

Mycotoxins

The results of fourteen mycotoxins, including aflatoxin B₁, B₂, G₁ and G₂ (AFLA Total), fumonisin B₁, B₂ and B₃ (FUM Total), deoxynivalenol (DON), 15-acetyl-deoxynivalenol (15-ADON), ochratoxin A, T2-toxin, H-T2 toxin, zearalenone (ZON), and diplodiatoxin, are reported in 350 maize samples selected from the 1000 maize crop samples of the 2023/24 season. This is the first year that we also include results for diplodiatoxin. It should be noted that the levels for diplodiatoxin should be seen as indicative values as the analyses are not validated due to the lack of certified reference materials for this mycotoxin. Levels of 15-ADON, the acetylated derivative of DON, are commonly associated with DON levels and are typically found when samples contain DON. For the purpose of this report, 15-ADON levels were not discussed.

Multi-mycotoxin monitoring in locally produced maize has been included in the maize crop quality survey since the 2010/11 maize production season, thus for a total of fourteen seasons to date. The samples were representatively selected for white and yellow maize from all the production regions, representing approximately 35 - 40 % of the survey samples.

Number of samples analysed over the fourteen seasons

Since the onset of mycotoxin analyses in the maize quality monitoring program in 2010, a total of 4 127 maize samples have been analysed. During the first three seasons, fewer samples were analysed. As the annual crop quality program matured, the number of samples was increased to 350 per year for the last eleven years (Table 27). The majority of samples were analysed from the Mpumalanga, Free State, and North West production regions. More yellow maize samples were analysed from Mpumalanga, KwaZulu Natal, and Northern Cape, while more white maize samples were analysed for the Free State, North West, Gauteng, and Limpopo production regions. The fewest samples were analysed from the Western and eastern Cape regions, which are not typically considered as maize production regions. For these two provinces, only yellow maize samples were analysed.

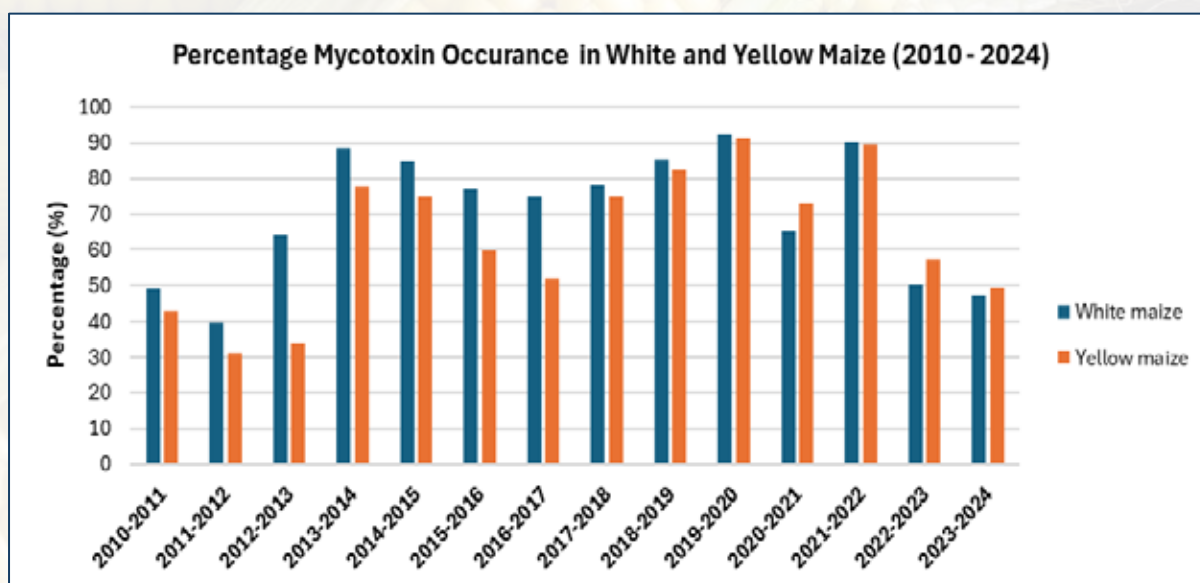
Table 27. Number of white and yellow maize samples analysed from the nine provinces over fourteen production seasons from 2010 to 2024

Region	Maize	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2024
Western Cape (Region 1-6)	White	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Yellow	0	0	0	0	0	1	0	0	1	0	0	0	2	3
Eastern Cape (Region 7-9)	White	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Yellow	0	0	0	0	0	4	0	0	0	1	0	3	3	4
Northern Cape (Region 10 -11)	White	0	0	1	0	1	1	2	3	2	3	2	1	1	0
	Yellow	2	3	3	5	9	17	14	9	16	10	8	13	13	10
North West (Region 12 - 20)	White	20	25	10	33	53	48	42	68	50	72	54	65	65	53
	Yellow	13	9	9	26	51	25	27	46	27	29	32	36	32	31
Free State (Region 21 - 28)	White	19	17	23	63	32	26	54	36	51	80	50	58	51	49
	Yellow	7	11	10	51	29	32	45	31	45	41	39	37	45	38
Mpumalanga (Region 29 -33)	White	4	11	14	45	60	48	52	43	42	27	59	37	41	59
	Yellow	5	17	16	80	71	80	59	63	52	47	61	49	49	62
Gauteng (Region 34)	White	2	3	5	13	12	11	14	12	12	9	11	10	11	9
	Yellow	0	1	3	12	11	13	14	12	14	8	12	10	10	10
Limpopo (Region 35)	White	1	1	1	3	2	10	4	6	8	2	2	6	6	6
	Yellow	0	0	1	3	2	6	3	4	7	4	2	6	5	3
KwaZulu Natal (Region 36)	White	3	1	2	8	8	12	11	7	10	7	8	8	7	6
	Yellow	1	1	2	8	9	16	9	10	13	10	10	11	9	7
Total White Maize Samples		49	58	56	165	168	156	179	175	175	200	186	185	182	182
Total Yellow Maize Samples		28	42	44	185	182	194	171	175	175	150	164	165	168	168
Total Samples		77	100	100	350	350	350	350	350	350	350	350	350	350	350

Number of samples that tested positive for at least one mycotoxin over the fourteen seasons

As shown in Graph 53, the percentage of white maize that tested positive for at least one mycotoxin was higher than that for yellow maize from the 2010/11 to the 2019/20 production seasons. Starting in the 2020/21 season, this trend changed, with a higher percentage of yellow maize testing positive. It should be noted that the percentages for both white and yellow maize that tested positive were similar in the 2019/20 season. For the current production season, the percentages of white and yellow maize that tested positive for at least one mycotoxin were the lowest since the 2013/14 season, during which a consistent number of samples (350) were analysed.

The highest percentage of maize that tested positive were during the 2019/20 and 2021/22 seasons, where more than 90 % of the samples tested positive.



Graph 53. The percentage white and yellow maize tested positive for at least one mycotoxin over fourteen seasons from 2010 to 2024

The mean mycotoxin concentrations in white and yellow maize over fourteen production seasons, from the 2010/11 to 2023/24 production seasons will be discussed. The mean concentrations are calculated for samples that tested positive. The report will first provide a summary of all the production regions, followed by a detailed analysis of each of the nine individual provinces. Diplodiatoxin was only analysed in the last six seasons from the 2018/19 season.

All production regions

The mean mycotoxin concentrations in white and yellow maize from all the production regions over fourteen seasons from 2010 to 2024 are shown in Graph 54. The maximum mycotoxin concentrations ($\mu\text{g/kg}$) in white and yellow maize samples in Tables 28 and 29, respectively.

Aflatoxins were detected in two maize samples (one white and one yellow) analysed during the current season with concentrations of 41 $\mu\text{g/kg}$ and 45 $\mu\text{g/kg}$, respectively. Both these values exceed the maximum allowable level for certain farm feeds and human consumption.

The mean total FUM concentration for white maize was 285 $\mu\text{g/kg}$. While this level is higher than the 132 $\mu\text{g/kg}$ reported in the previous season, it remains lower than the average concentration over the thirteen seasons. The mean total FUM concentration for yellow maize was 223 $\mu\text{g/kg}$, this level is the lowest concentration over the thirteen seasons. The mean DON concentration in white maize was 316 $\mu\text{g/kg}$ and 230 $\mu\text{g/kg}$ in yellow maize. These levels were lower than the past seven

seasons. None of the samples contained FUM or DON higher than the South African regulated maximum allowable level for farm feed or human consumption during the current season.

The mean ZON concentration in white maize was 43 µg/kg and concentrations appear to be constant over the past twelve seasons, ranging from 31 to 90 µg/kg. The mean ZON concentration in yellow maize was 62 µg/kg, lower than levels reported for the previous two seasons. In the first three seasons from 2010 to 2013, no ZON was detected in yellow maize, since then levels ranged from 33 to 131 µg/kg.

The mean diplodiatxin concentration was 123 µg/kg in white maize, which was lower than the previous two seasons. Yellow maize had a mean diplodiatxin concentration of 222 µg/kg. There appears to be an increase in diplodiatxin in yellow maize over the last six seasons.

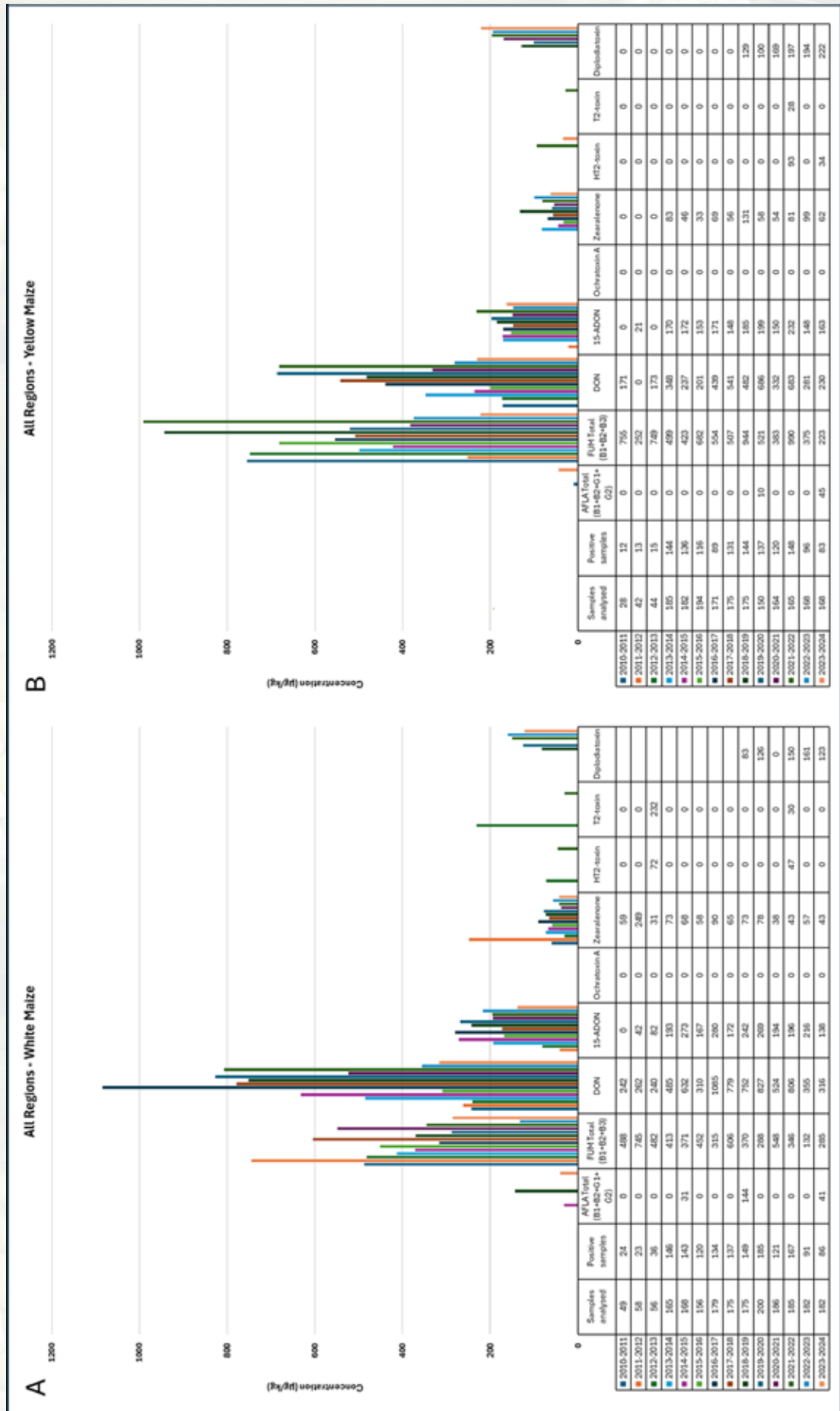
Considering the data from the last fourteen production seasons, the maize samples analysed as part of the annual crop quality survey show that they are predominantly contaminated by DON, 15-ADON, FUM, diplodiatxin, and ZON in both white and yellow maize. DON concentrations seem to be slightly higher in white maize compared to the levels reported in yellow maize. Although ochratoxin A was not detected in any maize samples over the past fourteen years, infrequent detection of Aflatoxin (AFLA), HT2-toxin, and T2-toxin occurred.

Table 28. The maximum mycotoxin concentrations (µg/kg) in white maize samples analysed for all production regions

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	49	-	1341	883	-	-	187	-	-	-
2011-2012	58	-	4419	485	85	-	297	-	-	-
2012-2013	56	-	1600	617	82	-	41	72	232	-
2013-2014	165	-	2927	6134	861	-	445	-	-	-
2014-2015	168	48	1809	9736	1768	-	337	-	-	-
2015-2016	156	-	6865	1585	310	-	127	-	-	-
2016-2017	179	-	3913	7698	964	-	399	-	-	-
2017-2018	175	-	8356	3510	394	-	361	-	-	-
2018-2019	175	143	7341	11181	737	-	271	-	-	319
2019-2020	200	-	3911	7700	1173	-	539	-	-	663
2020-2021	186	-	5373	3256	571	-	101	-	-	0
2021-2022	185	-	1333	3934	491	-	143	47	30	595
2022-2023	182	-	557	2061	379	-	107	-	-	560
2023-2024	182	41	1805	908	154	-	107	-	-	402

Table 29. The maximum mycotoxin concentrations (µg/kg) in yellow maize samples analysed for all production regions

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	28	-	1401	222	-	-	-	-	-	-
2011-2012	42	-	720	-	21	-	-	-	-	-
2012-2013	44	-	4395	184	-	-	-	-	-	-
2013-2014	185	-	5357	2601	300	-	354	-	-	-
2014-2015	182	-	3382	851	238	-	124	-	-	-
2015-2016	194	-	11347	640	184	-	44	-	-	-
2016-2017	171	-	6059	1552	381	-	113	-	-	-
2017-2018	175	-	6082	2348	263	-	121	-	-	-
2018-2019	175	-	34740	3256	593	-	957	-	-	1235
2019-2020	150	10	5928	5060	768	-	243	-	-	360
2020-2021	164	-	2648	2169	309	-	56	-	-	312
2021-2022	165	-	18301	6879	1115	-	428	93	28	1347
2022-2023	168	-	3127	2205	255	-	328	-	-	777
2023-2024	168	45	1339	741	262	-	113	34	-	2389



Graph 54. The mean mycotoxin concentrations in white maize (A) and yellow maize (B) from all production regions over fourteen seasons from 2010 to 2024

Western Cape (Region 1 - 6) and Eastern Cape (Region 7 - 9)

The mean mycotoxin concentrations in yellow maize from the Western Cape and Eastern Cape regions over fourteen seasons from 2010 to 2024 are shown in Graph 55, and the maximum mycotoxin concentrations (µg/kg) in yellow maize samples in Tables 30 and 31, respectively.

In total only 7 and 15 yellow maize samples were analysed for the Western and Eastern Cape, respectively; no white maize samples were analysed for mycotoxins.

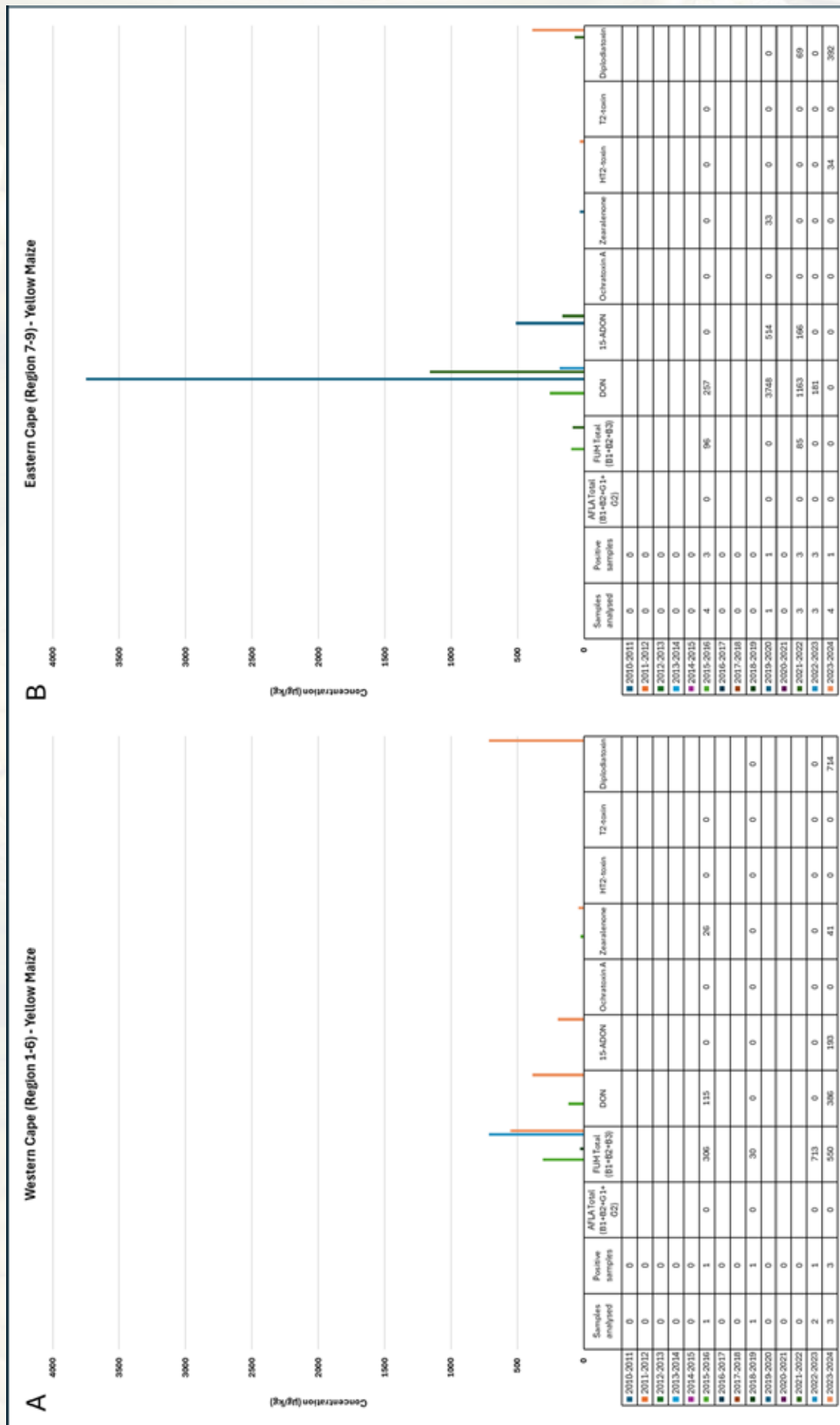
The mean concentrations for the total FUM, DON, and ZON in the yellow maize samples for the Western Cape were 550 µg/kg, 386 µg/kg, and 41 µg/kg respectively. No FUM, DON, or ZON were detected in the yellow maize samples from the Eastern Cape. The HT2-toxin concentration in a single sample from the Eastern Cape was 34 µg/kg. The mean diplodiatxin concentrations were 714 µg/kg and 392 µg/kg for the Western and Eastern Cape regions respectively.

Table 30. The maximum mycotoxin concentrations (µg/kg) in yellow maize samples analysed for the Western Cape (Region 1 - 6)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearalene	HT2-toxin	T2-toxin	Diplodia-toxin
2010-2011	0	-	-	-	-	-	-	-	-	-
2011-2012	0	-	-	-	-	-	-	-	-	-
2012-2013	0	-	-	-	-	-	-	-	-	-
2013-2014	0	-	-	-	-	-	-	-	-	-
2014-2015	0	-	-	-	-	-	-	-	-	-
2015-2016	1	-	306	115	-	-	26	-	-	-
2016-2017	0	-	-	-	-	-	-	-	-	-
2017-2018	0	-	-	-	-	-	-	-	-	-
2018-2019	1	-	30	-	-	-	-	-	-	-
2019-2020	0	-	-	-	-	-	-	-	-	-
2020-2021	0	-	-	-	-	-	-	-	-	-
2021-2022	0	-	-	-	-	-	-	-	-	-
2022-2023	2	-	713	-	-	-	-	-	-	-
2023-2024	3	-	1339	708	262	-	41	-	-	714

Table 31. The maximum mycotoxin concentrations (µg/kg) in yellow maize samples analysed for the Eastern Cape (Region 7 - 8)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearalene	HT2-toxin	T2-toxin	Diplodia-toxin
2010-2011	0	-	-	-	-	-	-	-	-	-
2011-2012	0	-	-	-	-	-	-	-	-	-
2012-2013	0	-	-	-	-	-	-	-	-	-
2013-2014	0	-	-	-	-	-	-	-	-	-
2014-2015	0	-	-	-	-	-	-	-	-	-
2015-2016	4	-	143	439	-	-	-	-	-	-
2016-2017	0	-	-	-	-	-	-	-	-	-
2017-2018	0	-	-	-	-	-	-	-	-	-
2018-2019	0	-	-	-	-	-	-	-	-	-
2019-2020	1	-	-	3748	514	-	33	-	-	-
2020-2021	0	-	-	-	-	-	-	-	-	-
2021-2022	3	-	85	2001	220	-	-	-	-	69
2022-2023	3	-	-	241	-	-	-	-	-	-
2023-2024	4	-	-	-	-	-	-	34	-	392



Graph 55. The mean mycotoxin concentrations in yellow maize from the Western Cape (A) and Eastern Cape (B) regions over fourteen seasons from 2010 to 2024

Northern Cape (Region 10 - 11)

The mean mycotoxin concentrations in white and yellow maize from the Northern Cape regions over fourteen seasons from 2010 to 2024 are shown in Graph 56, and the maximum mycotoxin concentrations (µg/kg) in white and yellow maize samples in Tables 32 and 33, respectively.

Over the past fourteen seasons, 17 white maize and 132 yellow maize samples were analysed for mycotoxins. No white maize samples were analysed this season.

The mean FUM concentration of 161 µg/kg in yellow maize samples was lower than the previous two seasons. The highest mean concentration (2 669 µg/kg) was reported for the 2021/22 season. The highest FUM concentration of 18 301 µg/kg in yellow maize (2021/22 season) and 8 356 µg/kg in white maize (2017/18 season).

The mean DON concentration of 393 µg/kg were similar to the previous season (327 µg/kg), but lower than the highest mean concentration of 2 067 µg/kg reported for the 2021/22 season. The highest DON concentration was 6 879 µg/kg in yellow maize (2021/22 season), while the highest DON concentration in white maize was 1 915 µg/kg (2019/22 season).

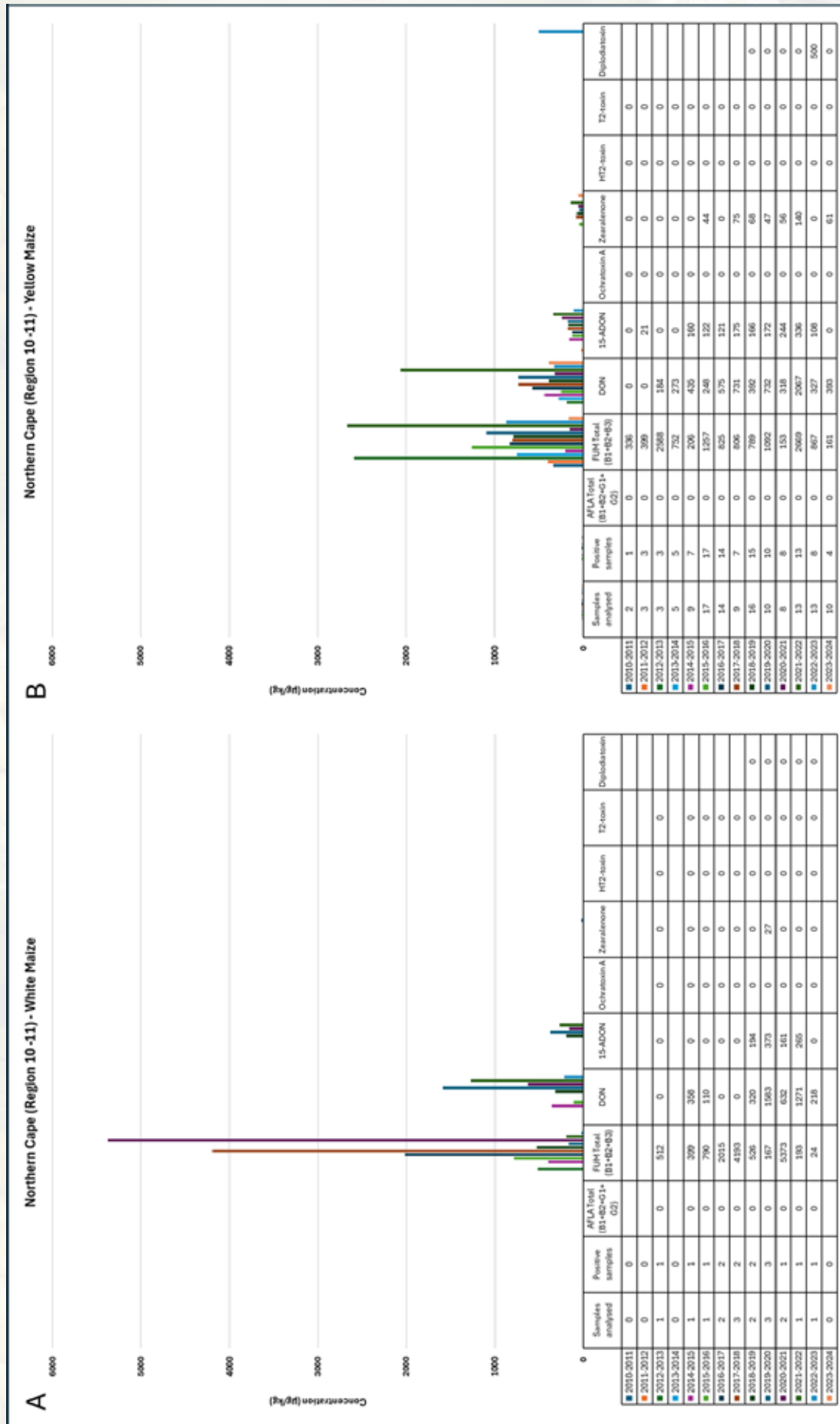
ZON levels have been consistently higher in yellow maize compared to white maize over fourteen seasons from 2010 to 2024. Diplodiatoxin was only reported in yellow maize (500 µg/kg) during the 2022/23 season.

Table 32. The maximum mycotoxin concentrations (µg/kg) in white maize samples analysed for the Northern Cape (Region 10 - 11)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	0	-	-	-	-	-	-	-	-	-
2011-2012	0	-	-	-	-	-	-	-	-	-
2012-2013	1	-	512	-	-	-	-	-	-	-
2013-2014	0	-	-	-	-	-	-	-	-	-
2014-2015	1	-	399	358	-	-	-	-	-	-
2015-2016	1	-	790	110	-	-	-	-	-	-
2016-2017	2	-	3913	-	-	-	-	-	-	-
2017-2018	3	-	8356	-	-	-	-	-	-	-
2018-2019	2	-	526	509	194	-	-	-	-	-
2019-2020	3	-	311	1915	433	-	27	-	-	-
2020-2021	2	-	5373	632	161	-	-	-	-	-
2021-2022	1	-	193	1271	265	-	-	-	-	-
2022-2023	1	-	24	218	-	-	-	-	-	-
2023-2024	0	-	-	-	-	-	-	-	-	-

Table 33. The maximum mycotoxin concentrations (µg/kg) in yellow maize samples analysed for the Northern Cape (Region 10 - 11)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	2	-	336	-	-	-	-	-	-	-
2011-2012	3	-	720	-	21	-	-	-	-	-
2012-2013	3	-	4395	184	-	-	-	-	-	-
2013-2014	5	-	1801	391	-	-	-	-	-	-
2014-2015	9	-	779	567	169	-	-	-	-	-
2015-2016	17	-	7801	554	122	-	44	-	-	-
2016-2017	14	-	2435	795	153	-	-	-	-	-
2017-2018	9	-	2996	1822	263	-	75	-	-	-
2018-2019	16	-	2043	1318	166	-	109	-	-	-
2019-2020	10	-	5928	1838	252	-	88	-	-	-
2020-2021	8	-	376	516	244	-	56	-	-	-
2021-2022	13	-	18301	6879	1115	-	428	-	-	-
2022-2023	13	-	3127	642	109	-	-	-	-	500
2023-2024	10	-	235	559	-	-	61	-	-	-



Graph 56. The mean mycotoxin concentrations in white maize (A) and yellow maize (B) from the Northern Cape regions over fourteen seasons from 2010 to 2024

North West (Region 12 – 20)

The mean mycotoxin concentrations in white and yellow maize from the Northern West regions over fourteen seasons from 2010 to 2024 are shown in Graph 57. The maximum mycotoxin concentrations (µg/kg) in white and yellow maize samples in Tables 34 and 35, respectively.

Over the past fourteen seasons, 658 white maize and 393 yellow maize samples were analysed for mycotoxins. Aflatoxins were detected in two maize samples (one white and one yellow) analysed during the current season. The AFLA B₁ concentration in the white maize sample was 41 µg/kg and the AFLA B₁ concentration in the yellow maize sample was 19 µg/kg. Both these values exceed the maximum allowable level for certain farm feeds and human consumption. Six maize samples have tested positive for total Aflatoxin over the past fourteen years. This includes three samples from the 2014/15 season in white maize, with total AFLA concentrations ranging from 6 to 48 µg/kg one sample from the 2019/20 season in yellow maize, with a concentration of 10 µg/kg; and two samples from the current season (one white and one yellow), with concentrations of 41 µg/kg and 45 µg/kg, respectively.

The mean concentration of total FUM in white maize was 436 µg/kg, which is higher than the previous season (101 µg/kg). For yellow maize, the mean total FUM concentration was 170 µg/kg, the lowest concentration reported for the previous thirteen seasons. The mean DON concentration in the white maize samples of 342 µg/kg was lower than the last two seasons, and the mean DON concentration in the yellow maize of 141 µg/kg is lower than the last seven seasons. None of the samples contained FUM or DON higher than the South African regulated maximum allowable level for farm feed or human consumption during the current season.

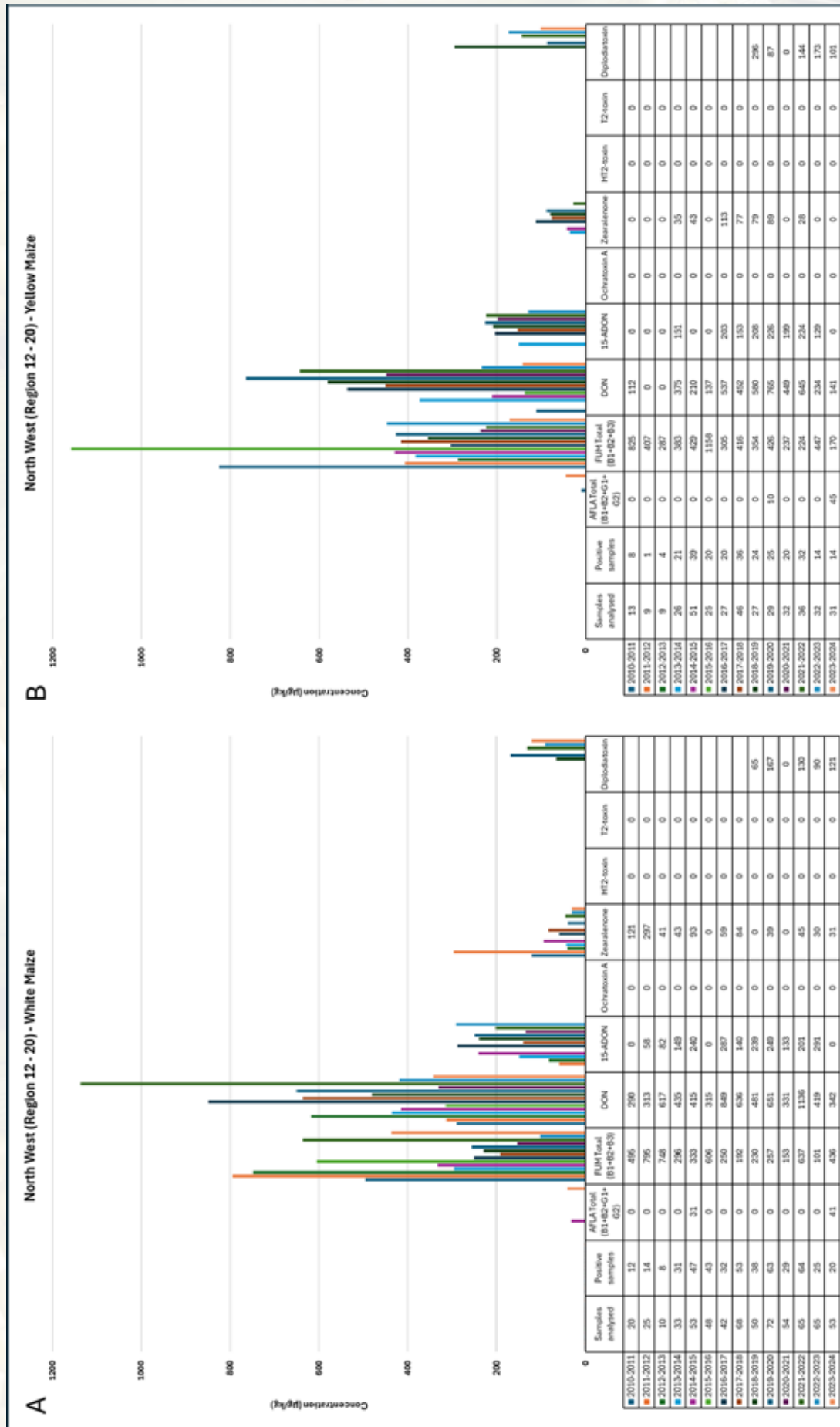
The ZON level of 31 µg/kg was similar to the last season (30 µg/kg) for white maize and was not detected in yellow maize. Diplodiatoxin concentrations appear to be constant over the past three seasons, ranging from 90 to 130 µg/kg for white maize and 101 to 173 µg/kg for yellow maize.

Table 34. The maximum mycotoxin concentrations (µg/kg) in white maize samples analysed for the North West (Region 12 - 20)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ + G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15- ADON	Ochratoxin A	Zearale none	HT2- toxin	T2- toxin	Diplodia -toxin
2010-2011	20	-	1341	883	-	-	187	-	-	-
2011-2012	25	-	2235	485	85	-	297	-	-	-
2012-2013	10	-	1592	617	82	-	41	-	-	-
2013-2014	33	-	758	1837	248	-	64	-	-	-
2014-2015	53	48	1439	1391	290	-	93	-	-	-
2015-2016	48	-	6865	598	-	-	-	-	-	-
2016-2017	42	-	1441	7698	964	-	65	-	-	-
2017-2018	68	-	771	3016	261	-	84	-	-	-
2018-2019	50	-	781	2410	467	-	-	-	-	68
2019-2020	72	-	638	7516	829	-	54	-	-	663
2020-2021	54	-	351	810	151	-	-	-	-	-
2021-2022	65	-	1333	3678	491	-	132	-	-	491
2022-2023	65	-	229	2061	379	-	30	-	-	91
2023-2024	53	41	1538	604	-	-	36	-	-	299

Table 35. The maximum mycotoxin concentrations (µg/kg) in yellow maize samples analysed for the North West (Region 12 - 20)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ + G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15- ADON	Ochratoxin A	Zearale none	HT2- toxin	T2- toxin	Diplodia -toxin
2010-2011	13	-	1401	119	-	-	-	-	-	-
2011-2012	9	-	407	-	-	-	-	-	-	-
2012-2013	9	-	541	-	-	-	-	-	-	-
2013-2014	26	-	1003	1353	270	-	44	-	-	-
2014-2015	51	-	2200	328	-	-	60	-	-	-
2015-2016	25	-	11347	159	-	-	-	-	-	-
2016-2017	27	-	1244	1488	381	-	113	-	-	-
2017-2018	46	-	2109	1696	244	-	86	-	-	-
2018-2019	27	-	1393	2501	593	-	127	-	-	555
2019-2020	29	10	1901	5060	768	-	243	-	-	112
2020-2021	32	-	691	2169	237	-	-	-	-	-
2021-2022	36	-	549	2955	787	-	42	-	-	711
2022-2023	32	-	1073	730	129	-	-	-	-	226
2023-2024	31	45	397	207	-	-	-	-	-	124



Graph 57. The mean mycotoxin concentrations in white maize (A) and yellow maize (B) from the Northern West regions over fourteen seasons from 2010 to 2024

Free State (Region 21 - 28)

The mean mycotoxin concentrations in white and yellow maize from the Free State regions over fourteen seasons from 2010 to 2024 are shown in Graph 58, and the maximum mycotoxin concentrations (µg/kg) in white and yellow maize samples in Tables 36 and 37, respectively.

Over the past fourteen seasons, 609 white maize and 461 yellow maize samples were analysed for mycotoxins. No Aflatoxins were reported for this season. However, during the 2018/19 season, one sample contained a total Aflatoxin concentration of 143 µg/kg, with AFLA B₁ reported at 48 µg/kg and AFLA G₁ at 95 µg/kg.

The mean total FUM concentrations for both the white maize (133 µg/kg) and yellow maize (113 µg/kg) were lower than the past season. There appears to be a consistent decreasing trend in the mean total FUM concentrations for white and yellow maize.

The mean DON concentrations were 331 µg/kg for white maize and 192 µg/kg for yellow maize. These levels were similar to the previous season. None of the samples contained FUM or DON higher than the South African regulated maximum allowable level for farm feed or human consumption during the current season.

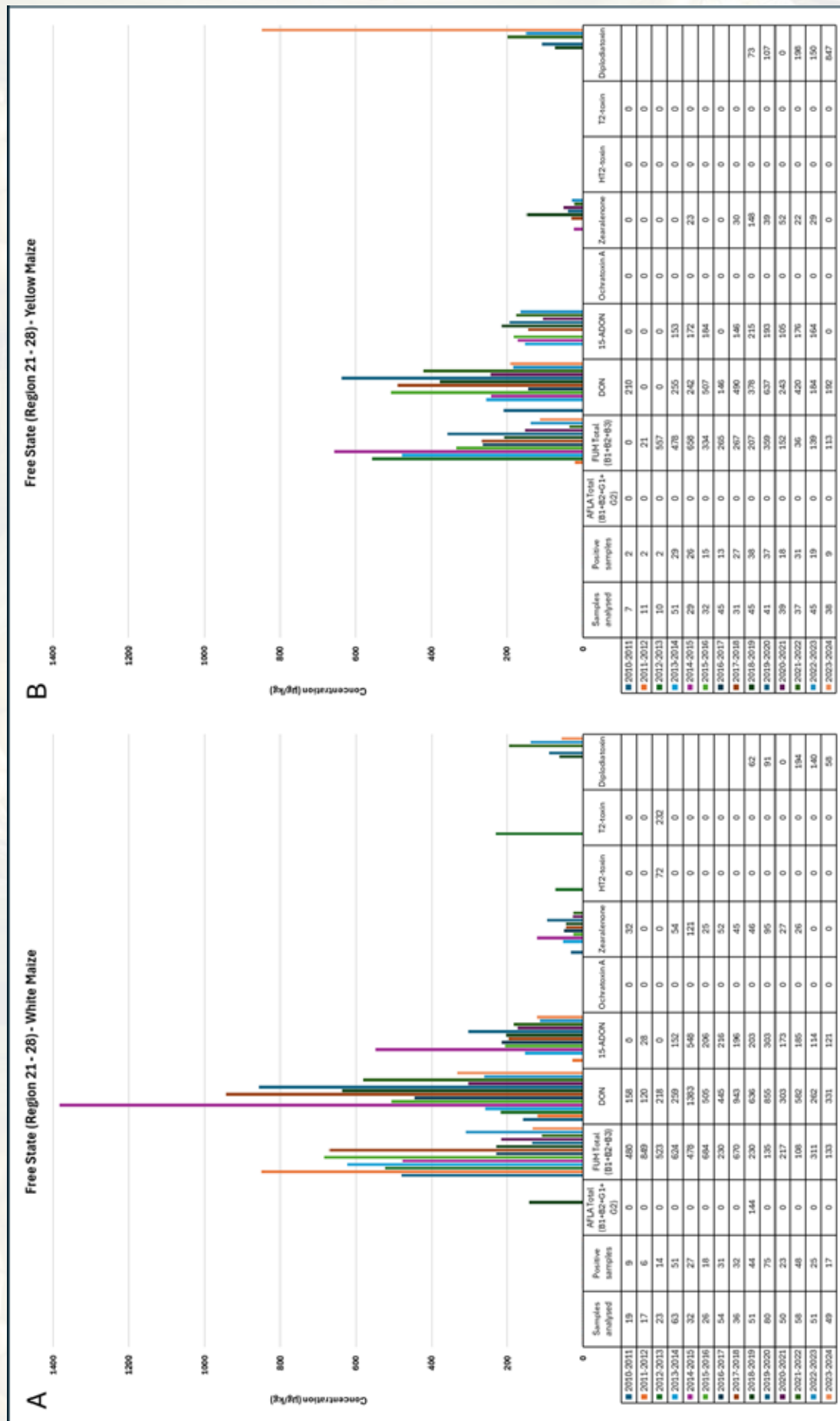
No ZON was detected in any of the white or yellow maize, in this season. The mean diplodiatoxin concentrations in the white maize of 85 µg/kg was lower than the past two seasons. For yellow maize the mean diplodiatoxin concentration was 847 µg/kg, which is higher than the levels previously reported, with a maximum concentration of 2 389 µg/kg.

Table 36. The maximum mycotoxin concentrations (µg/kg) in white maize samples analysed for the Free State (Region 21 - 28)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	19	-	1126	201	-	-	41	-	-	-
2011-2012	17	-	4419	120	28	-	-	-	-	-
2012-2013	23	-	1600	241	-	-	-	72	232	-
2013-2014	63	-	2927	791	269	-	82	-	-	-
2014-2015	32	-	1727	9736	1768	-	337	-	-	-
2015-2016	26	-	3430	1585	310	-	26	-	-	-
2016-2017	54	-	836	1868	365	-	73	-	-	-
2017-2018	36	-	7328	2378	391	-	91	-	-	-
2018-2019	51	143	1303	3604	593	-	60	-	-	98
2019-2020	80	-	491	7700	1173	-	539	-	-	188
2020-2021	50	-	239	1159	315	-	27	-	-	-
2021-2022	58	-	285	2545	301	-	35	-	-	595
2022-2023	51	-	557	653	114	-	-	-	-	396
2023-2024	49	-	232	855	121	-	-	-	-	65

Table 37. The maximum mycotoxin concentrations (µg/kg) in yellow maize samples analysed for the Free State (Region 21 - 28)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	7	-	-	222	-	-	-	-	-	-
2011-2012	11	-	21	-	-	-	-	-	-	-
2012-2013	10	-	943	-	-	-	-	-	-	-
2013-2014	51	-	1720	868	196	-	-	-	-	-
2014-2015	29	-	3382	528	238	-	23	-	-	-
2015-2016	32	-	1109	640	184	-	-	-	-	-
2016-2017	45	-	847	148	-	-	-	-	-	-
2017-2018	31	-	685	1606	217	-	30	-	-	-
2018-2019	45	-	872	1454	294	-	148	-	-	246
2019-2020	41	-	1420	2150	278	-	39	-	-	242
2020-2021	39	-	228	531	105	-	52	-	-	-
2021-2022	37	-	40	3330	211	-	22	-	-	806
2022-2023	45	-	252	562	164	-	29	-	-	281
2023-2024	38	-	147	308	-	-	-	-	-	2389



Graph 58. The mean mycotoxin concentrations in white maize (A) and yellow maize (B) from the Free State regions over fourteen seasons from 2010 to 2024

Mpumalanga (Region 29 - 33)

The mean mycotoxin concentrations in white and yellow maize from the Mpumalanga regions over fourteen seasons from 2010 to 2024 are shown in Graph 59. The maximum mycotoxin concentrations (µg/kg) in white and yellow maize samples in Tables 38 and 39, respectively.

Over the past fourteen seasons, 542 white maize and 711 yellow maize samples were analysed for mycotoxins. The mean total FUM concentration for white maize (184 µg/kg) was slightly higher than the previous season (89 µg/kg) but still lower than the last ten seasons. The mean total FUM concentration for yellow maize was 235 µg/kg, which was also lower than the last ten seasons.

The mean DON concentrations were 337 µg/kg for white maize and 243 µg/kg for yellow maize. These levels were lower than the last seven seasons. None of the samples contained FUM or DON higher than the South African regulated maximum allowable level for farm feed or human consumption during the current season.

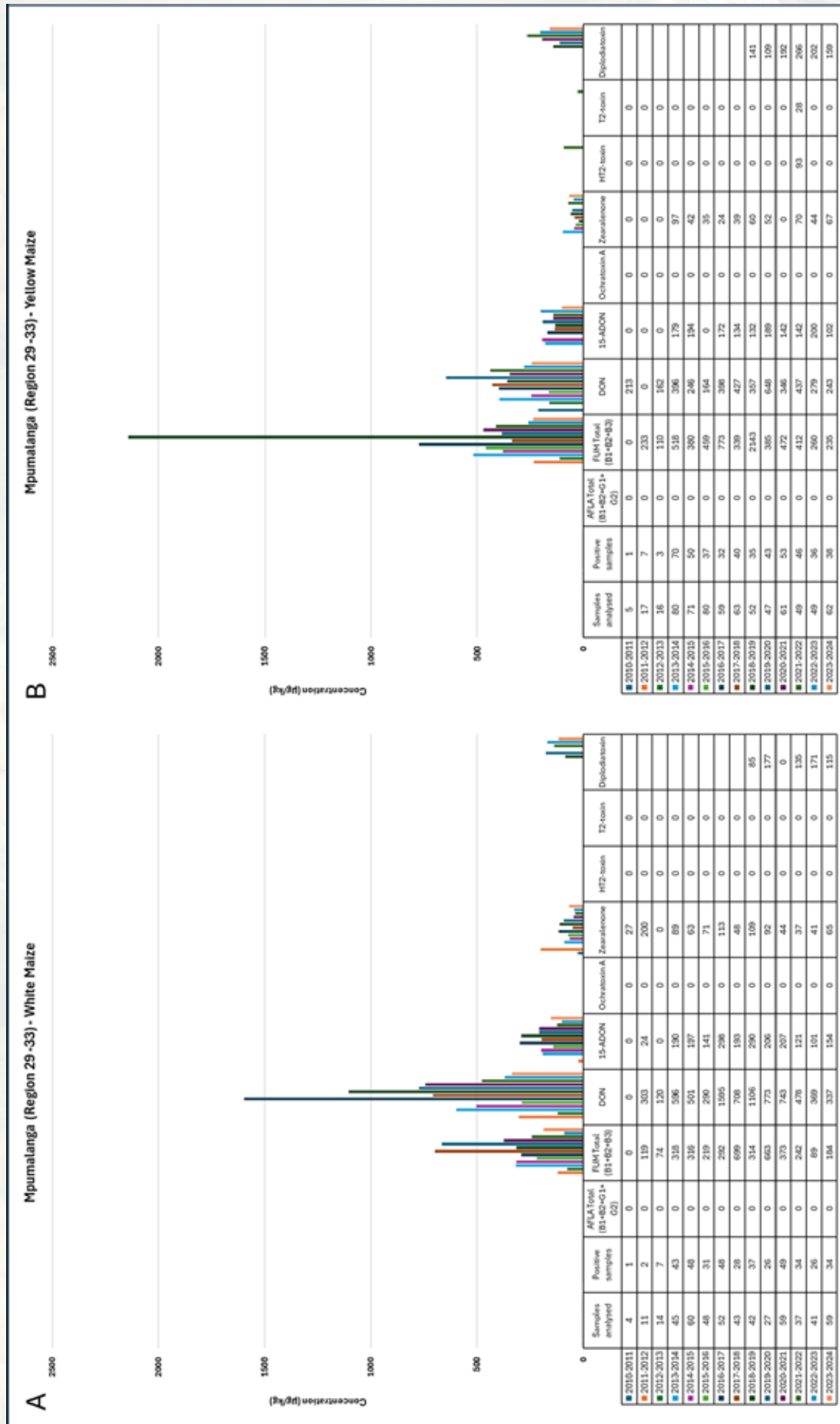
The mean ZON concentrations were 65 µg/kg for white maize and 67 µg/kg for yellow maize, higher than the previous season. The mean diplodiatxin concentrations were lower than the previous season for both white maize (115 µg/kg) and yellow maize (159 µg/kg).

Table 38. The maximum mycotoxin concentrations (µg/kg) in white maize samples analysed for Mpumalanga (Region 29 - 33)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	4	-	-	-	-	-	27	-	-	-
2011-2012	11	-	119	303	24	-	200	-	-	-
2012-2013	14	-	143	139	-	-	-	-	-	-
2013-2014	45	-	1195	2730	305	-	445	-	-	-
2014-2015	60	-	1320	3260	764	-	212	-	-	-
2015-2016	48	-	785	801	184	-	127	-	-	-
2016-2017	52	-	2135	7671	802	-	399	-	-	-
2017-2018	43	-	3316	2812	394	-	97	-	-	-
2018-2019	42	-	1503	11181	737	-	271	-	-	319
2019-2020	27	-	3911	5225	612	-	270	-	-	504
2020-2021	59	-	2356	3256	571	-	101	-	-	-
2021-2022	37	-	603	1794	141	-	49	-	-	317
2022-2023	41	-	293	1366	101	-	43	-	-	560
2023-2024	59	-	607	908	154	-	107	-	-	304

Table 39. The maximum mycotoxin concentrations (µg/kg) in yellow maize samples analysed for Mpumalanga (Region 29 - 33)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	5	-	-	213	-	-	-	-	-	-
2011-2012	17	-	695	-	-	-	-	-	-	-
2012-2013	16	-	212	162	-	-	-	-	-	-
2013-2014	80	-	5357	2601	300	-	354	-	-	-
2014-2015	71	-	1236	851	228	-	71	-	-	-
2015-2016	80	-	1993	304	-	-	36	-	-	-
2016-2017	59	-	6059	1552	212	-	24	-	-	-
2017-2018	63	-	1540	2348	192	-	58	-	-	-
2018-2019	52	-	34740	777	193	-	75	-	-	1235
2019-2020	47	-	1084	1857	333	-	79	-	-	360
2020-2021	61	-	2648	1248	309	-	-	-	-	312
2021-2022	49	-	1603	2373	240	-	179	93	28	1347
2022-2023	49	-	1314	851	255	-	45	-	-	777
2023-2024	62	-	627	741	102	-	113	-	-	676



Graph 59. The mean mycotoxin concentrations in white maize (A) and yellow maize (B) from the Mpumalanga regions over fourteen seasons from 2010 to 2024

Gauteng (Region 34)

The mean mycotoxin concentrations in white and yellow maize from the Gauteng region over fourteen seasons from 2010 to 2024 are shown in Graph 60, and the maximum mycotoxin concentrations (µg/kg) in white and yellow maize samples in Tables 40 and 41 respectively.

Over the past fourteen seasons, 134 white maize and 130 yellow maize samples were analysed for mycotoxins. In the current season, only FUM and DON were reported for white maize. The mean concentration for total FUM was 52 µg/kg; FUM was not detected in white maize samples during the previous two seasons. The mean DON concentration was 155 µg/kg, which is lower than the concentrations reported for the last eleven seasons.

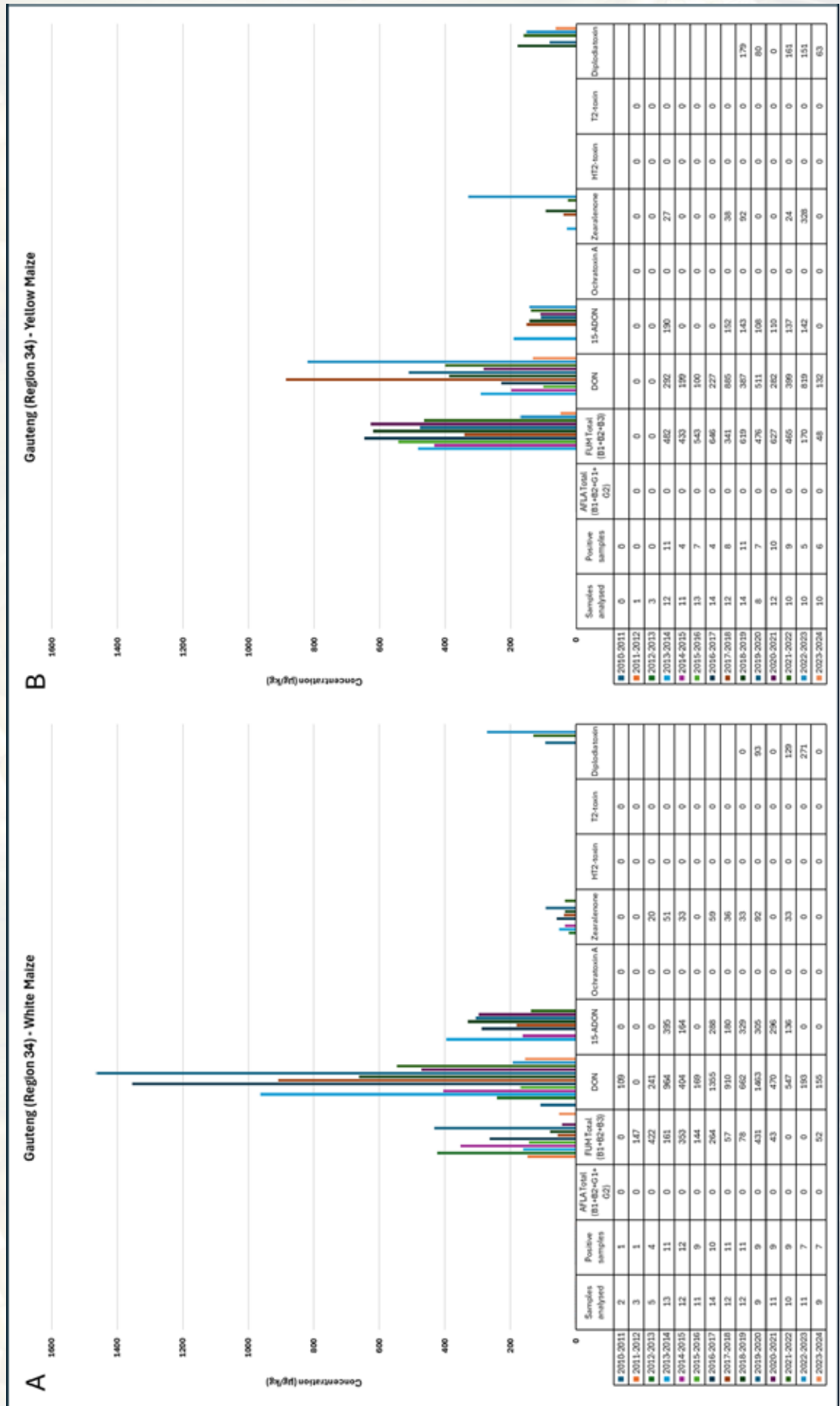
For yellow maize, FUM, DON, and diplodiatxin levels were reported. The mean total FUM concentration of 48 µg/kg was lower than the previous ten seasons. The mean DON concentration was 132 µg/kg, which was lower than the last seven seasons. The mean diplodiatxin concentration was 63 µg/kg, which was lower than the last three seasons.

Table 40. The maximum mycotoxin concentrations (µg/kg) in white maize samples analysed for Gauteng (Region 34)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	2	-	-	109	-	-	-	-	-	-
2011-2012	3	-	147	-	-	-	-	-	-	-
2012-2013	5	-	1161	241	-	-	20	-	-	-
2013-2014	13	-	418	6134	861	-	56	-	-	-
2014-2015	12	-	1809	1135	215	-	35	-	-	-
2015-2016	11	-	339	257	-	-	-	-	-	-
2016-2017	14	-	708	3157	364	-	117	-	-	-
2017-2018	12	-	86	2432	310	-	49	-	-	-
2018-2019	12	-	152	3394	554	-	33	-	-	-
2019-2020	9	-	1314	3975	501	-	124	-	-	101
2020-2021	11	-	50	1599	403	-	-	-	-	-
2021-2022	10	-	-	1044	168	-	44	-	-	129
2022-2023	11	-	-	413	-	-	-	-	-	477
2023-2024	9	-	52	243	-	-	-	-	-	-

Table 41. The maximum mycotoxin concentrations (µg/kg) in yellow maize samples analysed for Gauteng (Region 34)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	0	-	-	-	-	-	-	-	-	-
2011-2012	1	-	-	-	-	-	-	-	-	-
2012-2013	3	-	-	-	-	-	-	-	-	-
2013-2014	12	-	1429	825	246	-	27	-	-	-
2014-2015	11	-	652	287	-	-	-	-	-	-
2015-2016	13	-	1431	100	-	-	-	-	-	-
2016-2017	14	-	1307	321	-	-	-	-	-	-
2017-2018	12	-	751	1828	163	-	38	-	-	-
2018-2019	14	-	2962	804	154	-	180	-	-	711
2019-2020	8	-	1231	905	109	-	-	-	-	96
2020-2021	12	-	782	508	115	-	-	-	-	-
2021-2022	10	-	812	969	137	-	24	-	-	393
2022-2023	10	-	298	2205	207	-	328	-	-	151
2023-2024	10	-	54	134	-	-	-	-	-	65



Graph 60. The mean mycotoxin concentrations in white maize (A) and yellow maize (B) from the Gauteng region over fourteen seasons from 2010 to 2024

Limpopo (Region 35)

The mean mycotoxin concentrations in white and yellow maize from the Limpopo region over fourteen seasons from 2010 to 2024 are shown in Graph 61. The maximum mycotoxin concentrations (µg/kg) in white and yellow maize samples in Tables 42 and 43 respectively.

In total, 58 white maize and 46 yellow maize samples were analysed for mycotoxins over the past fourteen seasons.

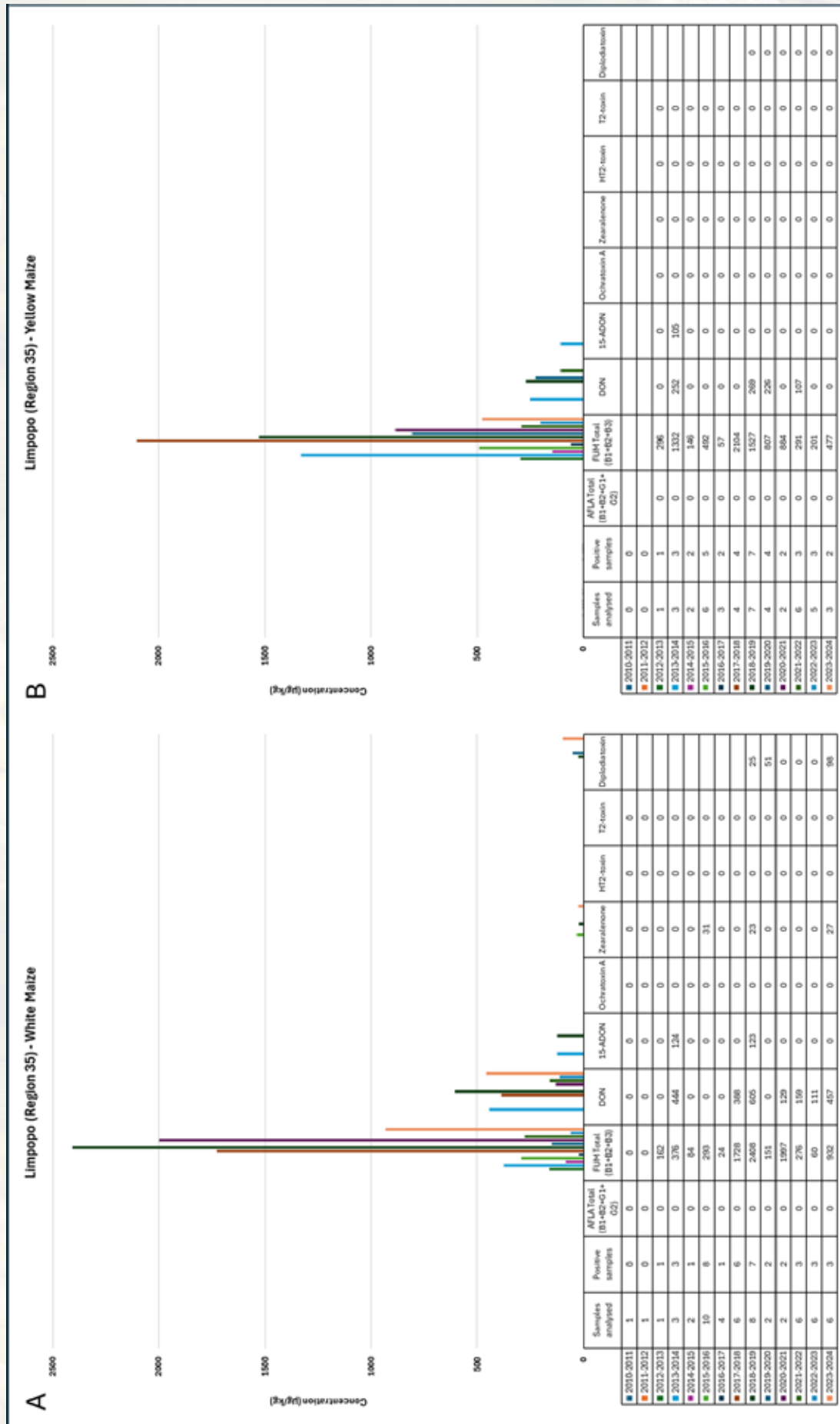
In the current season, FUM, DON, ZON, and diplodiatoxin were reported for white maize, while only FUM was detected in yellow maize. The mean concentrations for the total FUM were 932 µg/kg for white maize and 477 µg/kg for yellow maize. These concentrations are higher than the last two seasons. The mean DON concentration in the white maize samples was 457 µg/kg, which is higher than the levels reported for the last four seasons. This season was only the third time that ZON was reported in the last fourteen seasons, at a mean concentration of 27 µg/kg. The mean diplodiatoxin concentration was 98 µg/kg, higher than the past five seasons.

Table 42. The maximum mycotoxin concentrations (µg/kg) in white maize samples analysed for Limpopo (Region 35)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	1	-	-	-	-	-	-	-	-	-
2011-2012	1	-	-	-	-	-	-	-	-	-
2012-2013	1	-	162	-	-	-	-	-	-	-
2013-2014	3	-	394	444	124	-	-	-	-	-
2014-2015	2	-	84	-	-	-	-	-	-	-
2015-2016	10	-	854	-	-	-	31	-	-	-
2016-2017	4	-	24	-	-	-	-	-	-	-
2017-2018	6	-	4505	701	-	-	-	-	-	-
2018-2019	8	-	7341	1047	123	-	23	-	-	25
2019-2020	2	-	253	-	-	-	-	-	-	51
2020-2021	2	-	3952	129	-	-	-	-	-	-
2021-2022	6	-	504	159	-	-	-	-	-	-
2022-2023	6	-	86	111	-	-	-	-	-	-
2023-2024	6	-	1805	457	-	-	27	-	-	98

Table 43. The maximum mycotoxin concentrations (µg/kg) in yellow maize samples analysed for Limpopo (Region 35)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	0	-	-	-	-	-	-	-	-	-
2011-2012	0	-	-	-	-	-	-	-	-	-
2012-2013	1	-	296	-	-	-	-	-	-	-
2013-2014	3	-	2482	350	105	-	-	-	-	-
2014-2015	2	-	210	-	-	-	-	-	-	-
2015-2016	6	-	1086	-	-	-	-	-	-	-
2016-2017	3	-	75	-	-	-	-	-	-	-
2017-2018	4	-	6082	-	-	-	-	-	-	-
2018-2019	7	-	4393	369	-	-	-	-	-	-
2019-2020	4	-	2702	226	-	-	-	-	-	-
2020-2021	2	-	1708	-	-	-	-	-	-	-
2021-2022	6	-	550	107	-	-	-	-	-	-
2022-2023	5	-	316	-	-	-	-	-	-	-
2023-2024	3	-	818	-	-	-	-	-	-	-



Graph 61. The mean mycotoxin concentrations in white maize (A) and yellow maize (B) from the Limpopo region over fourteen seasons from 2010 to 2024

KwaZulu Natal (Region 36)

The mean mycotoxin concentrations in white and yellow maize from the KwaZulu Natal region over fourteen seasons from 2010 to 2024 are shown in Graph 62, and the maximum mycotoxin concentrations (µg/kg) in white and yellow maize samples in Tables 44 and 45 respectively.

Over the past fourteen seasons, 98 white maize and 116 yellow maize samples were analysed for mycotoxins. No FUM was detected in white maize samples during the current season and there has been a consistent decline in FUM levels over the past four seasons. The mean total FUM concentration for yellow maize was 133 µg/kg. While this level is higher than the 21 µg/kg reported in the previous season, it remains lower than the average concentration of the past eight seasons. The mean DON concentrations were 430 µg/kg in white maize and 186 µg/kg in yellow maize. These levels are lower than those reported for the last six seasons.

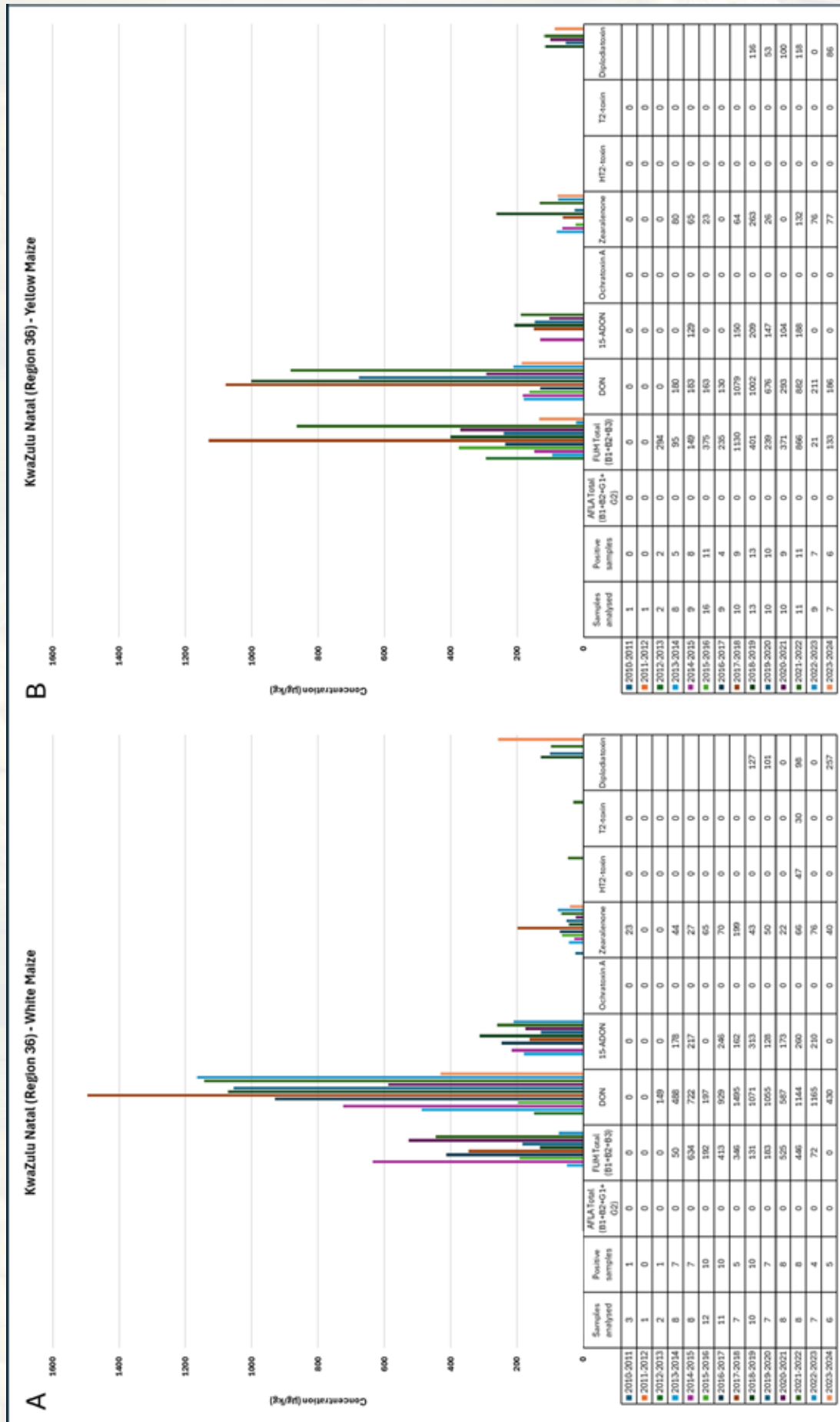
The mean ZON concentration in white maize was 40 µg/kg, a level lower than the past two seasons. For yellow maize the mean ZON concentration (77 µg/kg) was similar to the previous season. This season, the highest mean diplodiatxin concentration in white maize was reported at 257 µg/kg. For yellow maize, the mean diplodiatxin concentration was 86 µg/kg, which is higher than the previous season when no diplodiatxin was detected.

Table 44. The maximum mycotoxin concentrations (µg/kg) in white maize samples analysed for KwaZulu Natal (Region 36)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	3	-	-	-	-	-	23	-	-	-
2011-2012	1	-	-	-	-	-	-	-	-	-
2012-2013	2	-	-	149	-	-	-	-	-	-
2013-2014	8	-	78	1351	245	-	47	-	-	-
2014-2015	8	-	1575	1285	307	-	36	-	-	-
2015-2016	12	-	426	253	-	-	65	-	-	-
2016-2017	11	-	783	3836	387	-	128	-	-	-
2017-2018	7	-	447	3510	210	-	361	-	-	-
2018-2019	10	-	400	4058	694	-	93	-	-	239
2019-2020	7	-	279	2105	152	-	78	-	-	145
2020-2021	8	-	852	1198	210	-	22	-	-	-
2021-2022	8	-	1113	3934	315	-	143	47	30	109
2022-2023	7	-	72	1848	210	-	107	-	-	-
2023-2024	6	-	-	675	-	-	49	-	-	402

Table 45. The maximum mycotoxin concentrations (µg/kg) in yellow maize samples analysed for KwaZulu Natal (Region 36)

Season	Samples analysed	AFLA Total (B ₁ +B ₂ +G ₁ +G ₂)	FUM Total (B ₁ +B ₂ +B ₃)	DON	15-ADON	Ochratoxin A	Zearale none	HT2-toxin	T2-toxin	Diplodia -toxin
2010-2011	1	-	-	-	-	-	-	-	-	-
2011-2012	1	-	-	-	-	-	-	-	-	-
2012-2013	2	-	361	-	-	-	-	-	-	-
2013-2014	8	-	163	236	-	-	127	-	-	-
2014-2015	9	-	331	372	129	-	124	-	-	-
2015-2016	16	-	863	234	-	-	23	-	-	-
2016-2017	9	-	453	130	-	-	-	-	-	-
2017-2018	10	-	2708	1956	174	-	121	-	-	-
2018-2019	13	-	1319	3256	331	-	957	-	-	493
2019-2020	10	-	661	1353	184	-	28	-	-	53
2020-2021	10	-	955	442	104	-	-	-	-	100
2021-2022	11	-	866	3128	420	-	257	-	-	233
2022-2023	9	-	21	358	-	-	111	-	-	-
2023-2024	7	-	217	332	-	-	77	-	-	110



Graph 62. The mean mycotoxin concentrations in white maize (A) and yellow maize (B) from the KwaZulu Natal region over fourteen seasons from 2010 to 2024