Fusarium graminearum mycotoxins associated with grain mould of maize in South Africa

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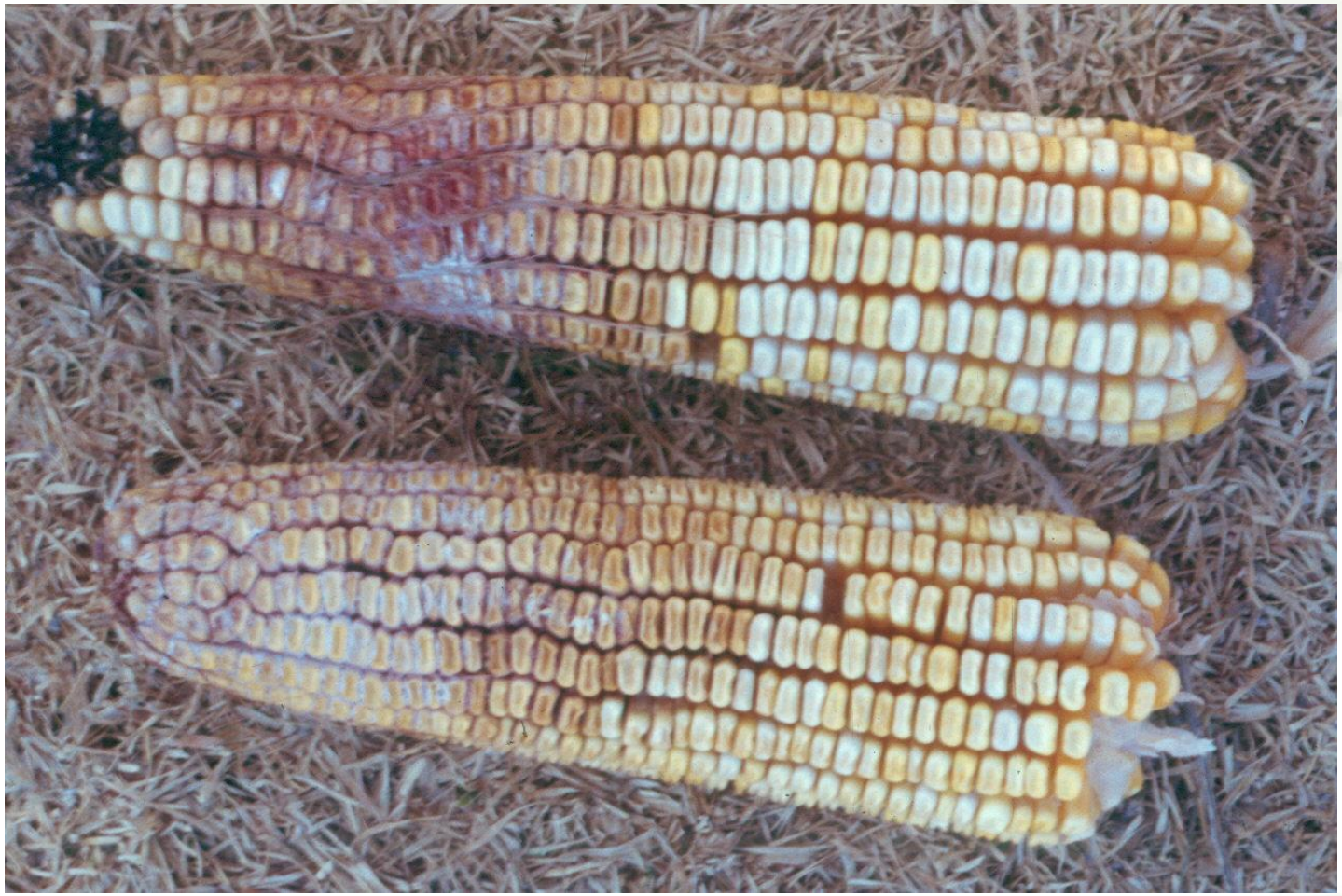
Two distinct aspects to this project the first (collaboration with SU) will be presented by Prof Bradley Flett ARC-GCI and the second (collaboration with ARC-PPRI and UFS) by Prof Neal McLaren UFS

SYMPTOMS OF GIBBERELLA EAR ROT

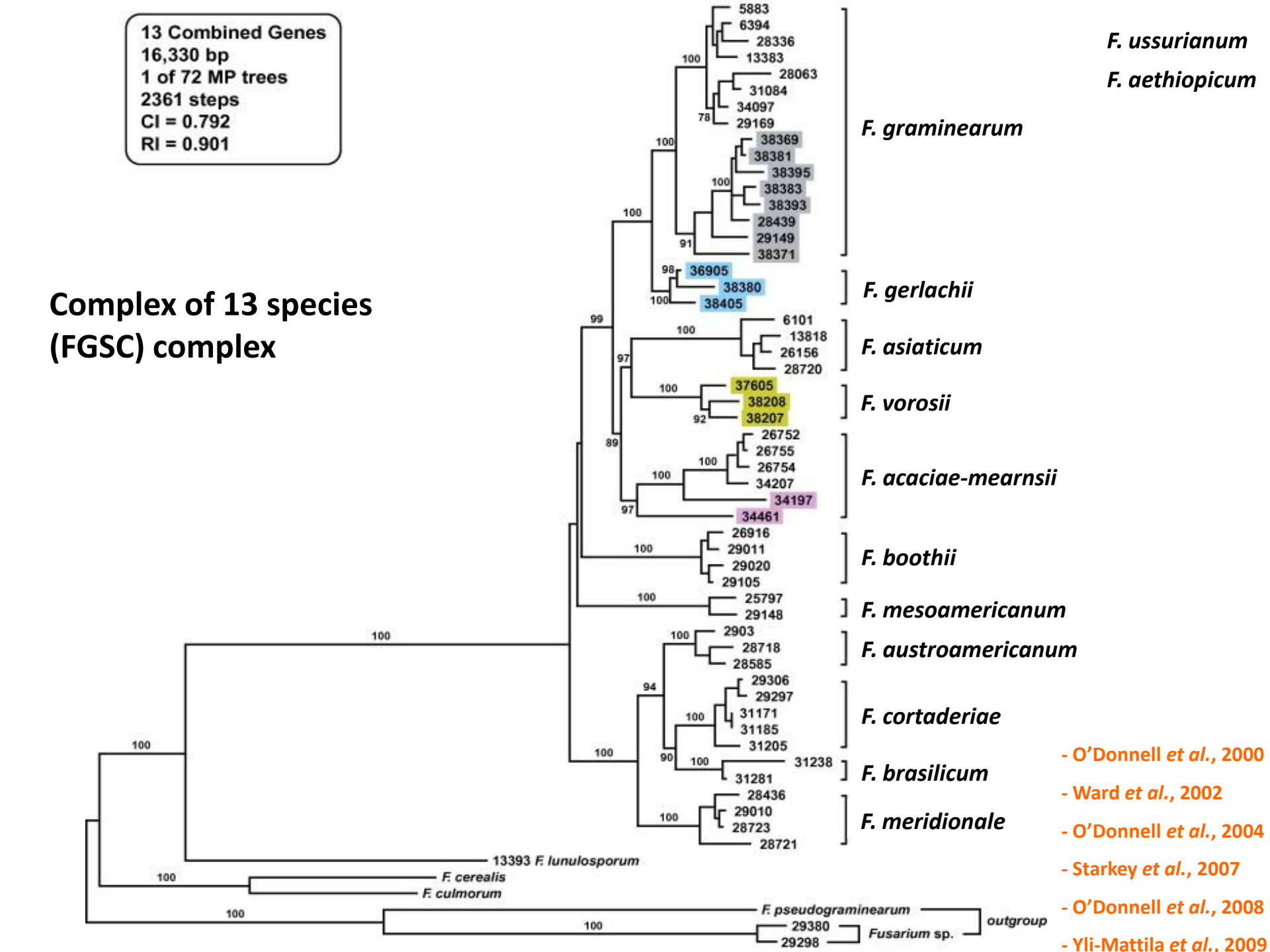


INTRODUCTION

- Gibberella ear stalk and root rot of maize (*F. graminearum*)
- Recent studies have divided the *Fusarium graminearum* species complex (FGSC) into a number of species/lineages
- Problems increased when rotated with other graminaceous hosts

INTRODUCTION

- Produce mycotoxins: DON, NIV and ZEA
- DON and NIV – protein synthesis inhibitors and cause anaemia, immunosuppression, haemorrhage, diarrhoea and emesis.
- ZEA – non-steroidal estrogenic mycotoxins – estrogenic symptoms
- Chemotyping of FGSC isolates


13 Combined Genes
16,330 bp
1 of 72 MP trees
2361 steps
CI = 0.792
RI = 0.901
Complex of 13 species (FGSC) complex
F. ussurianum
F. aethiopicum
F. graminearum
F. gerlachii
F. asiaticum
F. vorosii
F. acaciae-mearnsii
F. boothii
F. mesoamericanum
F. austroamericanum
F. cortaderiae
F. brasilicum
F. meridionale
13393 F. lunulosporum
F. cerealis
F. culmorum
F. pseudograminearum
29380
29298
Fusarium sp.
outgroup
- O'Donnell et al., 2000
- Ward et al., 2002
- O'Donnell et al., 2004
- Starkey et al., 2007
- O'Donnell et al., 2008
- Yli-Mattila et al., 2009

AIM

1) Determine distribution and co-occurrence of four *Fusarium* species and their mycotoxins (focus on FGSC)
2) FGSC of GER of maize in South Africa

MATERIALS AND METHODS

Distribution and co-occurrence of four *Fusarium* species and their mycotoxins

- Maize samples collected from 2 cultivars from 14 representative localities
- Real-time PCR used to quantify grain colonisation by the 4 major *Fusarium* species
- Multi-toxin analysis HPLC-MS was used to quantify mycotoxins

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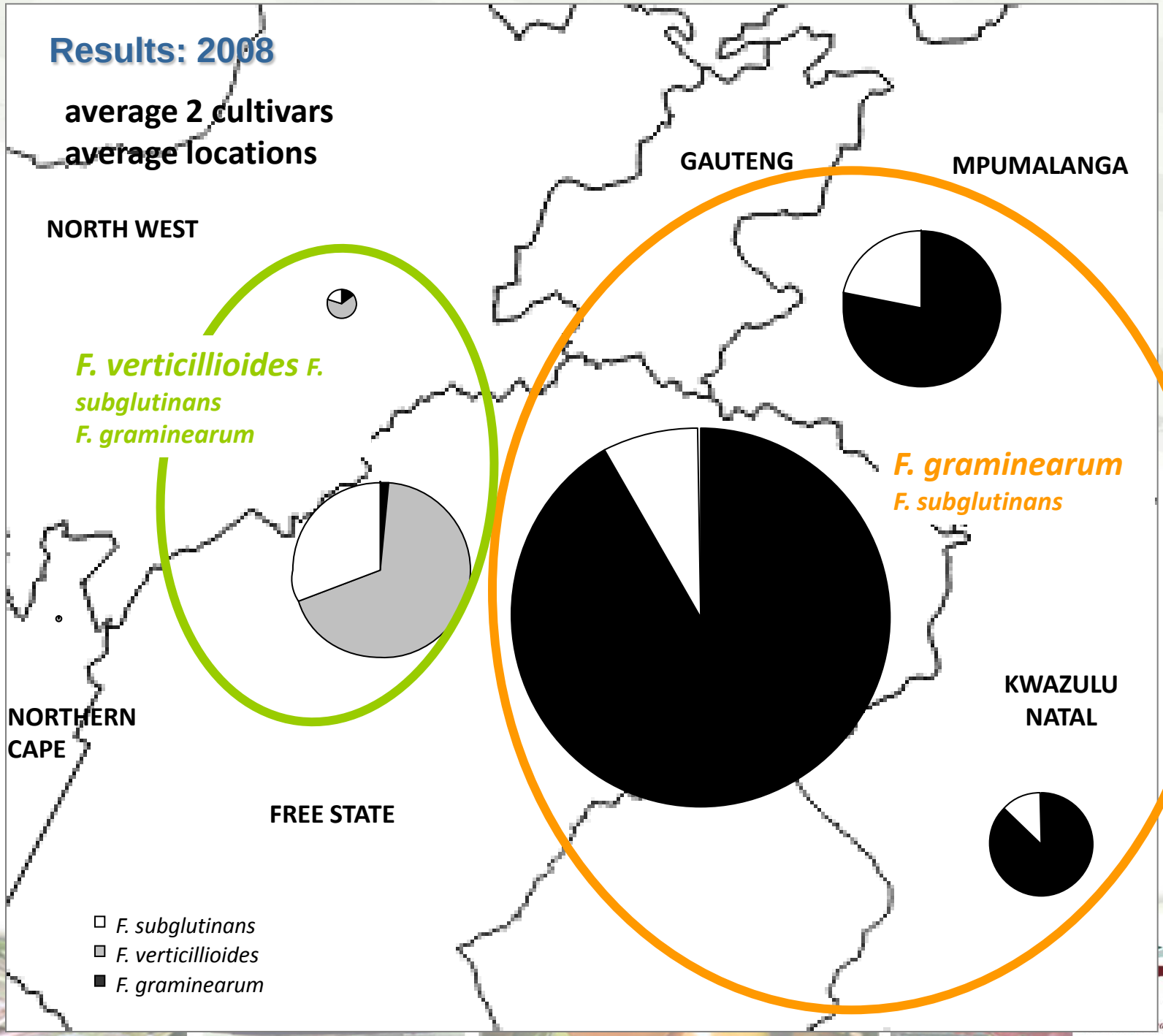
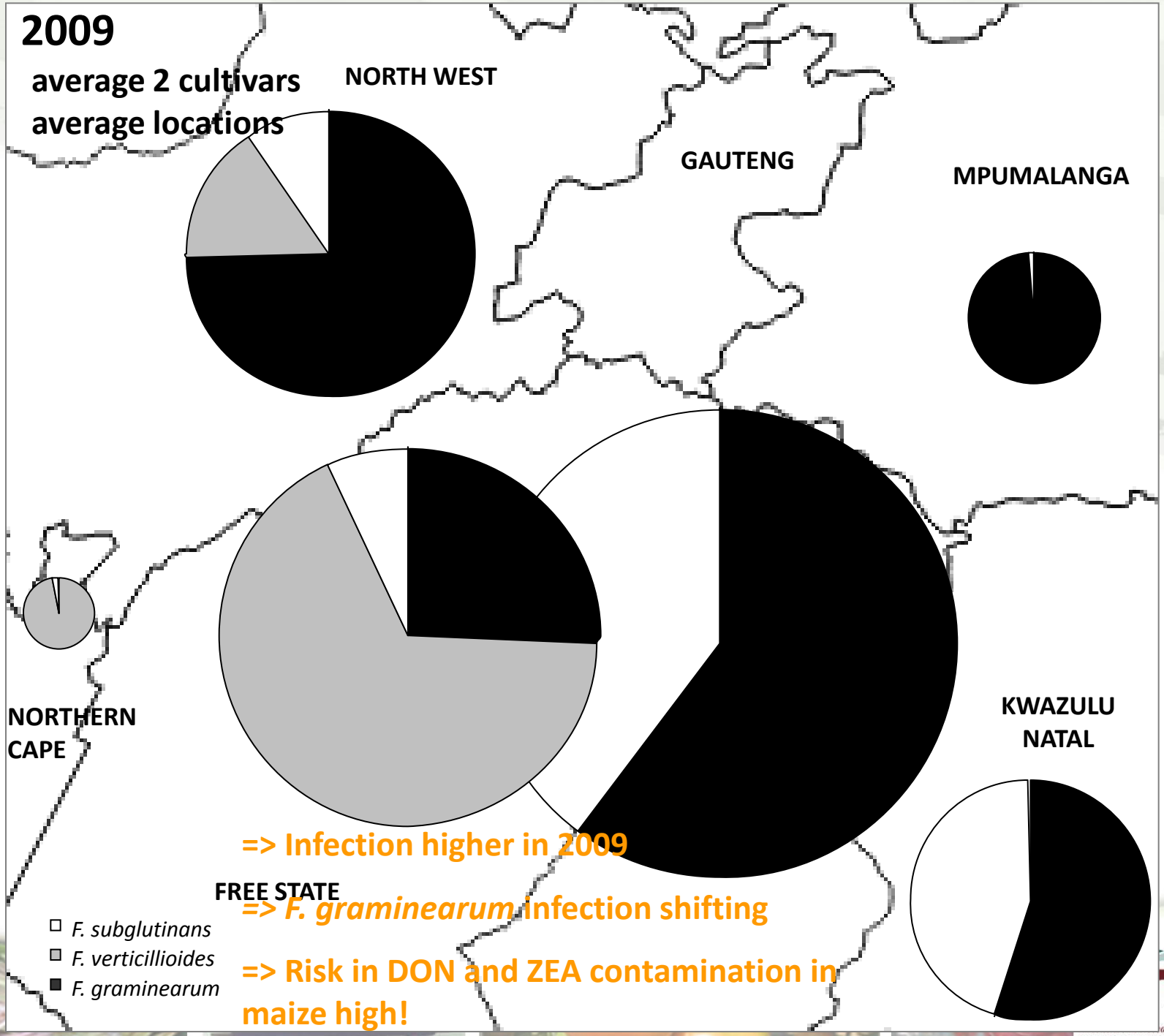

Results: 2008
average 2 cultivars
average locations
GAUTENG
MPUMALANGA
NORTH WEST
F. verticillioides F. subglutinans
F. graminearum
F. graminearum
F. subglutinans
KWAZULU NATAL
NORTHERN CAPE
FREE STATE
F. subglutinans
F. verticillioides
F. graminearum


2009
average 2 cultivars
average locations
NORTH WEST
GAUTENG
MPUMALANGA
NORTHERN CAPE
KWAZULU NATAL
FREE STATE
F. subglutinans
F. verticillioides
F. graminearum
=> Infection higher in 2009
=> F. graminearum infection shifting
=> Risk in DON and ZEA contamination in maize high!

RESULTS – MYCOTOXINS OF GER

Log of the sum of type B trichothecenes and zearalenone and the log of the infection coefficient of *F. graminearum* was linearly correlated ($R^2 = 0.74$)

DISCUSSION

- In 2008 *F. graminearum* was the dominant species in the eastern production areas
- In 2009 ear rots were higher and similar tendencies were noted but F. graminearum became predominant in the Northwest Province as well
- DON and ZEA were well correlated with *F. graminearum* grain biomass

MATERIALS AND METHODS
FGSC of GER of maize in South Africa

- 100 isolates of FGSC from GER were collected from various localities throughout the South African maize production area
- Multilocus genotyping assay were used to determine FGSC species identity and trichothecene chemotype (Ward *et al.*, 2008)
- One isolate was analysed further using sequence analysis and com-pared to other published sequences

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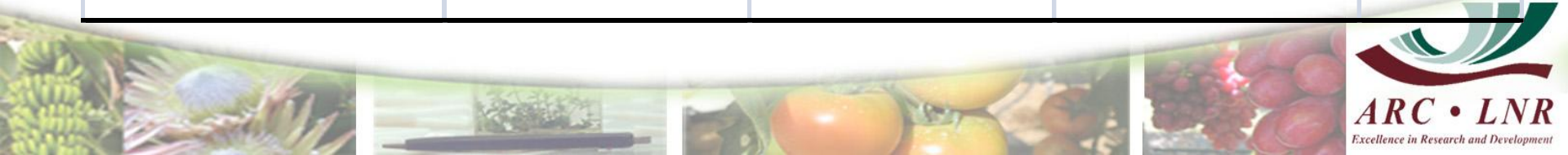
RESULTS

FGSC of GER/FHB of maize/wheat in South Africa

Host	Chemotype			*N* =
	15-ADON	NIV	3-ADON	
Wheat	93.1	6.1	0.7	277
Barley	99.3	0	0.7	148
Maize	100	0	0	100
Maize (roots)	86	14	0	35



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RESULTS

FGSC of GER of maize in South Africa

- 99/100 GER isolates were *F. boothii* which is a 15-ADON chemotype
- 1/100 GER isolate was collected in Gauteng and it was found to be a interspecific hybrid between *F. boothii* and *F. graminearum*

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DISCUSSION

FGSC of GER of maize in South Africa

- GER in South Africa is caused primarily by *F. boothii* which being a 15-ADON chemotype indicates that DON is the primary trichothecene
- The FGSC of GER differs significantly to that of maize root and crown rot as well as that of FHB of wheat and barley

CONCLUSION

- It appears that seasonal variation may affect the primary mycotoxins in maize production areas of South Africa
- GER is predominant in eastern production areas and may predominate in the north western production areas in South Africa
- The strong correlation between *F. graminearum* incidence and DON and ZEA indicates that these mycotoxins are a real threat in local maize production

CONCLUSION

- The predominance of *F. boothii* in the FGSC in GER indicates that the predominant trichothecene should be DON.
- The difference in the FGSC of GER and FHB counters the thought that wheat and maize rotations increase both diseases
- The hybrid isolate shows that there may still be some doubt as to whether the species within the FGSC are sexually incompatible

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ACKNOWLEDGEMENTS

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