fake
hoax
fairy tale
false
fiction
legend
fantasy
fabrication
gossip
myth
story
urban legend
news
reality
data
true
logical
facts
authentic
data
valid
knowledge
real thing
information
science
objective
proof
truth

Myths of mycotoxins in the grain industry

All mycotoxins are the same

Mycotoxin risks are region specific

Occurrence patterns stay the same

Only necessary to test for aflatoxin B_1 to ensure food safety

Do we test in the grain industry?

Maize grade is an indication of mycotoxin content

Possible to predict presence/absence of mycotoxins by visual appearance

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FACTS

~~Myths~~ of mycotoxins in the grain industry

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Are all mycotoxins the same?

- ✓ Mycotoxins are produced by mould (fungi)
- ✓ The reasons why the fungus produced mycotoxins are not yet fully understood……
- ✓ The fungus that produced the mycotoxin may be killed and absent
- ✓ Mycotoxins are stable compounds, cannot be destroyed easily

- X Different moulds produce different mycotoxins
- X Certain fungi may contaminate the crop during the growing season and during storage, other fungi infect commodities only during storage
- X Toxicity of mycotoxins
  - Antibiotics such as penicillin - fights bacteria in our bodies
  - Potent carcinogens such as aflatoxin,
  - Stunting, diplodiosis,

Conclusion: Mycotoxins may represent a risk in the food and feed supply chain.

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Mycotoxins in the grain industry

Are all mycotoxins the same?

Mycotoxin	Occurrence in staple grains	In SA produced grains	Toxicity	SA Regulations
Aflatoxins: B_1, B_2, G_1, G_2	Maize, wheat, rice, peanuts, sorghum	Peanuts, maize	AFLA B_1 is the most potent carcinogen, liver diseases in animals, stunting,	√
Deoxynivalenol and 15-acetyl deoxynivalenol	Maize, wheat, oats, barley	Maize, wheat	Vomiting, immunosuppressant, kidney problems	√
Fumonisin B_1, B_2, B_3	Maize, rice, sorghum	Maize	Brain disease in horses, tumour promotors, cancer, liver diseases	√
Ochratoxin A	Wheat, barley	?	Kidney and liver toxin	X
T-2 Toxin and H-T2 toxin	Maize, wheat, oats, barley, rice	Maize?	Inhibit protein synthesis, affects actively dividing cells= weight loss, diarrhoea	X
Zearalenone	Maize, wheat, barley, sorghum	Maize	Abortion, estrogenism, small litter size	X

Summary of SA mycotoxin regulations

R70, Feb 2010 SA Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act 36 of 1947)

Mycotoxin	Product	MRL (µg/kg)
Aflatoxin B_1	Maize and products derived from processing thereof	20
Deoxynivalenol	Feeding stuffs on a full ration basis	1000 - 5000
Fumonisin B_1	Feeding stuffs on a full ration basis	5000 – 50 000

SA Amendments to Government Notice No R.1145 dated October 2004, Government Notice No. 987 of 5 September 2016 (Act 54 of 1972)

Mycotoxin	Product	MRL (µg/kg)
Aflatoxin B_1	All foodstuffs	5
Deoxynivalenol	Cereal grains intended for further processing	2000
Fumonisin B_1 & B_2	Raw maize grain intended for further processing	4000

Other important mycotoxins regulated worldwide:

- **Ochratoxin A,**
- **T-2 and HT-2 toxin**
- **Zearalenone**

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Maize and Wheat crop mycotoxin monitoring objectives

Do we test in the grain industry?

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- ✓ *Evaluation of the status of occurrence of mycotoxins in South African maize and wheat produced in all the production regions.*
- ✓ *Supply reliable data as basis for targeted research projects to effectively manage the mycotoxin levels in maize.*
- ✓ *Enable the industry to measure the mycotoxin levels at intake (open field and pre-storage), at the processing stage (storage, pre-processing) and in the final food and feed products.*

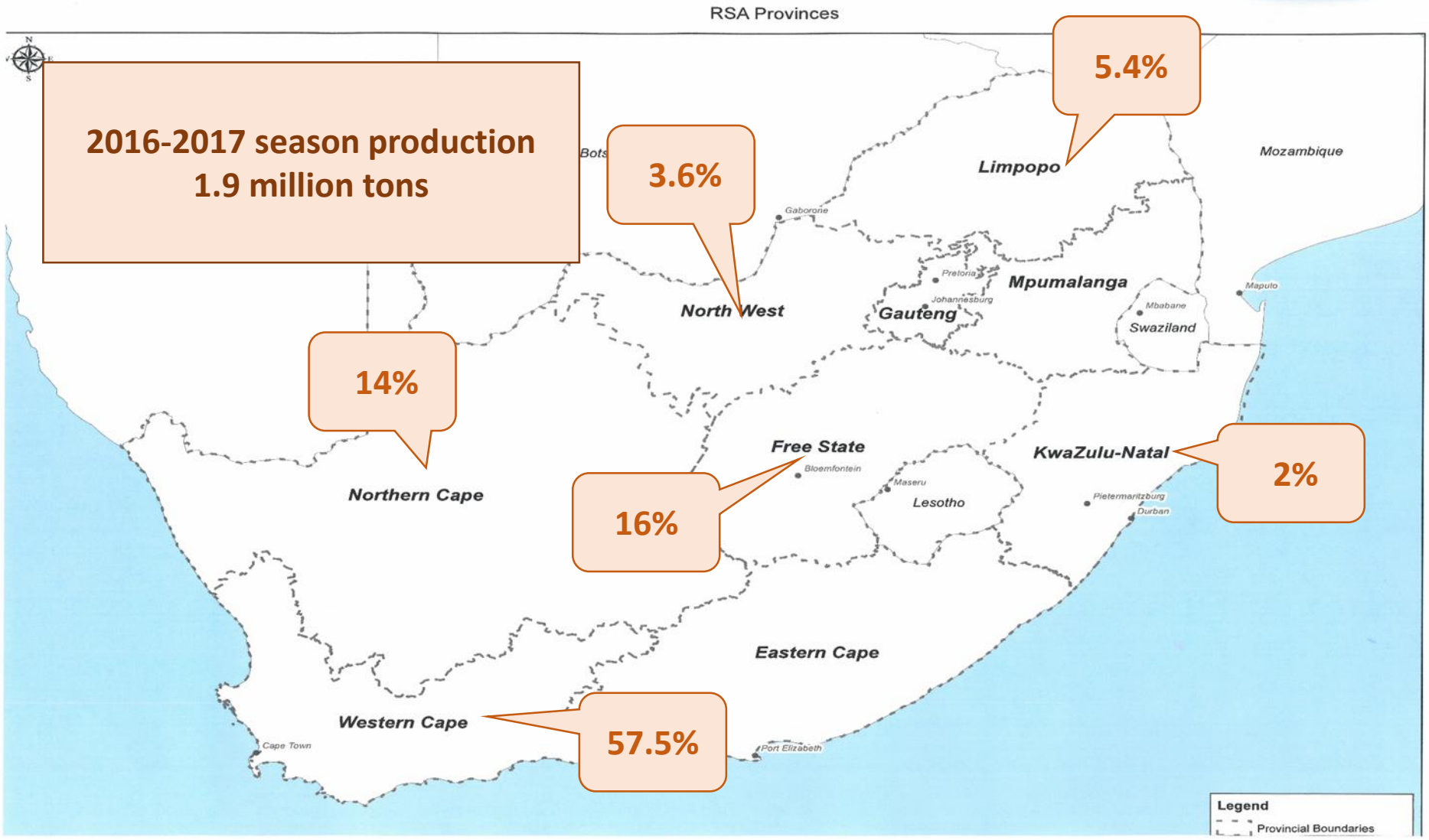
Occurrence patterns stays the same

Mycotoxin risks are region specific

Only necessary to test for aflatoxin B_1 to proof food safety

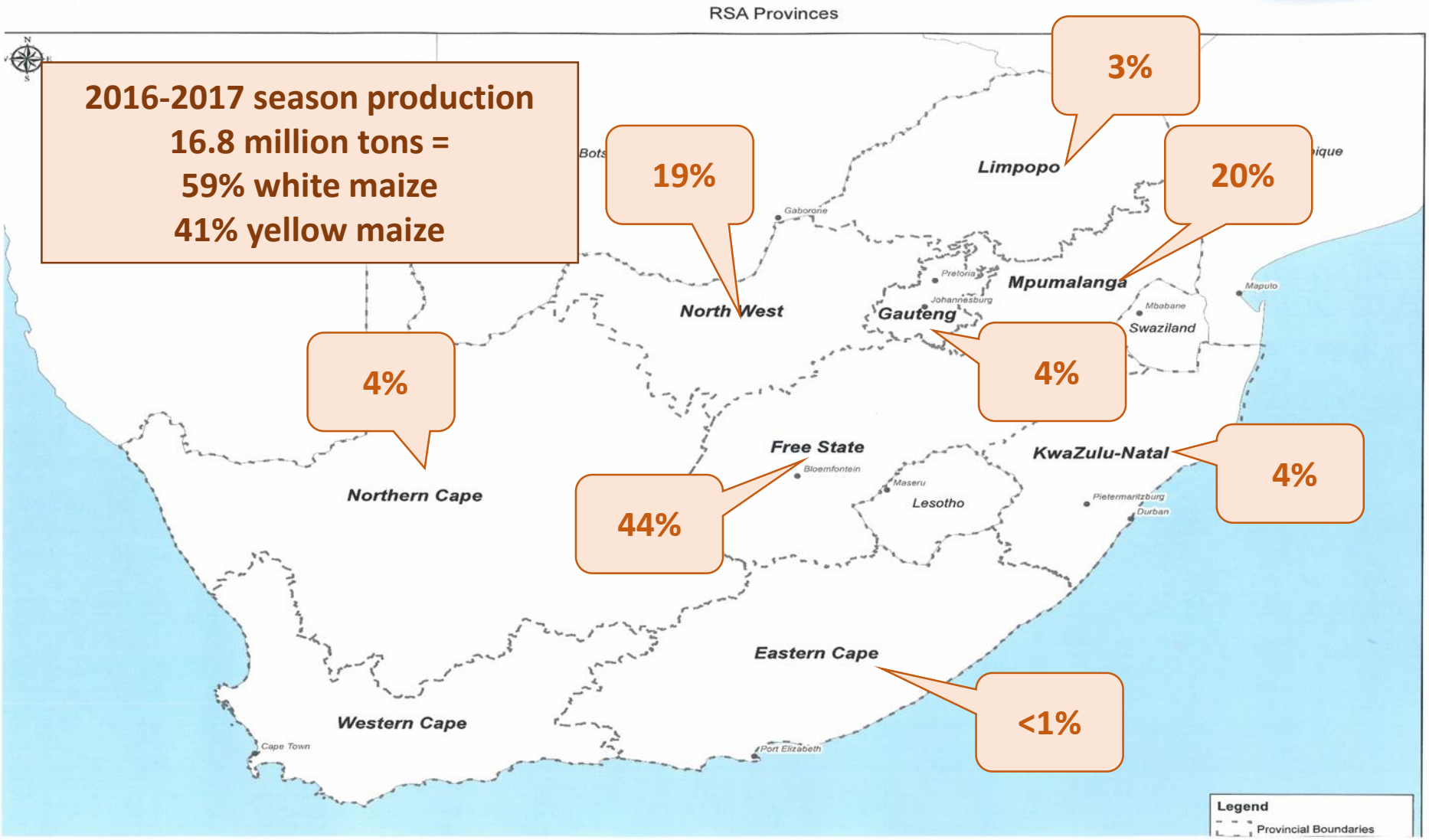
Wheat national crop quality surveys

Wheat Production Regions in South Africa
Annual average 1.8 million tons commercial wheat



Maize national crop quality surveys

Maize Production Regions in South Africa
Annually >10 million tons commercial maize



Samples: Mycotoxin monitoring (Post-harvest – pre-storage)

Surveys: approximately

1000 maize and

300 wheat samples/season

- Collected from commercial grain stores when delivered
- Each delivery is sampled as per the SA grading regulation
- Samples selected represent all the production regions proportionally
- Both white and yellow maize samples selected proportionally

350 maize and **40 wheat** samples selected/season for

multi-mycotoxin analyses

7 seasons from

2010/2011 – 2016/2017

- Milling process: Particle size of milled products <1 mm
- Milled samples mixed well enough to take a representative subsample for analysis (>60 min depending on milled sample size)

SAGL In-House multi-mycotoxin

LC-MS/MS accredited method

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Mycotoxin results: Wheat national crop quality survey

- ✓No aflatoxin B_1, B_2, G_1 & G_2
- ✓No Ochratoxin A
- ✓No T-2 toxin and HT-2 toxin found
- ✓No Zearalenone
- ✓No 15 ADON
- ✓No Fumonisin B_1, B_2 and B_3

❑ Mycotoxin found
  - Deoxynivalenol

Season	% samples with DON	DON average conc, µg/kg	DON max conc, µg/kg
2010 - 2011	0	-	-
2011 - 2012	5	ND	119
2012 - 2013	25	ND	380
2013 - 2014	2.5	ND	151
2014 - 2015	12.5	ND	361
2015 – 2016	10	ND	593
2016 - 2017	10	ND	501

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Mycotoxin results: Wheat national crop quality survey

SA Regulation for human consumption	Product	MRL (µg/kg)
Deoxynivalenol	Cereal grains intended for further processing	2000

Season	% samples with DON	DON average conc, µg/kg	DON max conc, µg/kg
2010 - 2011	0	-	-
2011 - 2012	5	ND	119
2012 - 2013	25	ND	380
2013 - 2014	2.5	ND	151
2014 - 2015	12.5	ND	361
2015 – 2016	10	ND	593
2016 - 2017	10	ND	501

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Mycotoxin results: Maize national crop quality survey

✓No aflatoxin B_1, B_2, G_1 & G_2 found in 7 seasons except 3 white maize samples found with Aflatoxin B_1 > 5 µg/kg in the 2014–2015 season

✓No Ochratoxin A and HT-2 toxin found

✓T-2 toxin only in 2 samples in 2012-2013 season

✓Mycotoxins found:

- Fumonisin B_1, B_2 and B_3
- Deoxynivalenol and 15-ADON
- Zearalenone

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Mycotoxin results: Maize national crop quality survey

Food and feed safety advantage for SA maize producers

✓No aflatoxin B_1, B_2, G_1 & G_2 found in 7 seasons except 3 white maize samples found with Aflatoxin B_1 > 5 µg/kg in the 2014–2015 season

✓No Ochratoxin A and HT-2 toxin found

✓T-2 toxin only in 2 samples in 2012-2013 season

✓Mycotoxins found:

- Fumonisin B_1, B_2 and B_3
- Deoxynivalenol and 15-ADON
- Zearalenone

Only necessary to test for aflatoxin B_1 to ensure food safety X

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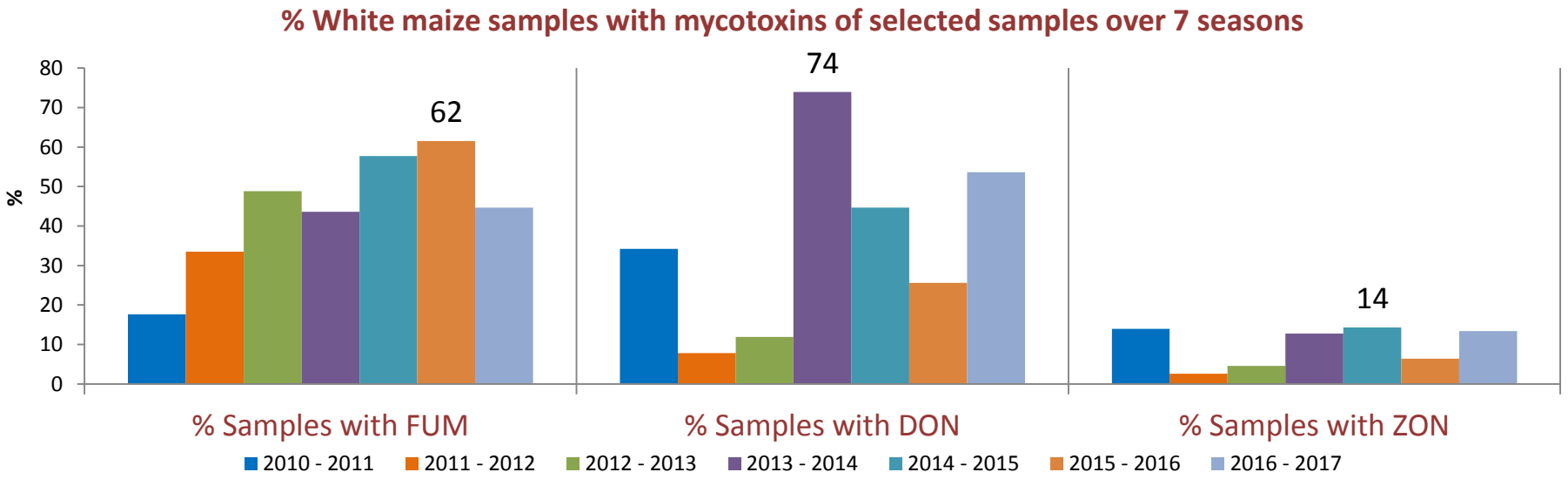
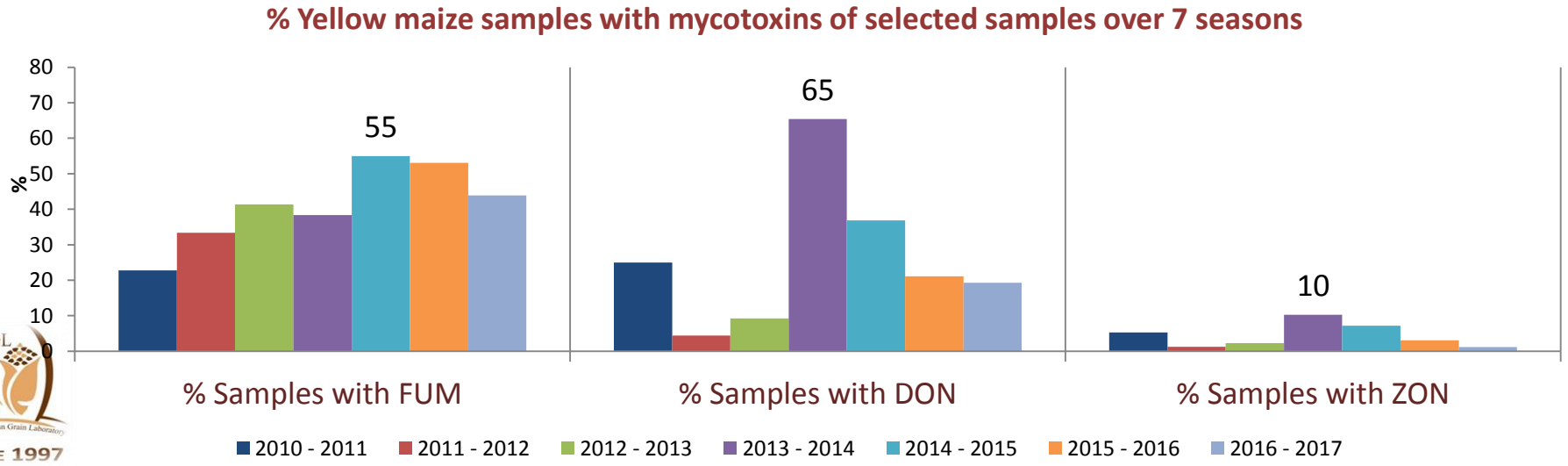
Mycotoxin results: Maize national crop quality survey

% Samples with mycotoxins over seven seasons (Post-harvest – pre-storage)





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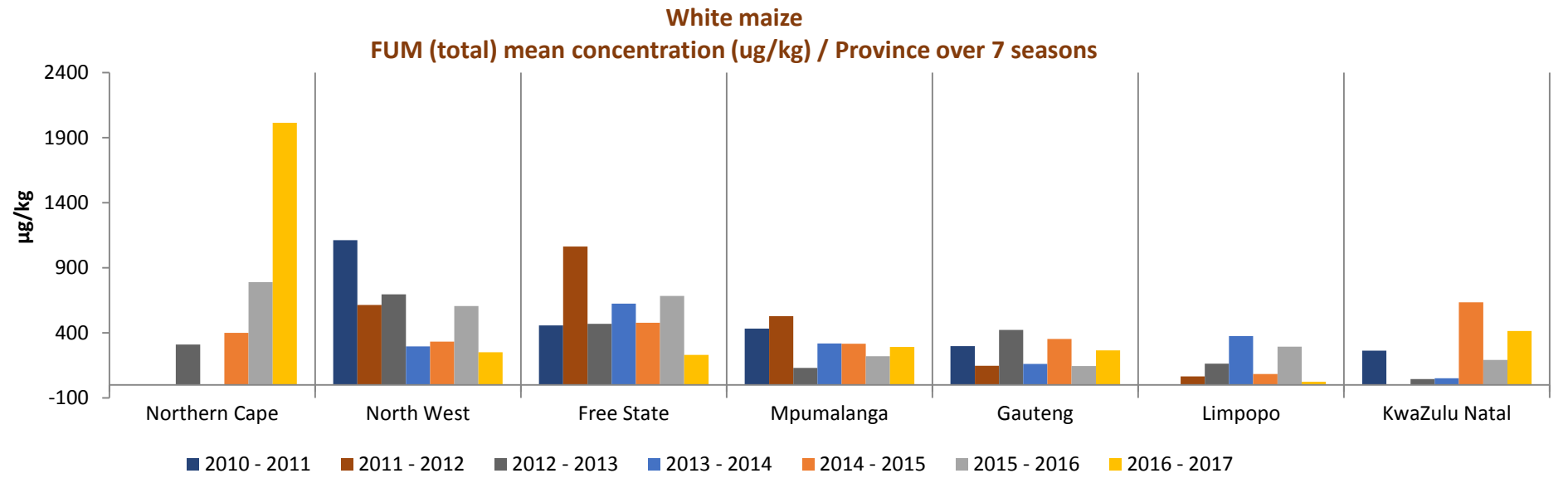
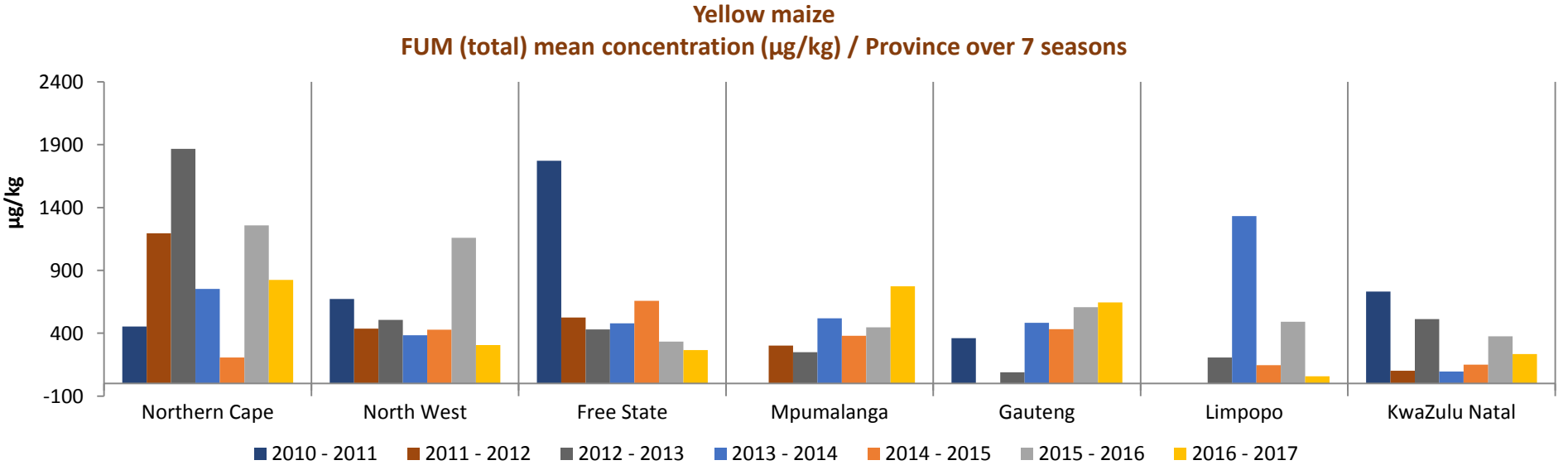
Project: Maize national crop quality survey

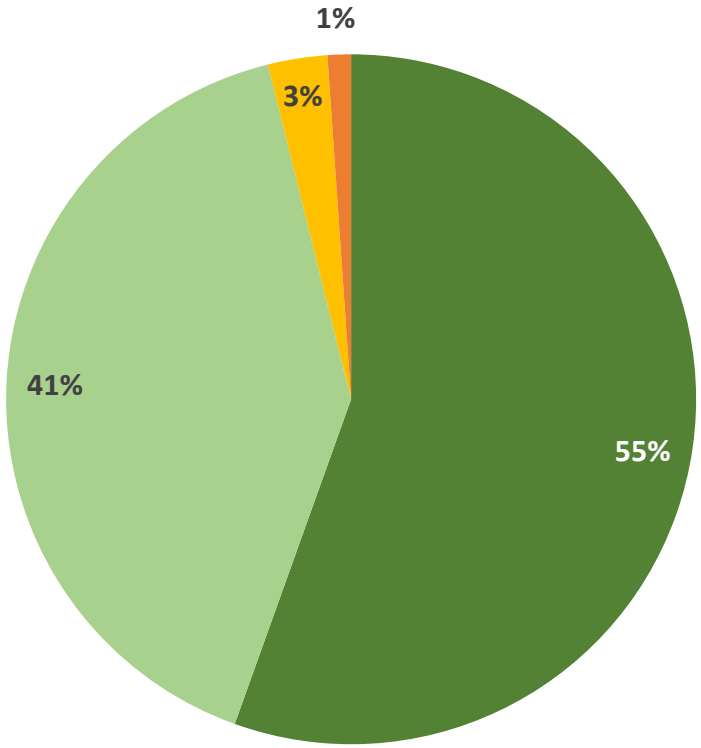




2016/2017 SA Maize crop: FUM occurrence

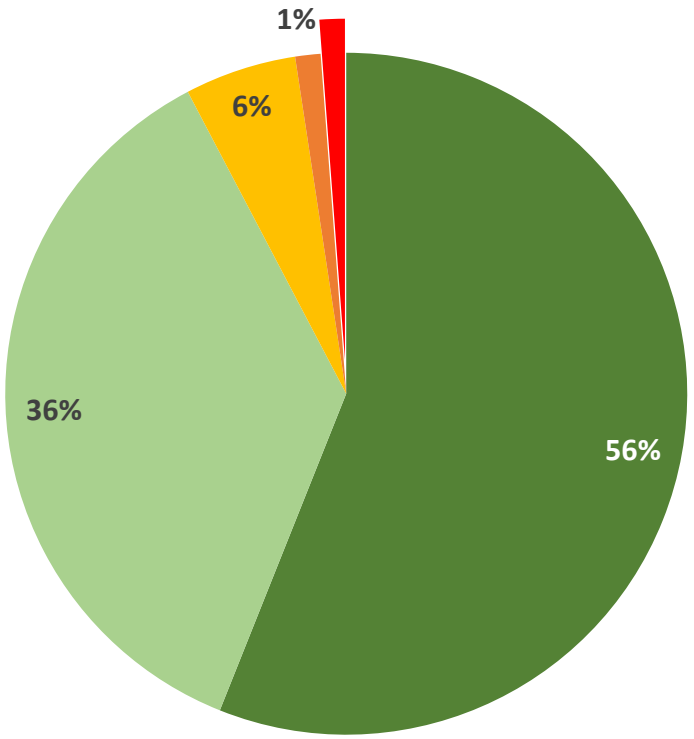
White maize crop - % samples with FUM

Max value 3913 µg/kg



Yellow maize crop - % samples with FUM

Max value 6059 µg/kg



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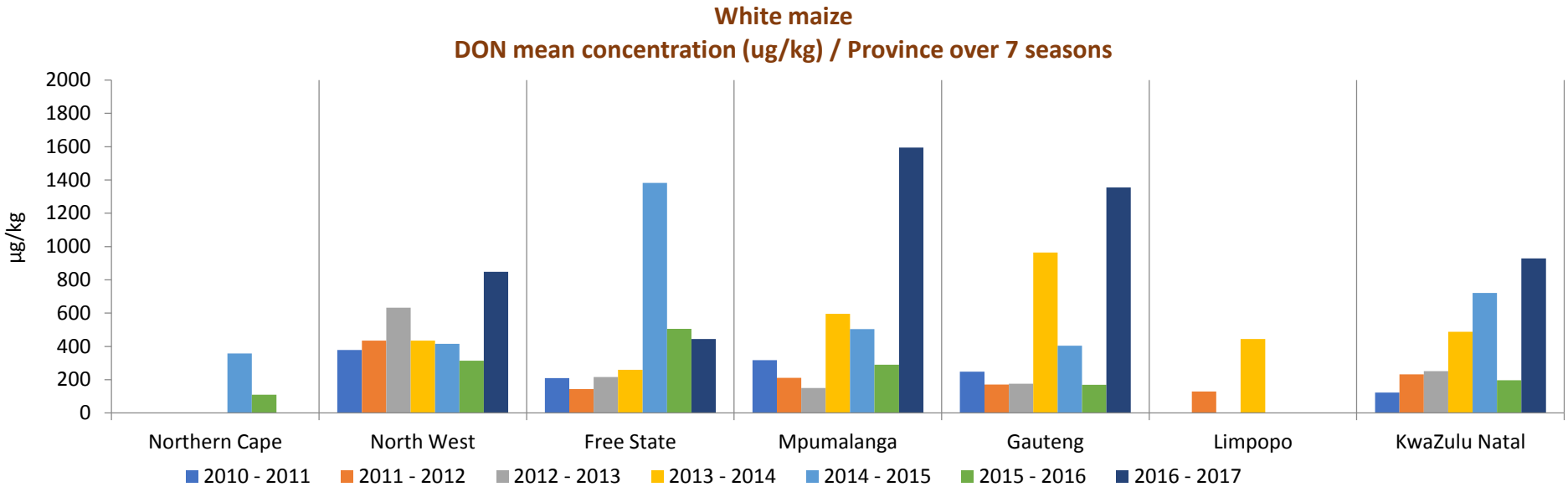
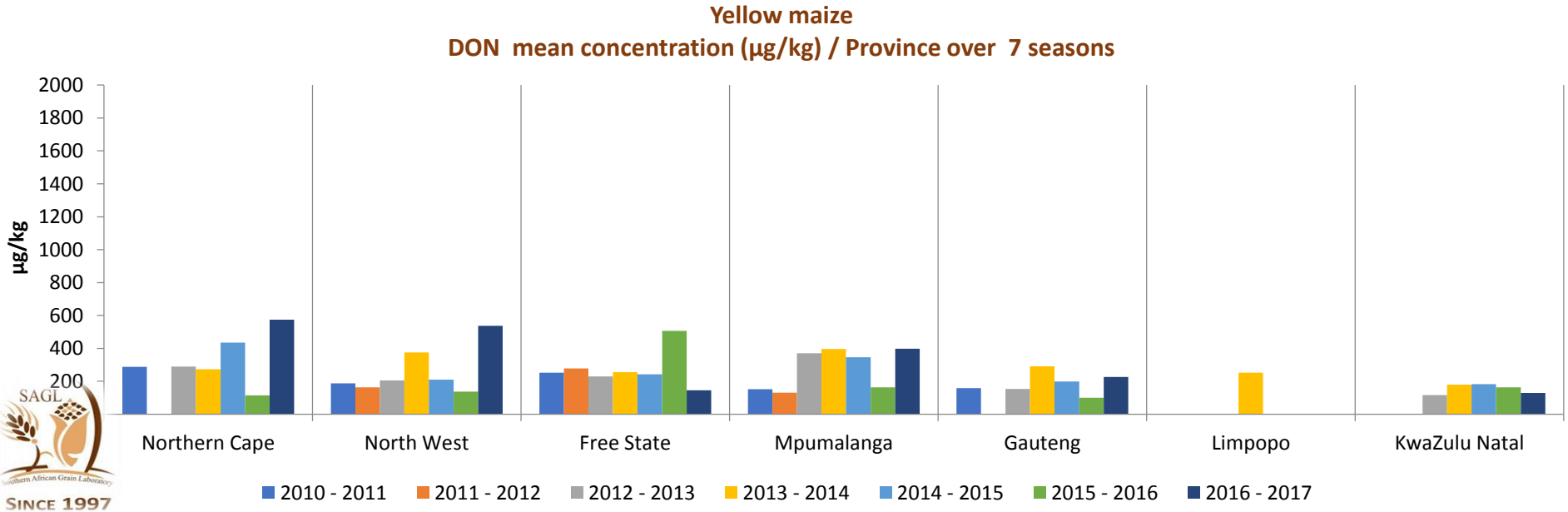
Project: Maize national crop quality survey





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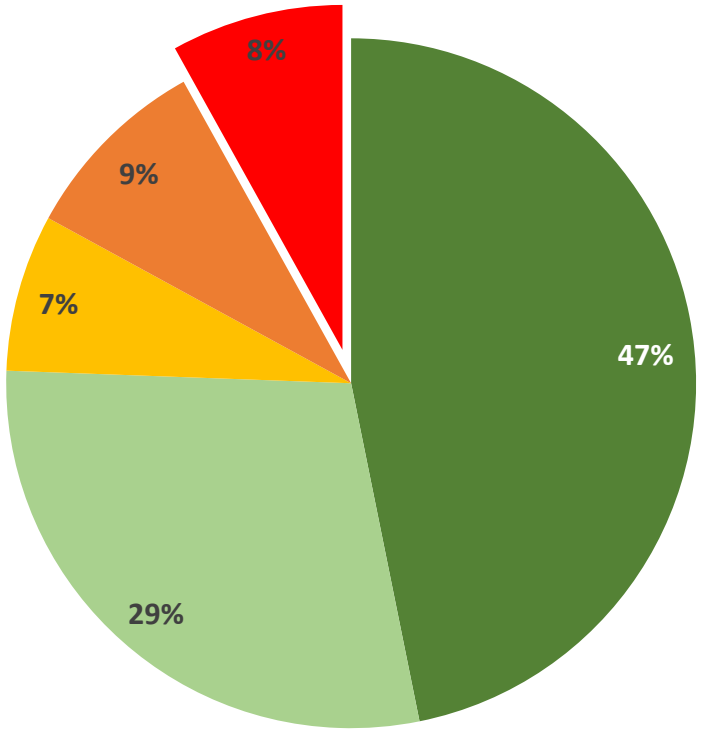
2016/2017 SA Maize crop: DON occurrence

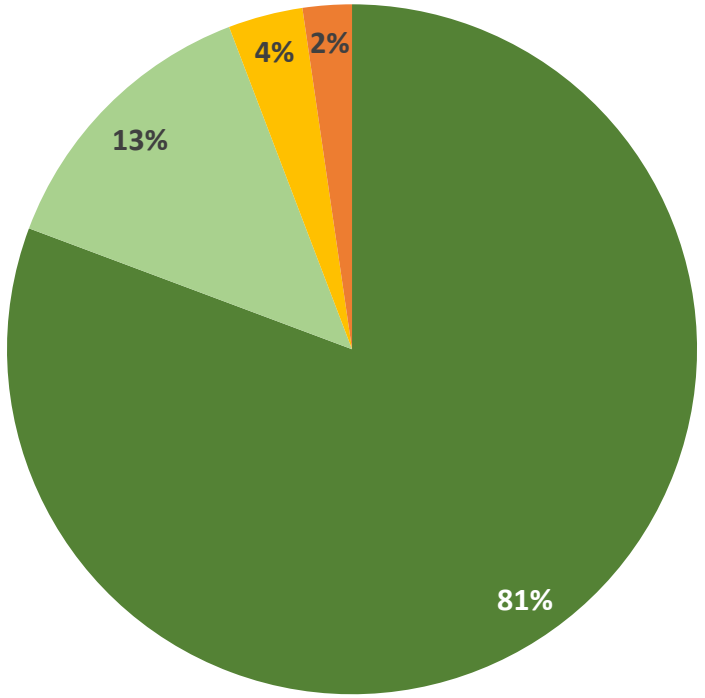
White maize crop - % samples with DON

Max value 7 698 µg/kg



Yellow maize crop - % samples with DON

Max value 1552 µg/kg



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FACTS ~~MYTHS~~

- The mycotoxin survey results give a representative SA perspective on the occurrence and concentration levels of mycotoxins in SA commercial produced wheat and maize.
- Different patterns of occurrence of mycotoxins exist depending on the season and production region for white and yellow maize.
- These differences highlight the importance of continuous monitoring.

Mycotoxin risks are NOT region specific

Occurrence patterns stay **NOT** the same

FACTS

Myths of mycotoxins in the grain industry

Possible to predict presence/absence of mycotoxins by visual appearance

Maize grade is an indication of mycotoxin content

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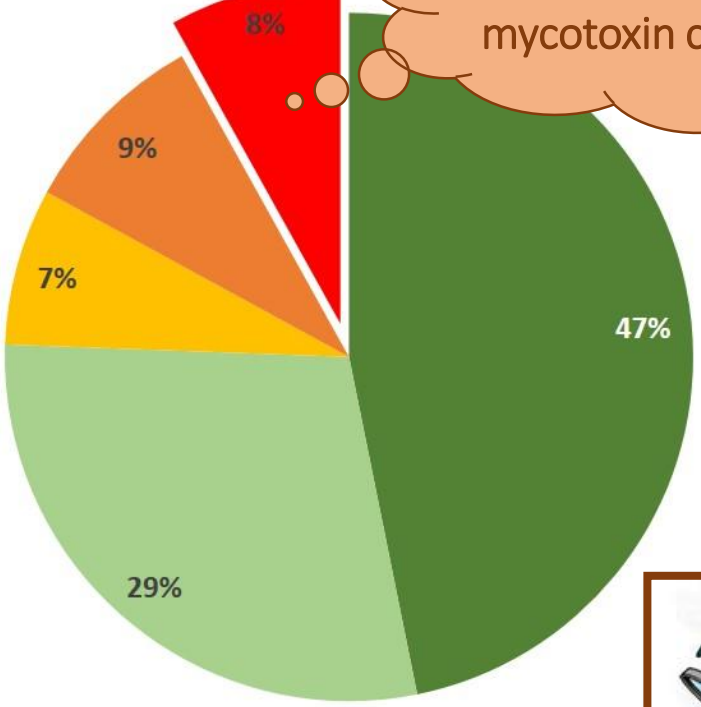
2016/2017 SA Maize crop: DON occurrence

White maize crop - % samples with DON

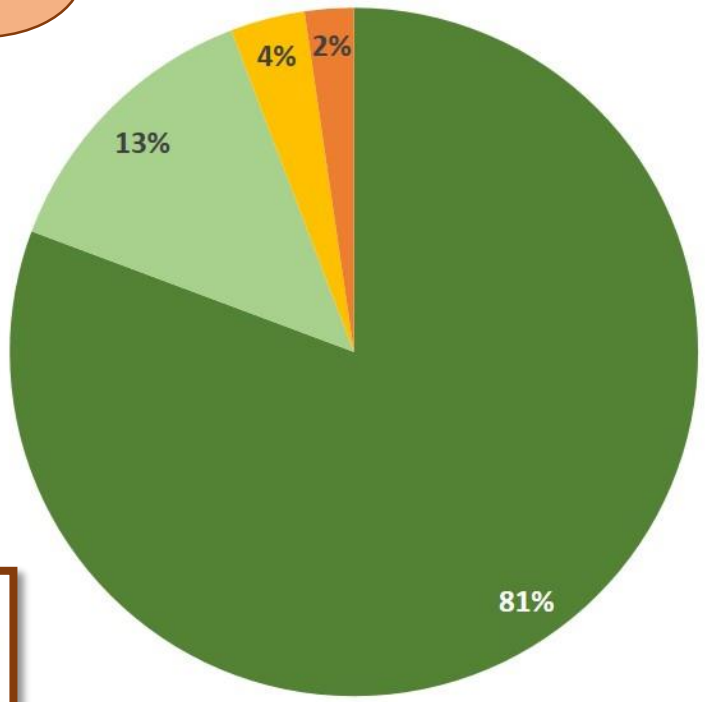
Max value 7 698 µg/kg



Is maize grade an indication of mycotoxin content?

Yellow maize crop - % samples with DON

Max value 1552 µg/kg



- No DON
- DON = 100 - <500 ug/kg
- DON = 500 - 1000 ug/kg
- DON >1000 - 2000 ug/kg
- DON > 2000 ug/kg

- No DON
- DON = 100 - <500 ug/kg
- DON = 500 - 1000 ug/kg
- DON >1000 - 2000 ug/kg
- DON > 2000 ug/kg

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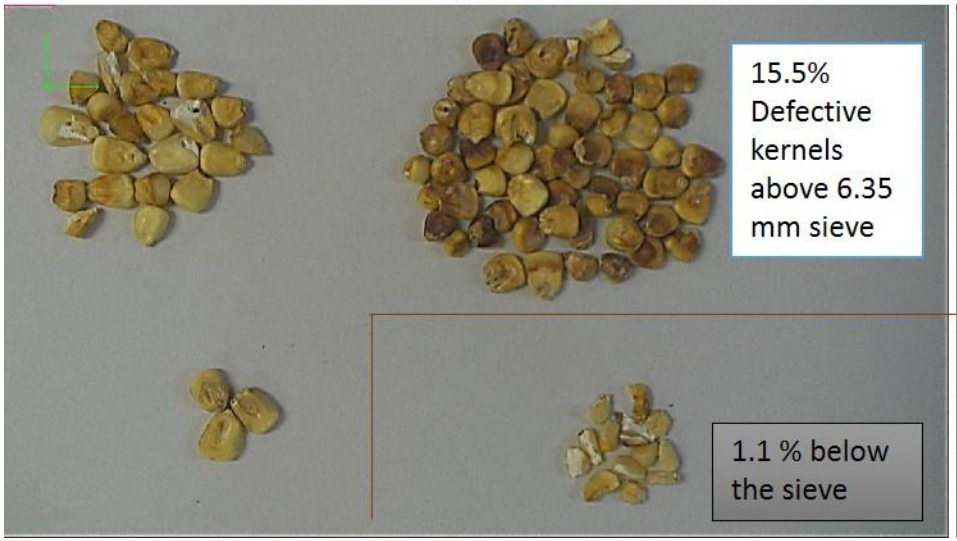
2016/2017 SA Maize grading results

WM3 DON = 7671 µg/kg



WM1 DON = 4758 µg/kg

WM2

FUM = 2135 µg/kg and DON = 3273 µg/kg

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2016/2017 SA Maize grading results

YM1

FUM = 4025 µg/kg and DON = 272 µg/kg

Is maize grade an indication of mycotoxin content?

COM

FUM = 1125 µg/kg

Grading results of 2016-2017 maize samples analysed for mycotoxins

NO MYCOTOXINS FOUND

- **Sample with highest % fusarium and diplodia observed (17.6%) contained no mycotoxins!**

- **YM3 sample, Region 30,**
  - ✓ **24% defective kernels above the 6.35 mm sieve,**
  - ✓ **17.6% kernels with visual "fungi" damage**

- **WM3 sample, Region 35,**
  - ✓ **11.5% defective kernels above the 6.35 mm sieve,**
  - ✓ **8% kernels with visual "fungi" damage**

Possible to predict presence/absence of mycotoxins by visual appearance???

Grading results of 2016-2017 maize samples analysed for mycotoxins

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- **YM3 sample, Region 30,**
  - ✓ **24% defective kernels above the 6.35 mm sieve,**
  - ✓ **17.6% kernels with visual "fungi" damage**

- **WM3 sample, Region 35,**
  - ✓ **11.5% defective kernels above the 6.35 mm sieve,**
  - ✓ **8% kernels with visual "fungi" damage**

MYCOTOXINS FOUND

- **43 samples without any visual "fungi" damage were tested for mycotoxins.**
- **19 of the 43 samples contained fumonisins and 8 samples DON.**

- **YM1 sample, Region 10,**
  - ✓ **FUM = 1708 µg/kg**
  - ✓ **1.4% defective kernels above the 6.35 mm sieve,**
  - ✓ **NO kernels with visual "fungi" damage**

- **WM1 sample, Region 13,**
  - ✓ **DON = 638 µg/kg**
  - ✓ **1.8% defective kernels above the 6.35 mm sieve,**
  - ✓ **NO kernels with visual "fungi" damage**

Conclusions

MYTHS	FACTS
All mycotoxins are the same	X
Only necessary to test for aflatoxin B_1 to ensure food safety	X
Mycotoxin risks are region specific	X
Occurrence patterns stay the same	X
Maize grade is an indication of mycotoxin content	X
Possible to predict presence/absence of mycotoxins by visual appearance	X
Do we test in the grain industry?	Yes and no

References

- Mycotoxin trends/season/region summarised in the Annual SA Maize Crop Quality Report and Wheat Crop Quality Report
- Annual Maize and Wheat Crop Survey Results reported on SAGL website: www.sagl.co.za
  - Annual reports and pages of reports on SAGL website

Without data you are just another person with an opinion

Acknowledgements

- AGBIZ GRAIN MEMBERS WHO COLLECT THE MAIZE AND WHEAT SAMPLES FOR THE NATIONAL CROP QUALITY PROJECTS
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- WIANA LOUW, GENERAL MANAGER SAGL
- THANK YOU FOR THE OPPORTUNITY TO CHANGE OUR MYTHS INTO FACTS

THANK YOU FOR YOUR ATTENTION