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Wheat canopy architecture to enhance resource use efficiency and yield in the high rainfall area

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Purpose:	To test whether we can increase radiation use efficiency and yield in wheat by changing architecture (floppy vs. erect leaves)
Location:	Moora
Soil Type:	Yellow sand
Soil Test Results:	69 kg N/ha of available soil N in 0-40 cm. 17 mg/kg soil Cowell P.
Rotation:	Canola
Growing Season Rainfall (April- October 2016):	365 mm

BACKGROUND SUMMARY

Anecdotal evidence shows that wheat varieties released in WA are gradually changing from floppy to more erect leaves. This change in canopy architecture (mainly leaf erectness) could have significant impact on yield across the rainfall zones of WA. In other crops like rice and corn, an erect leaf canopy has significantly increased yield by 20% or more. We believe this change in canopy architecture might have implications for improving wheat yield and that leaf erectness may be a useful trait for future breeding. It is hypothesized that wheat with an erect leaf canopy can utilize light more efficiently than that with floppy leaves and therefore produce greater yield. This experiment is designed to test the effect of wheat canopy architecture on wheat yield.

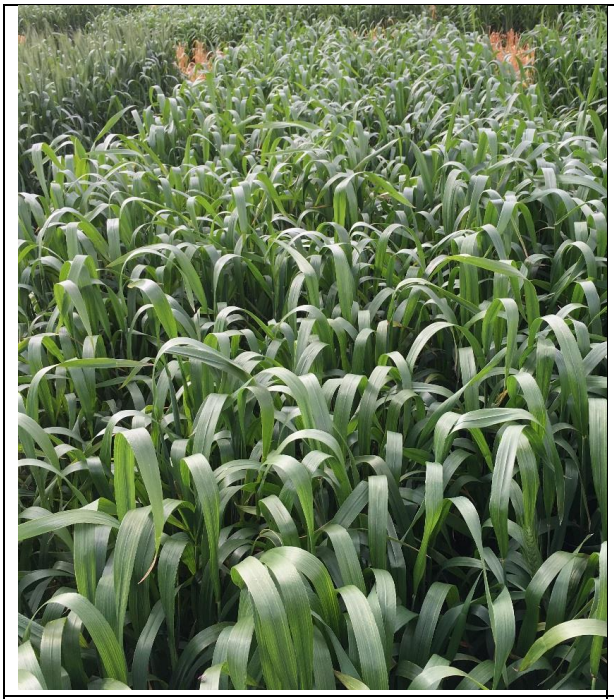
TRIAL DESIGN

Randomized block design with 3 replicates

Plot size:	8 m^2
Repetitions:	3 replicates
Crop type and varieties used:	25 commercial wheat varieties and 55 MAGIC population lines from CSIRO.
Seeding rates and dates:	60-70 kg/ha, targeting 150 plants/m^2, 6/5/2016
Fertilizer rates and dates:	Agras 80kg/ha+50 kg/ha urea at sowing, 80L/ha pf UAN on 15 July. 100 kg Urea at stem elongation.
Herbicide rates and dates:	At sowing, 2 L/ha Spreeseed, 1.5L/ha Treflan,100g/ha Sakura, 200 ml/ha of Dominex, and 200 ml/ha of Lorsban; 800 ml/ha Velocity, 300 ml/ha Prosaro on 15 June 2016

RESULTS

A total of 80 wheat lines evaluated at Moora showed significant variation in leaf architecture and were classified as having a floppy, moderately erect or erect leaf canopy. Two wheat lines with a typical floppy and erect leaf canopy are shown in Figure 1.



Wheat with floppy leaves

Wheat with erect leaves

Figure. 1 Two contrast wheat lines showing floppy and erect leaf canopy.

Wheat with erected leaf canopy tended to have small canopy till booting stage, but had greater leaf area index and long leaf duration from flowering to early grain filling (Fig. 2)

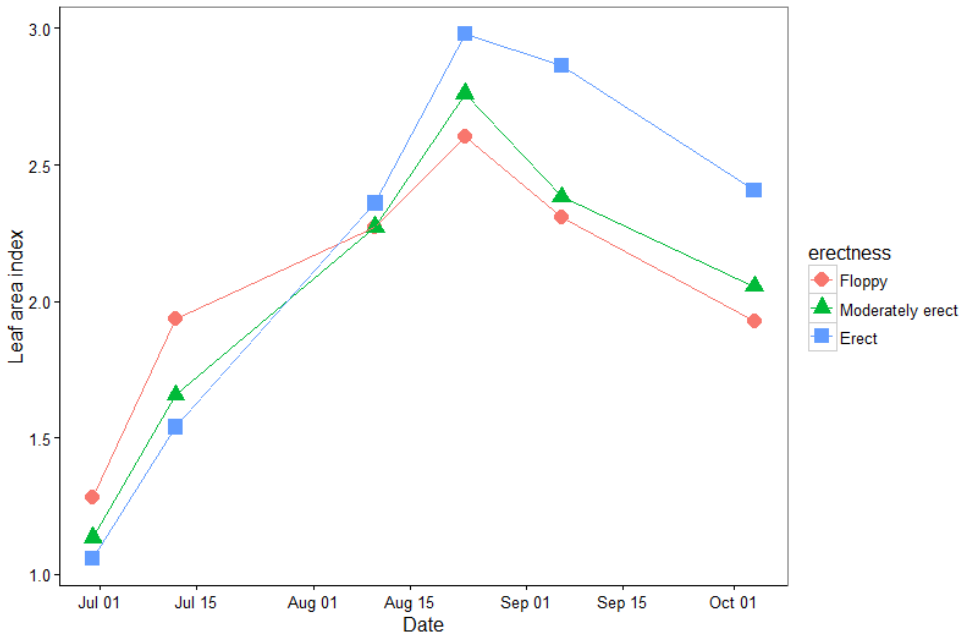


Figure. 2 Leaf area index of floppy, moderately erect and erect leaf canopy over the season

Wheat with a moderately erect or erect canopy had a significantly higher yield than those with a floppy canopy. On average, the floppy canopy wheat produced 3.8 t/ha, increasing to 4.1-4.2 t/ha in the more erect categories (Fig. 3). No difference in yield was oberved between moderately erect and erect canopy.

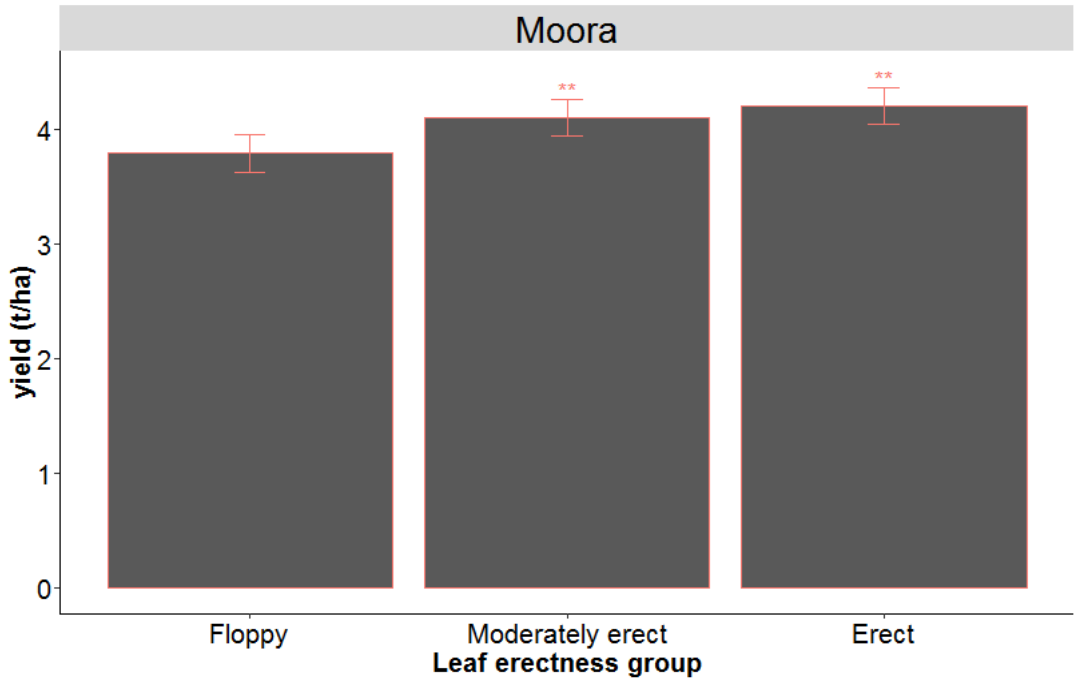


Figure. 3 Yield of wheat with floppy, moderately erect and erect leaf canopy at Morra in 2016. ** indicates that yield is different from that of floppy lines at *P* < 0.01

DISCUSSION

This is the first experiment to evaluate the effect of canopy architecture on wheat yield in Australia. The results show that leaf erectness appears to be an important trait for wheat in Western Australia. Erect leaves allow greater light penetration into the lower canopy. As a result a larger leaf area and longer duration of greenness is maintained in the canopy over time (Fig. 2), both of which could increase photosynthesis and improve yield (Fig. 3). More data across a wide range of environments are needed to prove the hypothesis, and test other effects on weed competition and disease incidence. We will continue to evaluate this hypothesis with WMG in 2017, and look to broaden our evaluation with future projects beyond that.

Acknowledgement

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