

Effect of *Busseola fusca* and  
*Fusarium verticillioides*  
interaction on Fusarium ear rot  
and fumonisin production in  
maize in South Africa  
(MTM 11/14)

E. Ncube (ARC-GCI)

# Collaborators

- Prof. B Flett – ARC-GCI & North-West University
- Prof. A Viljoen – Stellenbosch University
- Prof. J van den Berg – North-West University
- Prof. JBJ van Rensburg – ARC-GCI
- Ms BJ van Rensburg – ARC-GCI
- Ms A Schoeman – ARC-GCI
- Prof. GP Munkvold – Iowa State University, USA

# Introduction

- *F. verticillioides* occurs in many maize-producing regions in South Africa (both subsistence & commercial)
- Studies have been done on the European corn borer in the US
- *B. fusca* x *F. verticillioides* interaction on maize has not been studied in South Africa
- The effect this interaction has on Fusarium ear rot (FER) & fumonisin (FUM) contamination is not known

# Introduction

- It is also unknown whether or not *B. fusca* moths have preference for maize plants infected with *F. verticillioides*
- Important to study this interaction given *B. fusca* resistance to Bt maize discovered in recent seasons in South Africa

# *B. fusca* damage on maize

- *Busseola fusca* is considered the most important insect pest of maize in South Africa
- Significant yield losses have been attributed to stem borers





# *B. fusca* damage on maize ears



# Project aims

- To determine:
  - a) Effect of *B. fusca* x *F. verticillioides* interaction on FER and FUM contamination in both Bt and non-Bt maize hybrids
  - b) Effect of mechanical damage to maize ears on FER and FUM contamination
  - c) Role of *B. fusca* frass in *F. verticillioides* infection

# Project aims

- d) Oviposition preference, larval survival and growth rate of *B. fusca* on maize infected with *F. verticillioides*
- e) Effect of different *F. verticillioides* isolates on growth rate of *B. fusca* larvae
- f) Effect of insecticides on the *B. fusca* x *F. verticillioides* interaction and FER & FUM contamination



# Actions taken to date

- To determine whether *B. fusca* damage predisposes maize ears to FER and FUM contamination or *B. fusca* contributes in an additional way, perhaps as a vector
- Three trials, i.e. *B. fusca* damage & mechanical damage trials, planted during 2008/09, 2009/10 & 2010/11 seasons at the ARC-GCI experimental farm, Potchefstroom

# Materials and methods

## ***B. fusca* damage**

- Two trials planted at Potchefstroom
- Randomised complete block (RCB) design with 2 border rows on each side of the experimental row
- Three hybrids (Bt [PAN6236B] and its susceptible isohybrid [PAN6126], an unrelated non-Bt hybrid [PAN6723])

# Materials and methods

- **Four treatments**, six replicates:
  - F. verticillioides* inoculation
  - F. verticillioides* & *B. fusca* infestation
  - B. fusca* infestation
  - Control

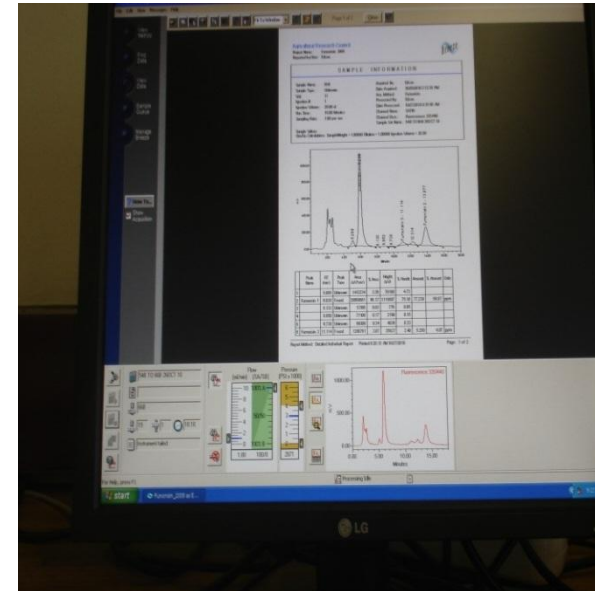
# Materials and methods

- A spore suspension of a high fumonisin-producing *F. verticillioides* isolate (MRC826) was inoculated
- *B. fusca* larvae obtained from a mass rearing facility at the ARC-GCI
- *B. fusca* infestation was done 6 weeks after plant emergence



# Materials and methods

- All ears were hand harvested
- FER was visually rated
- Fumonisin was quantified using HPLC
- *B. fusca* damage was evaluated by measuring the feeding tunnel length
- ANOVA was performed using Statgraphics5+

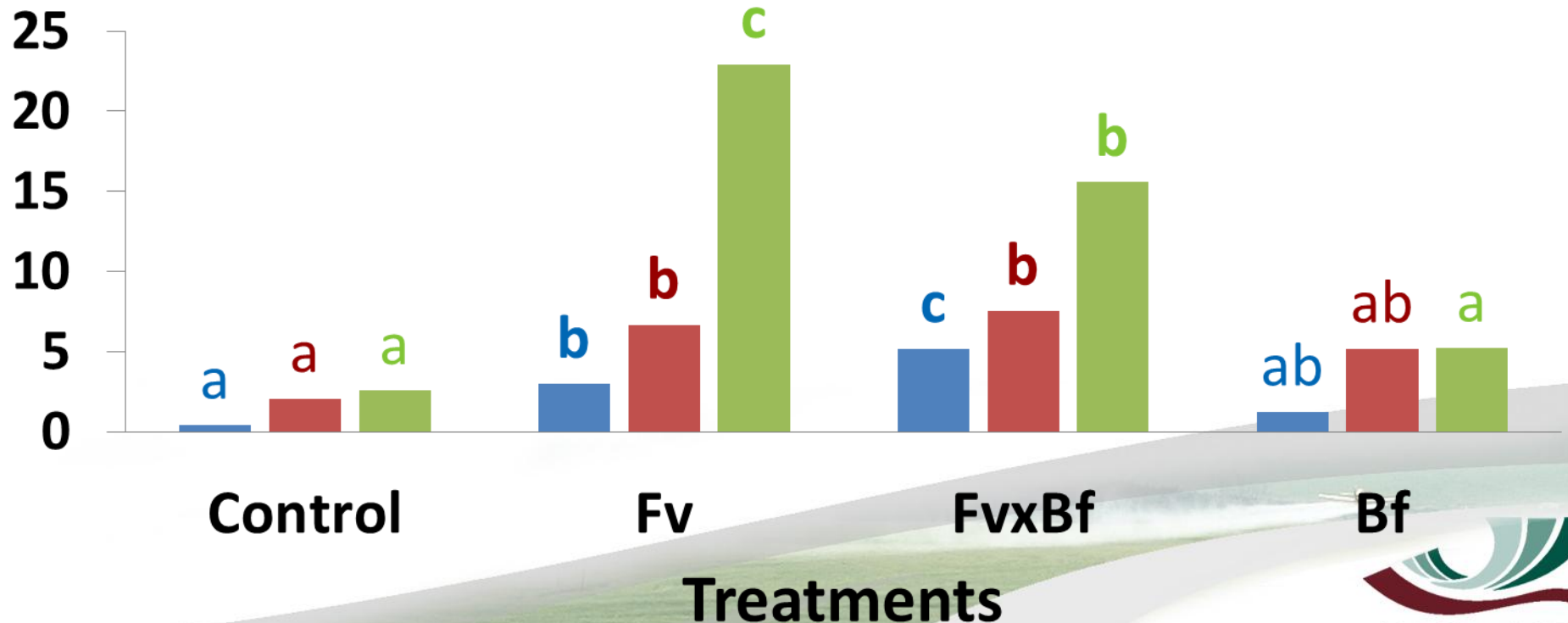


# Results (*B. fusca*): non-Bt hybrid

2008/09

$p < 0.05$

■ FER (%)   ■ *B. fusca* damage (cm)   ■ FUM ( $\mu\text{g/g}$ )



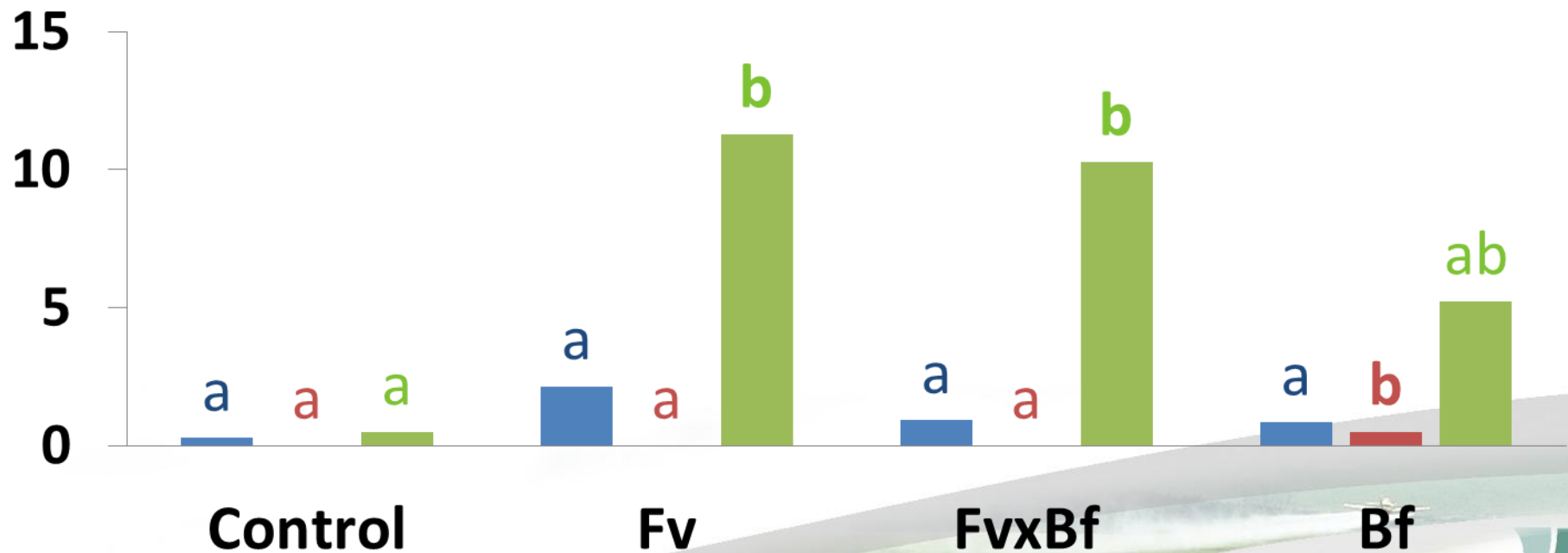


# Results (*B. fusca*): non-Bt hybrid

2010/11

$p < 0.05$

■ FER (%)   ■ *B. fusca* damage (cm)   ■ FUM ( $\mu\text{g/g}$ )



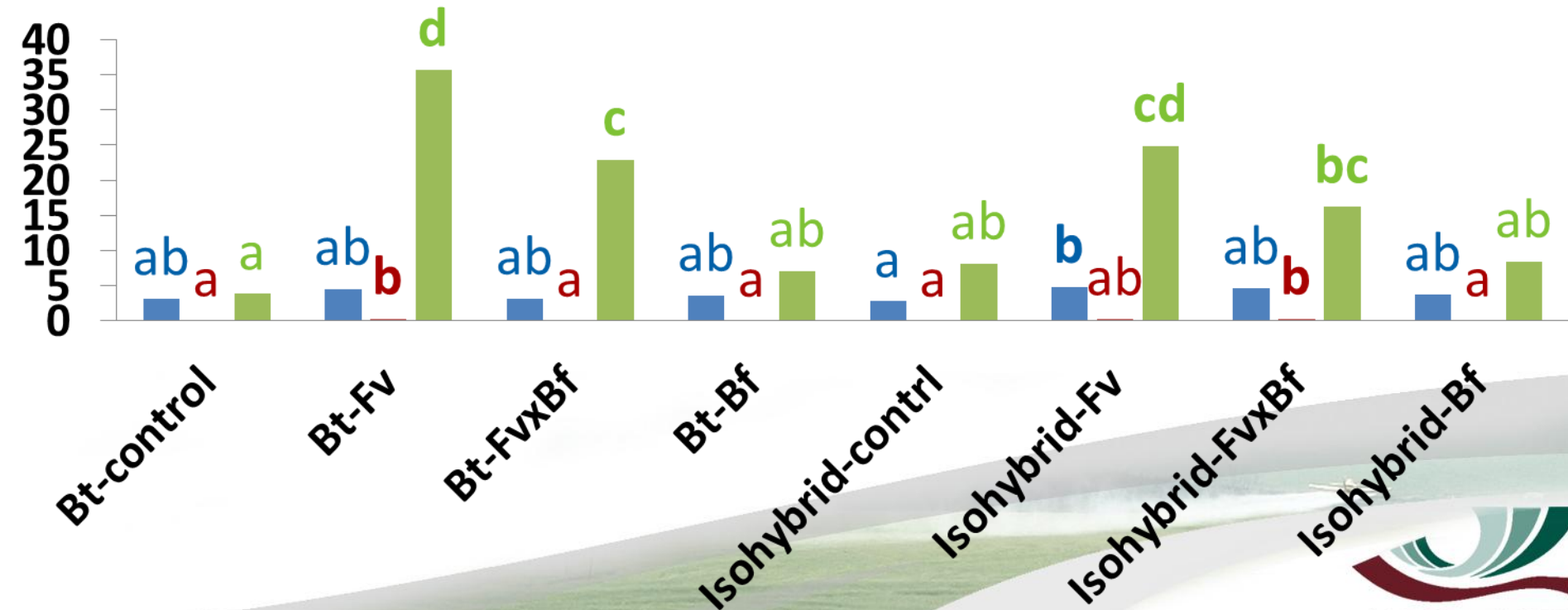
Treatments

# Results (*B. fusca*): Bt-hybrid and isohybrid

2009/10

$p < 0.05$

■ FER (%)    ■ *B. fusca* damage (cm)    ■ FUM ( $\mu\text{g/g}$ )

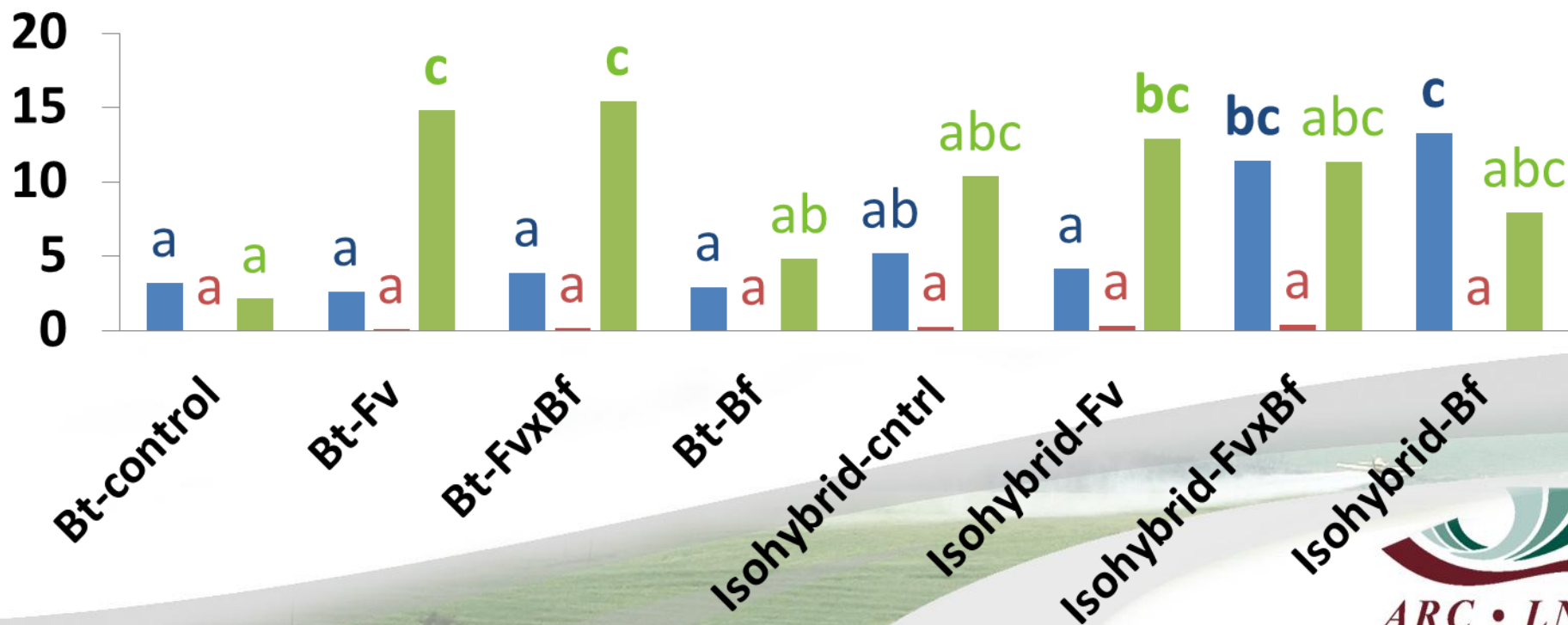


# Results (*B. fusca*): Bt-hybrid and isohybrid

2010/11

$p < 0.05$

■ FER (%)    ■ *B. fusca* damage (cm)    ■ FUM ( $\mu\text{g/g}$ )



# Materials and methods

## Mechanical damage

- Trial planted at Potchefstroom, (RCB) design
- Non-Bt (PAN6723) hybrid
- Cork borers (1.59, 1.75, 2.23 & 2.39 cm internal diameter) were used to damage ears at the blister stage with and without *F. verticillioides* inoculation

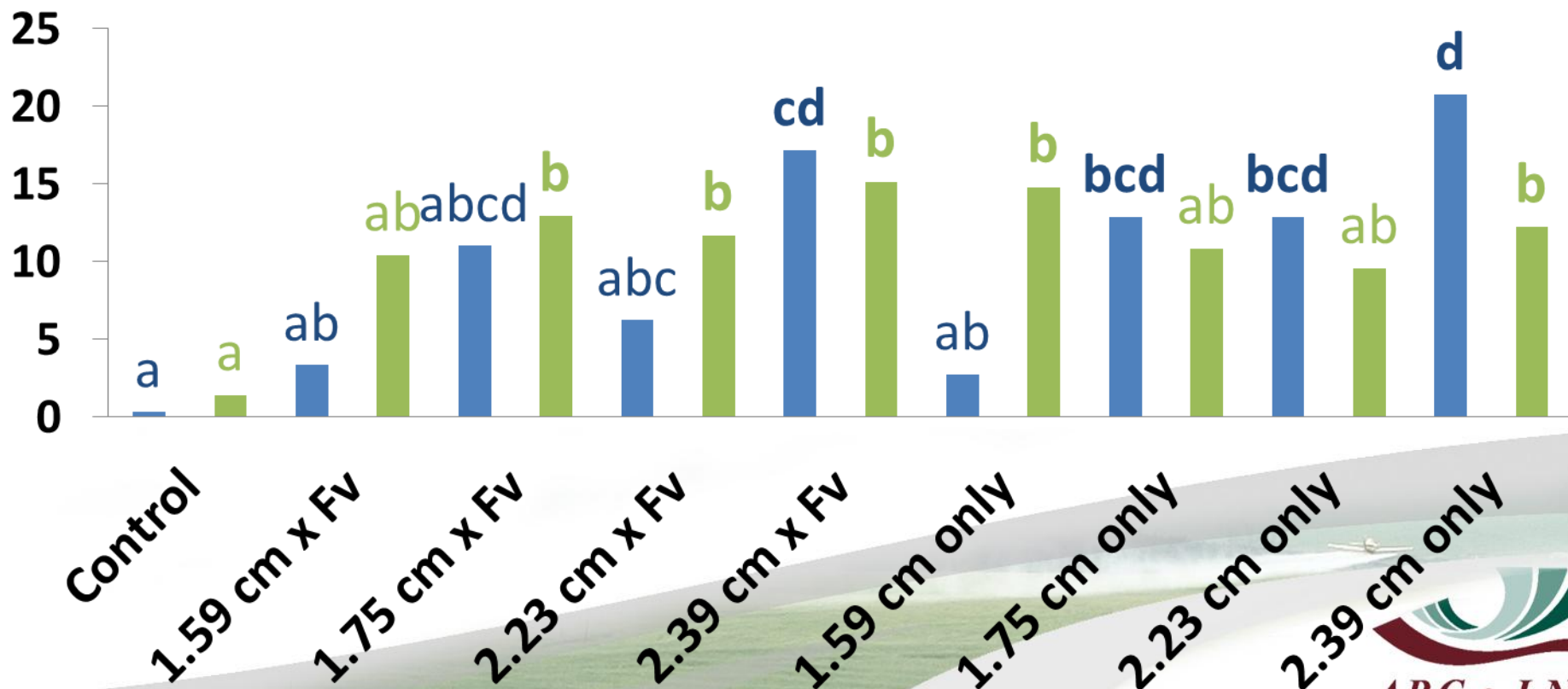


# Results (mechanical): non-Bt hybrid

2009/10

$p < 0.05$

■ FER (%)   ■ FUM ( $\mu\text{g/g}$ )

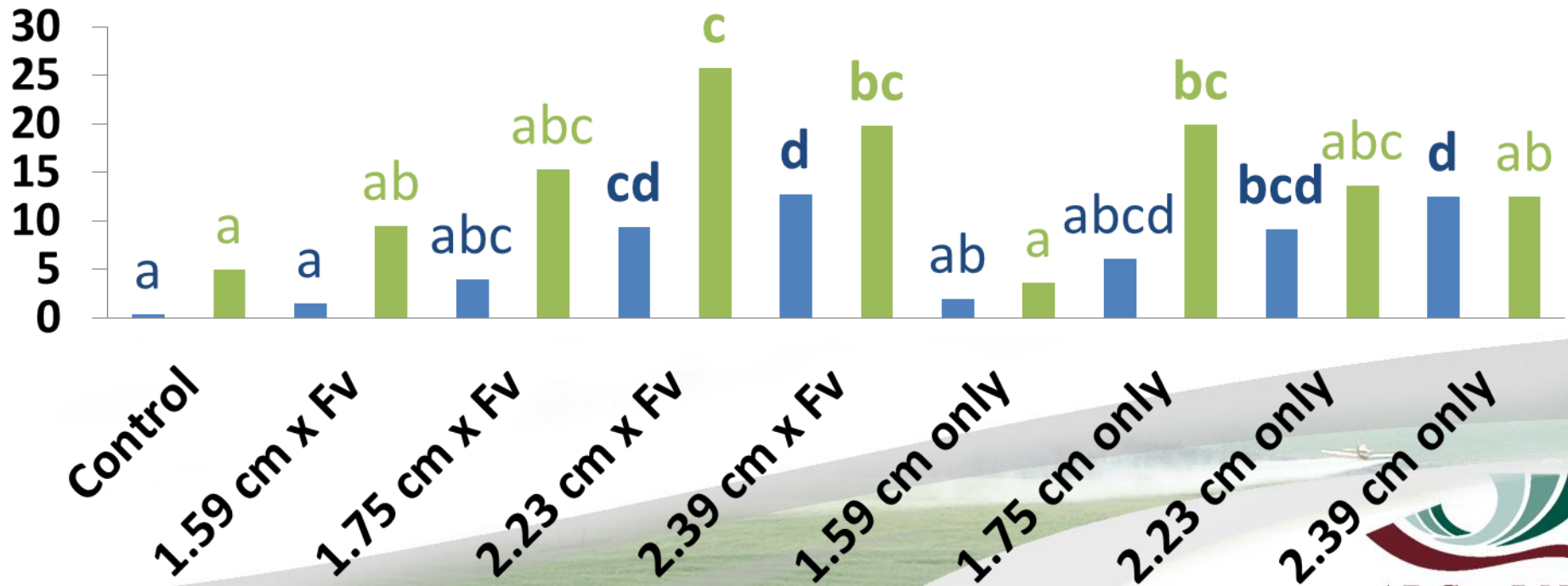


# Results (mechanical): non-Bt hybrid

2010/11

$p < 0.05$

■ FER (%)    ■ FUM ( $\mu\text{g/g}$ )





# Discussion

- Both *B. fusca* and mechanical damage significantly increase FER
- Fumonisin production appears to be independent of *B. fusca* infestation/damage



# Conclusion

- The Bt hybrid had less FER when compared to non-Bt hybrids implying that *B. fusca* increases FER
- *B. fusca* appears to play a significant role as a vector
- The role of *B. fusca* in vectoring *Fusarium verticillioides* is being studied further as per project aims laid out earlier
- Fumonisin contamination remain problematic in both Bt and non-Bt maize

# Progress made

- Popular articles - 3
- Congress oral/talk presentations - 2
- Congress poster presentations - 3
- Expected scientific publications - >3

# Acknowledgements

- The Maize Trust and the ARC for funding
- Field and laboratory assistance (Desiree, Nicolene, Monica, Maria)
- Annemie Erasmus for providing some *B. fusca* photos

**Thank you!**