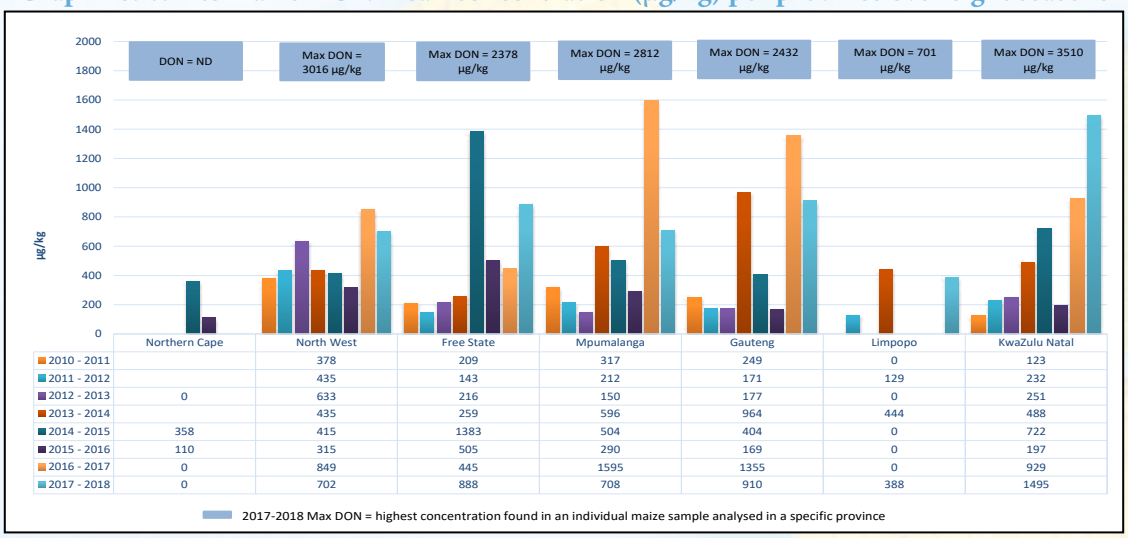
Graph 45: 2017/2017 Yellow Maize crop - Fumonisin occurance



Yellow maize	2013 - 2014	2014 - 2015	2015 - 2016	2016 - 2017	2017 - 2018
> 4000 µg/kg	0.5	0.0	1.0	1.2	0.6
> 2000 - 4000 µg/kg	0.5	1.6	1.5	1.2	1.7
750 - 2000 µg/kg	5.4	7.1	10.3	5.3	4.6
20 - < 750 µg/kg	31.9	46.2	40.2	36.3	39.4
No FUM (total)	61.6	45.1	46.9	56.1	53.7

The different patterns of the mean concentrations FUM, DON and ZON over the eight seasons in the different regions, confirmed again the well-known fact that the mycotoxin risk in maize produced, differ from season to season in the same region and also from region to region, because the occurrence and concentration levels of mycotoxins are influenced by climatic factors during the pre-harvest production period.

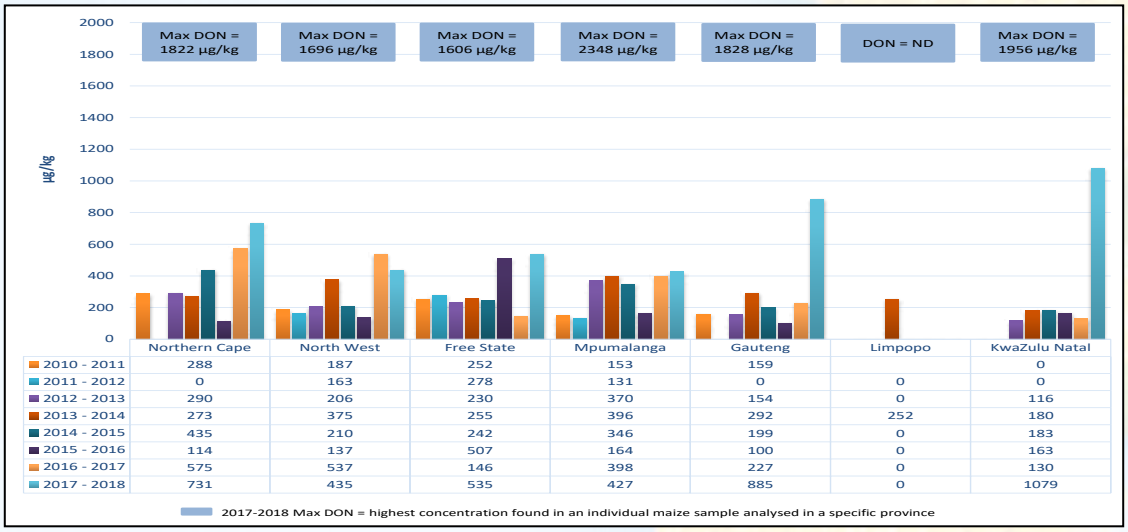
Graph 46: White maize DON mean concentration (µg/kg) per province over eight seasons



	Northern Cape	North West	Free State	Mpumalanga	Gauteng	Limpopo	KwaZulu Natal
2010 - 2011		378	209	317	249	0	123
2011 - 2012		435	143	212	171	129	232
2012 - 2013	0	633	216	150	177	0	251
2013 - 2014		435	259	596	964	444	488
2014 - 2015	358	415	1383	504	404	0	722
2015 - 2016	110	315	505	290	169	0	197
2016 - 2017	0	849	445	1595	1355	0	929
2017 - 2018	0	702	888	708	910	388	1495

2017-2018 Max DON = highest concentration found in an individual maize sample analysed in a specific province

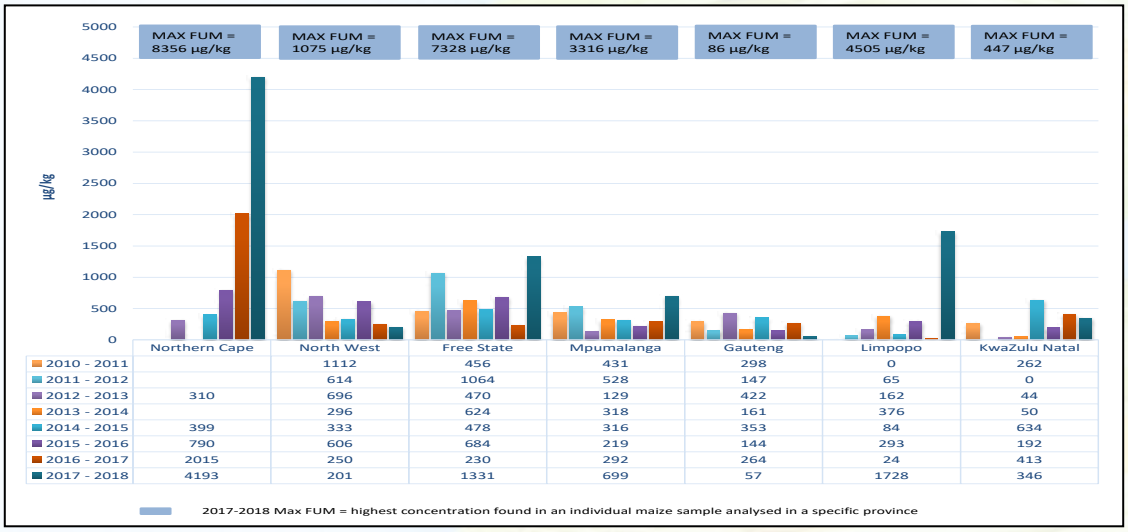
Graph 47: Yellow maize DON mean concentration (µg/kg) per province over eight seasons



	Northern Cape	North West	Free State	Mpumalanga	Gauteng	Limpopo	KwaZulu Natal
2010 - 2011	288	187	252	153	159		0
2011 - 2012	0	163	278	131	0	0	0
2012 - 2013	290	206	230	370	154	0	116
2013 - 2014	273	375	255	396	292	252	180
2014 - 2015	435	210	242	346	199	0	183
2015 - 2016	114	137	507	164	100	0	163
2016 - 2017	575	537	146	398	227	0	130
2017 - 2018	731	435	535	427	885	0	1079

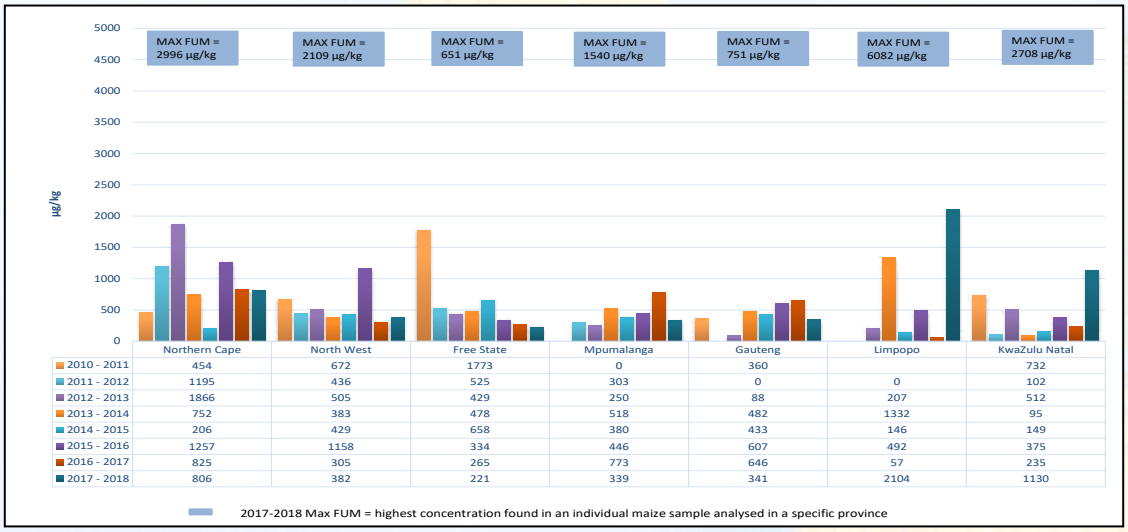
This season, the white maize FUM mean concentrations increased notably in four provinces as illustrated in Graph 48. Yellow maize mean concentrations increased notably in two provinces, see Graph 49.

Graph 48: White maize FUM mean concentration (µg/kg) per province over eight seasons



	Northern Cape	North West	Free State	Mpumalanga	Gauteng	Limpopo	KwaZulu Natal
2010 - 2011		1112	456	431	298	0	262
2011 - 2012		614	1064	528	147	65	0
2012 - 2013	310	696	470	129	422	162	44
2013 - 2014		296	624	318	161	376	50
2014 - 2015	399	333	478	316	353	84	634
2015 - 2016	790	606	684	219	144	293	192
2016 - 2017	2015	250	230	292	264	24	413
2017 - 2018	4193	201	1331	699	57	1728	346

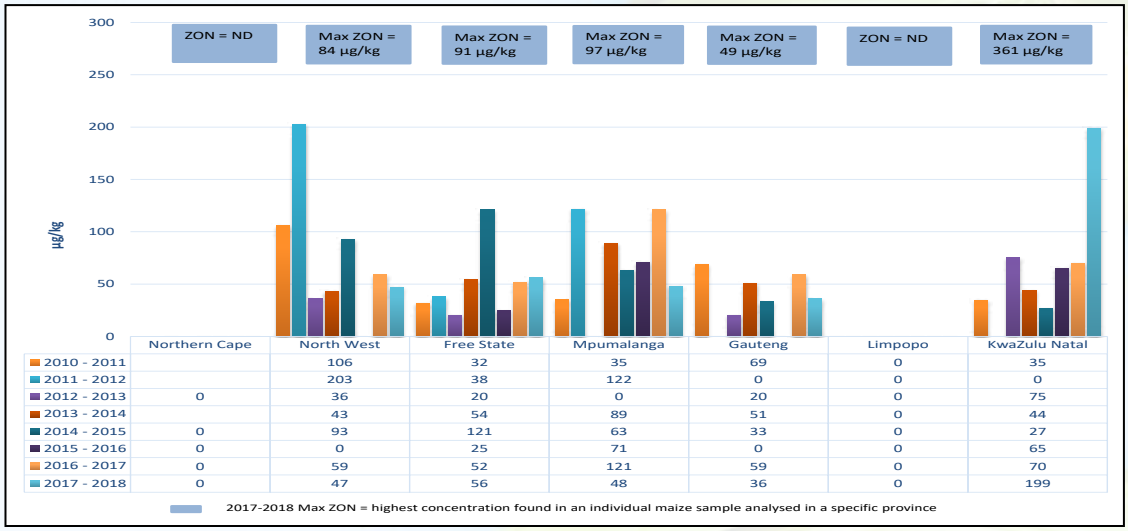
Graph 49: Yellow maize FUM mean concentration (µg/kg) per province over eight seasons



	Northern Cape	North West	Free State	Mpumalanga	Gauteng	Limpopo	KwaZulu Natal
2010 - 2011	454	672	1773	0	360		732
2011 - 2012	1195	436	525	303	0	0	102
2012 - 2013	1866	505	429	250	88	207	512
2013 - 2014	752	383	478	518	482	1332	95
2014 - 2015	206	429	658	380	433	146	149
2015 - 2016	1257	1158	334	446	607	492	375
2016 - 2017	825	305	265	773	646	57	235
2017 - 2018	806	382	221	339	341	2104	1130

ZON in white maize, was found in the same five provinces as in the previous seasons. In contrast to the previous season when ZON in yellow maize was only found in two provinces, this season ZON was reported in all the provinces except Limpopo. It must be noted that ZON was not found in any maize samples from the Limpopo region over the past eight seasons.

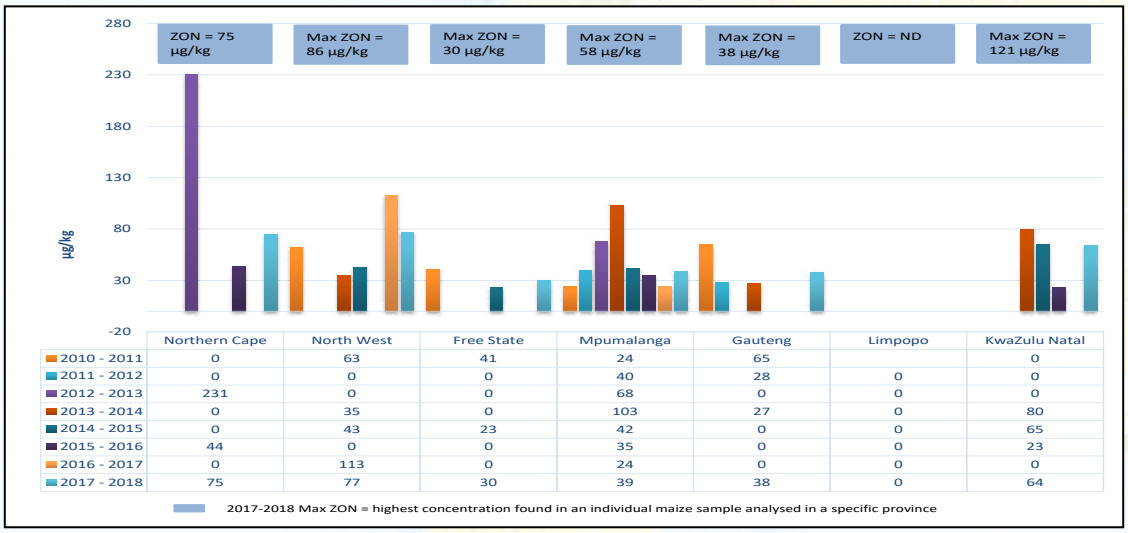
Graph 50: White maize ZON mean concentration (µg/kg) per province over eight seasons



	Northern Cape	North West	Free State	Mpumalanga	Gauteng	Limpopo	KwaZulu Natal
2010 - 2011		106	32	35	69	0	35
2011 - 2012		203	38	122	0	0	0
2012 - 2013	0	36	20	0	20	0	75
2013 - 2014		43	54	89	51	0	44
2014 - 2015	0	93	121	63	33	0	27
2015 - 2016	0	0	25	71	0	0	65
2016 - 2017	0	59	52	121	59	0	70
2017 - 2018	0	47	56	48	36	0	199

2017-2018 Max ZON = highest concentration found in an individual maize sample analysed in a specific province

Graph 51: Yellow maize ZON mean concentration (µg/kg) per province over eight seasons



	Northern Cape	North West	Free State	Mpumalanga	Gauteng	Limpopo	KwaZulu Natal
2010 - 2011	0	63	41	24	65		0
2011 - 2012	0	0	0	40	28	0	0
2012 - 2013	231	0	0	68	0	0	0
2013 - 2014	0	35	0	103	27	0	80
2014 - 2015	0	43	23	42	0	0	65
2015 - 2016	44	0	0	35	0	0	23
2016 - 2017	0	113	0	24	0	0	0
2017 - 2018	75	77	30	39	38	0	64

2017-2018 Max ZON = highest concentration found in an individual maize sample analysed in a specific province