

Grain yield performance of new wheat germplasm with resistance to Karnal bunt

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Key findings

- » There was no detectable yield penalty associated with Karnal bunt resistance when new wheat lines were compared with commercial varieties.
- » Three of the new wheat lines had yields comparable to Mace[®], Scout[®] and Suntop[®], the highest yielding commercial varieties.
- » Half of the new wheat germplasm with resistance to Karnal bunt had grain yields above the experiment's average.

Introduction

Karnal bunt, a disease of wheat caused by the fungus *Tilletia indica*, has the potential to seriously damage the Australian wheat industry because it is a quarantine barrier to international trade (Beattie & Biggerstaff 1999). It is not present in Australia, but carries a significant biosecurity risk. Developing resistant varieties is the most economical, sustainable and environmentally friendly approach to managing disease risk (Murray & Brennan 1998).

Genetic resistance to plant disease is an active process that requires investment by the plant which, in the absence of the parasite, might result in a yield penalty (Oliver et al. 2014). An international research collaboration with CIMMYT (International Maize and Wheat Improvement Center, Mexico) has developed new wheat germplasm carrying Karnal bunt resistance genes. These will be made available

to Australian breeders for variety development. As a prerequisite, this study was carried out to determine what penalties could affect yield or its components due to incorporating Karnal bunt resistance.

Treatments

The experiment was conducted at the Wagga Wagga Agricultural Institute in the 2015 winter cropping season. Six varieties known to be susceptible to Karnal bunt were chosen to represent the Australian-adapted cultivars. In comparison, 12 new wheat germplasm with resistance to Karnal bunt (Table 1), including a newly released cultivar (Super172) from the CIMMYT breeding program, were used for the study. The experiment design was a p-rep with two replicates. Data on grain yield was spatially analysed to account for field heterogeneity by using spatial information of the plot layouts (rows and columns) (Cullis & Gleeson 1991).

Table 1. New wheat germplasm with resistance to Karnal bunt.

Wheat germplasm	Pedigree
ZVS13_312	CHIBIA//PRLII/CM65531/3/SKAUZ/BAV92/4/MUNAL1
ZVS13_385	TAM200/PASTOR/TOBA97/3/HEILO
ZVS13_406	CHUANMAI 43*2/3/ATTILA/3*BCN*2//BAV92
ZWB10_44	ROLF07/7/CAL/NH//H567.71/3/SERI/4/CAL/NH/H567.71/5/2*KAUZ/6/PASTOR
ZWB11_172	WAXWING/4/BL 1496/MILAN/3/CROC_1/AE.SQUARROSA (205)//KAUZ/5/FRNCLN
ZWB11_95	MUNAL#1/FRANCOLIN#1
ZWB12_14	KIRITATI//ATTILA*2PASTOR/3/AKURI
ZWB12_187	FRANCOLIN#1BECARD//FRNCLN
ZWB12_30	BAJ#1/3/KIRITATI//ATTILA*2/PASTOR
ZWB12_31	BAJ#1/3/KIRITATI//ATTILA*2/PASTOR
ZWB12_4	CHIBIA//PRLII/CM65531/3/SKAUZ/BAV92/4/MUNAL#1
ZWB12_62	KLEIN DON ENRIQUE*2/3/FRET2/WBLL1//TACUPETO F2001

Results

The experiment was managed to achieve maximum yield potential. It was irrigated to the optimal level and top-dressed with nitrogen. The resulting grain yield was 4.7–8.0 t/ha (Figure 1). Grain yield variability was higher in the new wheat germplasm than in the commercial cultivars, probably indicating the difference in adaptation. Nevertheless, variance analysis indicated that there was no significant ($P = 0.19$) difference in grain yield amongst the genotypes. Super172, the newly released Karnal bunt resistant variety from CIMMYT, did not perform well in the experiment. Mace, Scout and Suntop were the highest yielding of the commercial varieties (Figure 1), but some of the Karnal bunt resistant lines also had comparable yields of ≥ 7.0 t/ha and six of the 12 lines had grain yields above the experiment's average.

Summary

This study used a field experiment to examine the yield performance of new wheat germplasm selected for resistance to Karnal bunt. There was no significant difference in yield between the new wheat lines and adapted, commercial varieties, indicating no evidence of yield penalty. On the contrary, three of the new lines yielded over 7 t/ha that compared favourably with the highest yielding of the commercial varieties.

References

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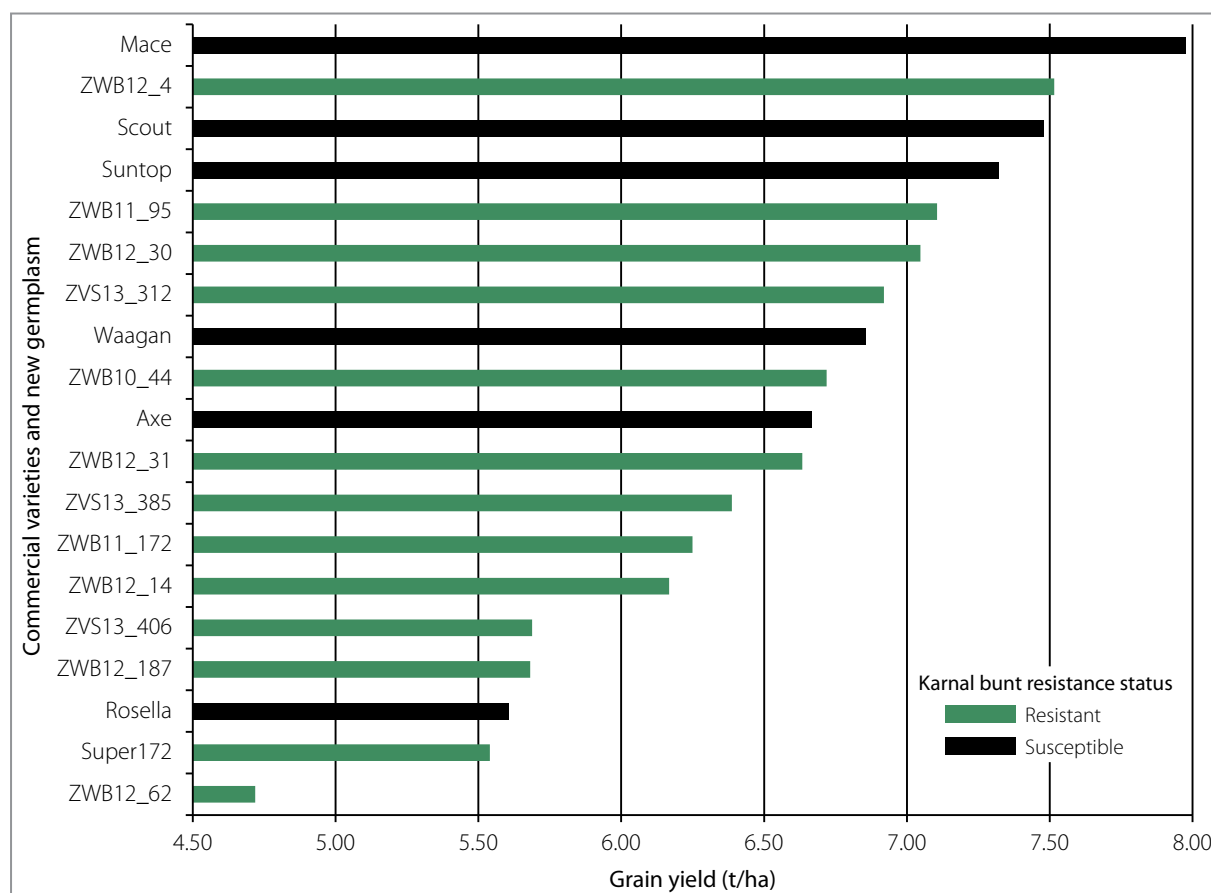


Figure 1. Yield performance of novel wheat germplasm with Karnal bunt resistance and current commercial varieties.