Committing agronomy in a public place

John Angus

CSIRO Agriculture and Food
Graham Centre, Charles Sturt University, Wagga Wagga
“Wattle Flat”, Stockinbingal

Donald Oration 2019
169 co-authors

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Undergraduate student of Geoff Leeper

Karl Popper: Conjecture and refutation
Hans Jenny: Soil organic matter
PhD student of Jack Wilson

Barley canopy photosynthesis

Erect leaves

Floppy leaves

Aust. J. Agric. Res. 23, 945-957
At CSIRO Land Divisions with and Bob Myers, 1973-1987

\[ N \text{ uptake} = \min(\text{crop demand}, \text{soil supply}) \]

“white peg agronomy”

Simple models with optimised parameters

No involvement with the National Soil Fertility Project
Shoot density predicted wheat yield response to N fertiliser – but only after break crops

Proc. 5th Aust. Agron. Conf. p551
Canopy N content is closely related to % canopy cover

Original image

29% of pixels with:

\[(1+L)(\text{Green} - \text{Red}) > 0\]

\[(\text{Green} + \text{Red})\]

*Field Crops Res. 118, 221-227.*
Recent N-fertilizer research

Low nitrogen-use efficiency by grazed crops

High nitrogen-use efficiency with mid-row banding

Photo: Leigh Vial
Nitrogen cycle for an average Australian wheat crop
(yield 2.1 t/ha, grain protein 10.9%, fertiliser N 45 kg/ha)
Lag in adopting N-fertiliser in Australia

30 year delay in technology adoption is common in US Agriculture*

*Alston et al. (2009) Persistence Pays (Springer)
Wheat after canola yielded $0.8 \pm 0.17$ t/ha more than wheat after wheat.
Extreme example of the break-crop effect

Wheat after wheat
Yield 2 t/ha

Wheat after canola
Yield 5 t/ha
Gas from a piece of mustard root suppressed the take-all fungus. The active compound is isothiocyanate (R-N=C-S).

**Mustard root**  
(*Brassica juncea*)

**Take-all fungus**  
(*Gaeumanomyces graminis tritici*)

*Plant and Soil* 162, 107-112
Broad-leaf crops make up 12% of total dryland crop area

Soil Research 55, 413-416.
Agricultural lime-use* tracks the canola area in NSW

*Sources: ABARES and NSW mining royalties office
More N from perennial pastures?
Production – environment trade-offs for dryland crops and pastures

Production

Lose

Win

Fallowing
Sub & super
Sulfonyl urea herbicides

Break crops and N fertiliser
Conservation farming in dry environments
Early sowing/late maturity
Perennial pastures
Liming

Lose

Win

Environment

Direct drilling in wet environments
Organic farming
Criteria for innovation*

• Clear agronomic evidence

• Process understanding

• Adoption evidence from national / regional statistics

*Eric von Hippel (2005) Democratizing Innovation, MIT Press, online
WA wheat yields have not outstripped barley yields despite more breeding expenditure.
250 years of selective breeding for speedy racehorses!
What next?

Neutralising subsurface soil acidification in southern Australia

Providing phosphorus and legumes in the Brigalow Bioregion

Reducing N-immobilisation and/or rhizodeposition of fertiliser N