Wheat variety performance at sodic dispersive sites in Merredin and Katanning in 2015

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Key messages

At Merredin, the variety Envoy was a clear yield winner over Mace at both the high and low ECa sites in a mid-June sowing. Overall, yields were nearly half in relation to water limited yield potential.

At Katanning, varieties Corack and Zen equalled Mace in yield but nothing surpassed Mace. The yields were however; lower than water limited yield potential for all varieties at this highly sodic and dispersive site.

Aims

To compare yield of a number of wheat varieties on sodic dispersive soil in low and medium rainfall sites in Western Australia.

Background

Many soils in the Western Australian Wheatbelt have subsoils with chemical and physical properties that restrict plant root growth and reduce water use thus impacting yield. High Sodicity and alkalinity occupies several million hectares in the Western Australian Wheatbelt. Sodicity, and associated transient salinity, has a greater negative effect on grain yield in low rainfall areas due to the increased concentration of ions such as Sodium and Boron. Little is known about the variation in tolerance of Australian wheat varieties to sodicity and yield response under different rainfall regimes. This paper presents first year yield results of elite wheat varieties on such sodic soils in three trials conducted in 2015.

Method

A network of National trials has been established to evaluate the performance of different wheat varieties on sodic soils. Two sites were selected in Western Australia for sodic and dispersive properties; one in each of low and medium rainfall zone. The low rainfall site at the DAFWA Merredin Research Station was chosen from soil chemical analysis and an EM38 paddock survey. EM38 measures apparent electrical conductivity at the surface and near surface of the soil profile. Due to the large variation in surface apparent electrical conductivity two adjacent sites with contrasting EM38 scores were used in Merredin. The medium rainfall site was chosen from a set of soil analyses from farmer properties. The site chosen was highly sodic grey clay, located at Broomehill 30 km south east of Katanning.

By definition sodic soils have an exchangeable sodium percentage >6 and very sodic soils have an exchangeable sodium percentage >15 but local experience in WA suggests that some soils start showing symptoms as ESP goes above 2 (https://www.agric.wa.gov.au/mypaddock).

The Katanning site was highly sodic throughout, highly alkaline and non-saline with no Magnesium issue while the paddock at Merredin was relatively less sodic, less alkaline and more saline (increasing to 5.03dS/cm at 50cm). However, given the low rainfall and deteriorated top soil structure of this paddock (DAFWA 3c) in Merredin, the effect of salts was likely to be high as the concentration in soil solution would increase rapidly under drying conditions.

Thirty seven wheat varieties were seeded in Latin square randomised block designs at Merredin (2 trials each containing 16 blocks x 10 plots each put in eight banks) and at Broomhill (16 blocks x 10 plots put in four banks). Each variety was replicated 4 times and Mace was used as a repeated standard check in each block. The wheat varieties that were grown included commonly grown Western Australian varieties, a selection of varieties that are being tested by other states and five international germplasm lines.

Seeding occurred on 12 Jun in Katanning into a moist soil, and on16 June in Merredin into a very dry soil that received rains two days later.

Results

Growing season (April to October) rainfall for trial sites in Merredin and Katanning (Broomehill) was 220mm and 271mm, respectively. Merredin received 34 mm more than Katanning in March but Katanning received 57mm more than Merredin over April and May. Average daily pan evaporation from March to May was 4.8mm at Merredin as compared to 3.2mm at Katanning. Spring at Merredin was particularly dry with only 7mm in September and 10mm in October thus markedly reducing yield potential due to dryness but probably also exacerbating the effect of salt in the root zone. Spring rainfall at Katanning was 25mm in September and 19mm in October. Senescence at Katanning was delayed and an additional 18mm was available in November while the crops were still green.

The trial mean yield was 1.02 t/ha +/- 0.108 and 1.09t/ha +/- 0.112, respectively, at the high and low EM signature sites in Merredin.

Mean yield levels at Katanning (2.35t/ha +/- 0.189) were higher than Merredin but were far below the calculated seasonal yield potential. A multiple site analysis will be conducted at the national level to clearly identify inherent tolerance to stresses at sodic soils. In the meantime, current analysis shown in figure 1 to figure 3 should provide a relative account of varieties in the two locations and we hope these are useful for local farmers in deciding varieties for their heavy land sodic soil paddocks.

Yield data is presented as deviation from Mace. In these figures, vertical dashed lines refer to Mace and each variety is shown as an average point with two whiskers. The average point refers to mean difference from Mace (vertical dashed line) while the whiskers represent error bars at 95% confidence level.

At Merredin, varieties Envoy followed by Hydra, Wyalkatchem and Westonia were top yielders with Envoy appearing to have slight edge over Mace at the low EM38 site but only Envoy was the clear winner at the high EM38 site.

At Katanning, yields of Corack and Zen were equal to Mace. Envoy, the top yielder at Merredin was significantly lower yielding than Mace at this site. We hypothesise that stress level at this site was so high that none of the varieties could match seasonal yield potential. A multi environment analysis over seasons and sites is required to understand varietal sensitivity more clearly.

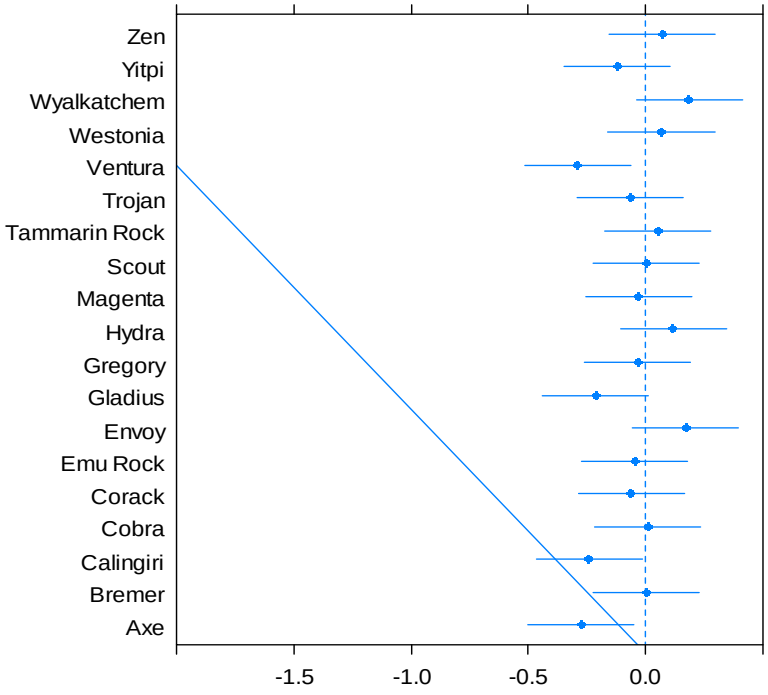

Figure 1. Yield difference (t/ha) of wheat varieties from Mace at the low EM38 site at Merredin. Vertical dotted line represents Mace. Central point of variety lines is the mean deviation in t/ha from Mace and the whiskers represent standard error. The values were calculated following a Best Linear Unbiased Prediction (BLUPs) model.

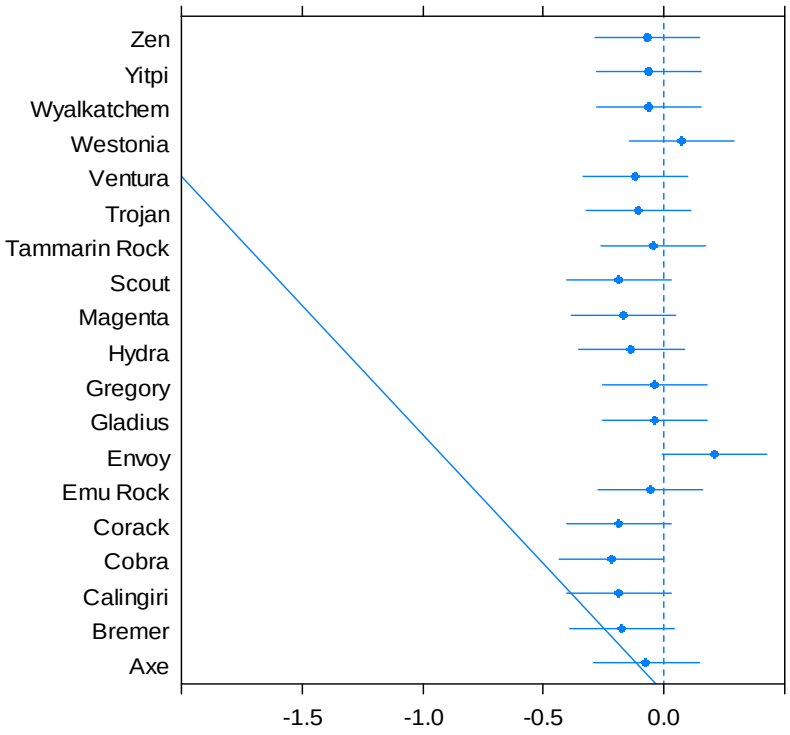

Figure 2. Yield difference (t/ha) of wheat varieties from Mace at the high EM38 site at Merredin. Vertical dotted line represents Mace. Central point of variety lines is the mean deviation in t/ha from Mace and the whiskers represent standard error. The values were calculated following a Best Linear Unbiased Prediction (BLUPs) model.

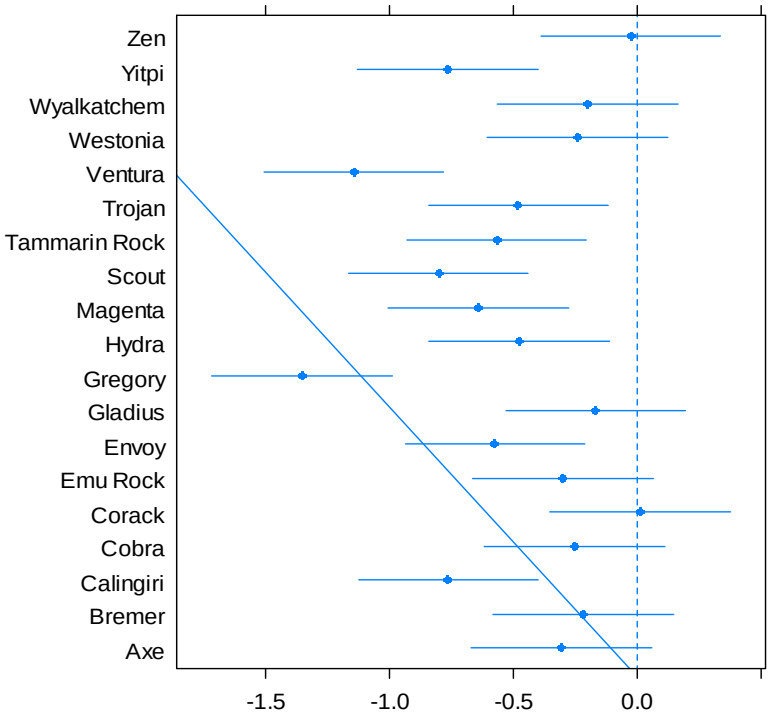

Figure 3. Yield difference (t/ha) of wheat varieties from Mace at Katanning. Vertical dotted line represents Mace. Central point of variety lines is the mean deviation in t/ha from Mace and the whiskers represent standard error. The values were calculated following a Best Linear Unbiased Prediction (BLUPs) model.

Conclusion

More data is required to rank varieties for tolerance to stresses associated with sodic soils. However, in the meanwhile, Envoy and Mace appeared high yielding options under late sown conditions in the low rainfall zone. Varieties Mace, Corack and Zen were promising at Katanning.

Key words

Sodic soil, dispersive soil, wheat varieties, low rainfall, medium rainfall, salinity,

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