APSIM - Agricultural Production Systems Simulator

Assoc. Prof. Dr. Ahmad M. Manschadi

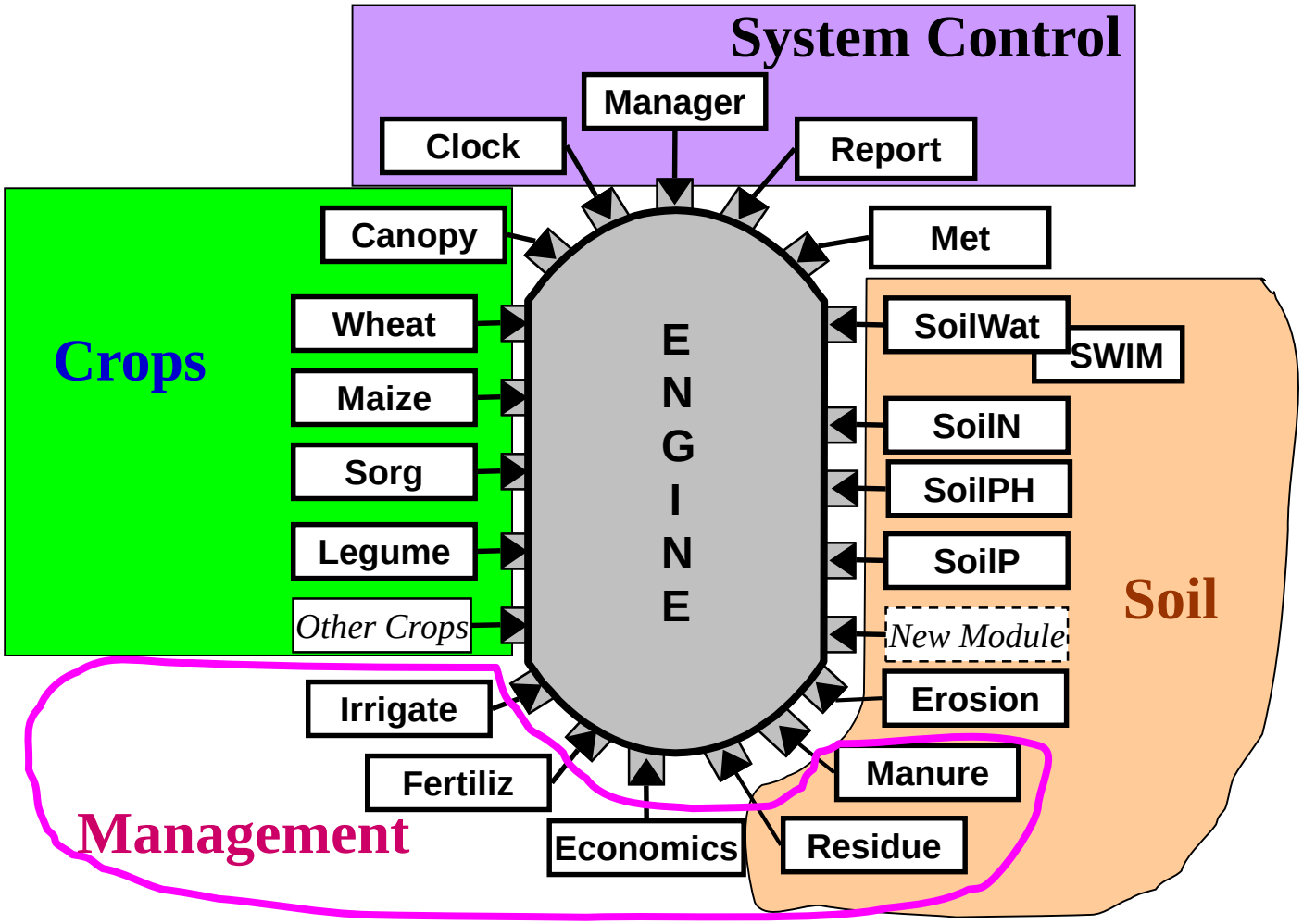
Outline

- APSIM
  - Design
  - Concept
  - Capabilities
- Testing and evaluation
- APSIM demonstration
- APSIM-Derived DSS Tools - WhopperCropper

- **APSIM development initiated in early 1990s**
- **APSRU (Agricultutal Production Systems Research Unit)**
- **Investment: more than A$ 13 million**

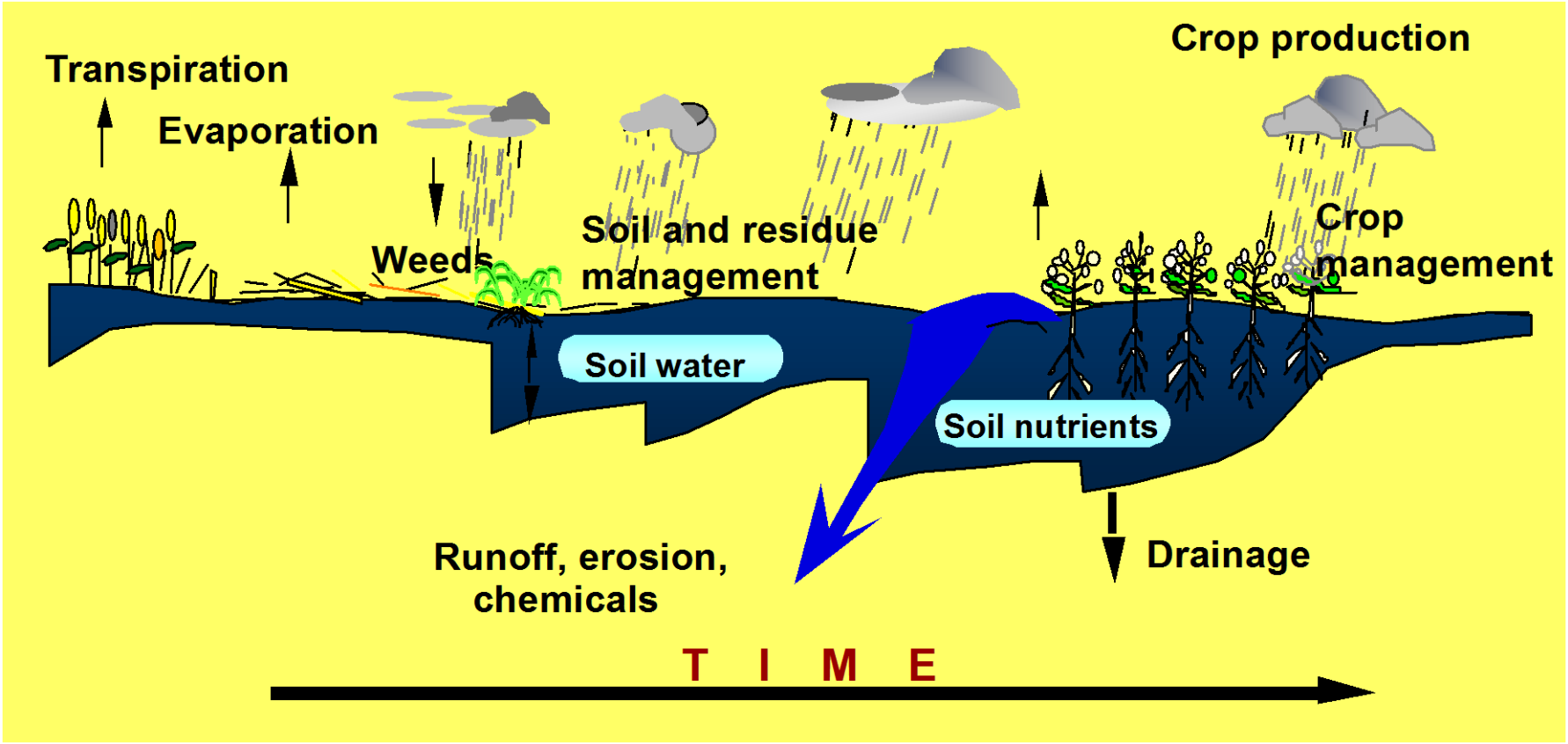
… the soil provides a central focus, crops, seasons and managers come and go, finding the soil in one state and leaving it in another …….

- **APSIM – A farming systems modelling framework**



- **APSIM simulates**
  - mechanistic growth of crops, pastures, trees, weeds ...
  - key soil processes (water, solutes, N, P, carbon, pH)
  - surface residue dynamics & erosion
  - dryland or irrigated systems
  - range of management options (fertilisation, tillage, irrigation, …)
  - crop rotations + fallowing + mixtures
  - biotic stresses (parasitic weeds)
  - dynamics of populations (eg. weed seedbank)
  - short or long term effects
  - high software engineering standards

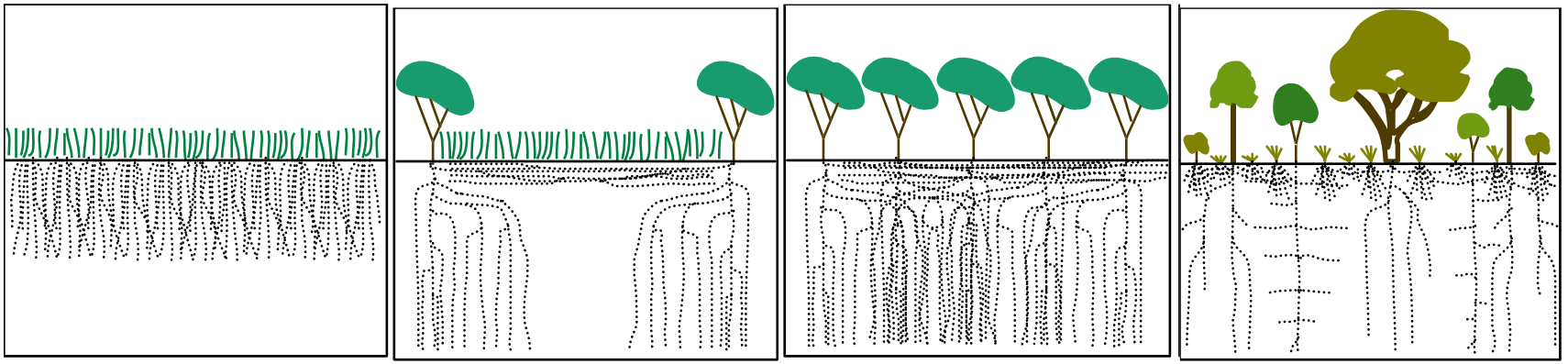
- Systems simulation over time



- Systems simulation across different scales

gene – crop – farm – catchment - region

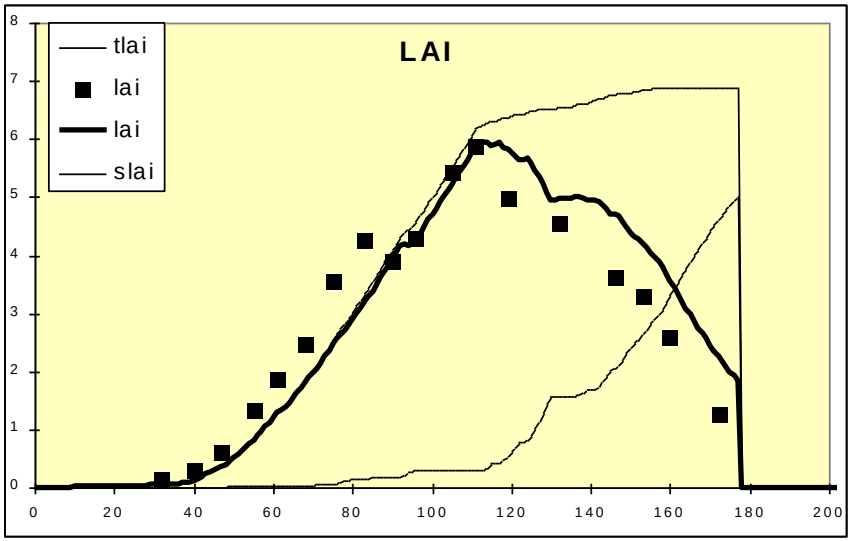
- Systems simulation of the cropping, novel agroforestry systems and native woodland

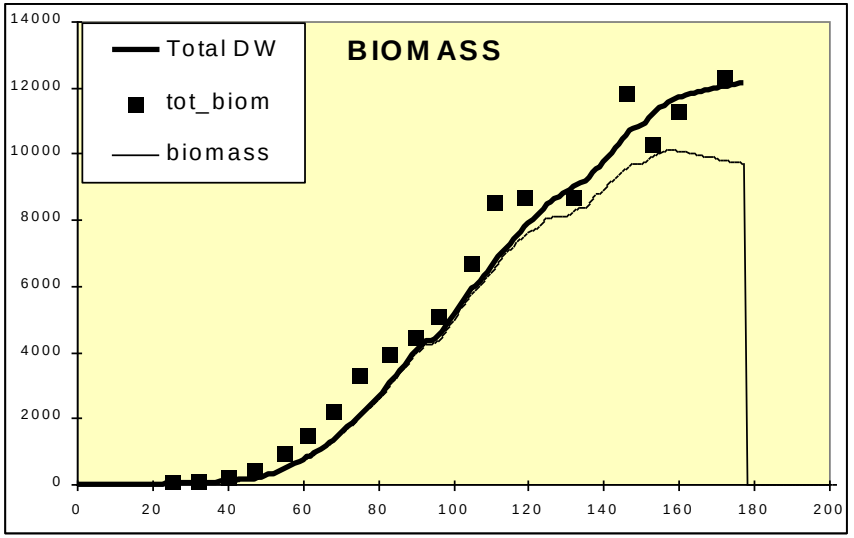


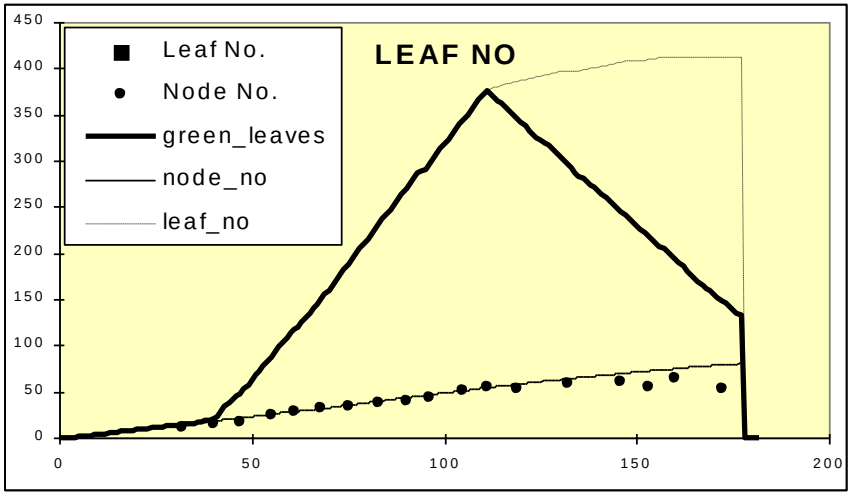
Example APSIM applications

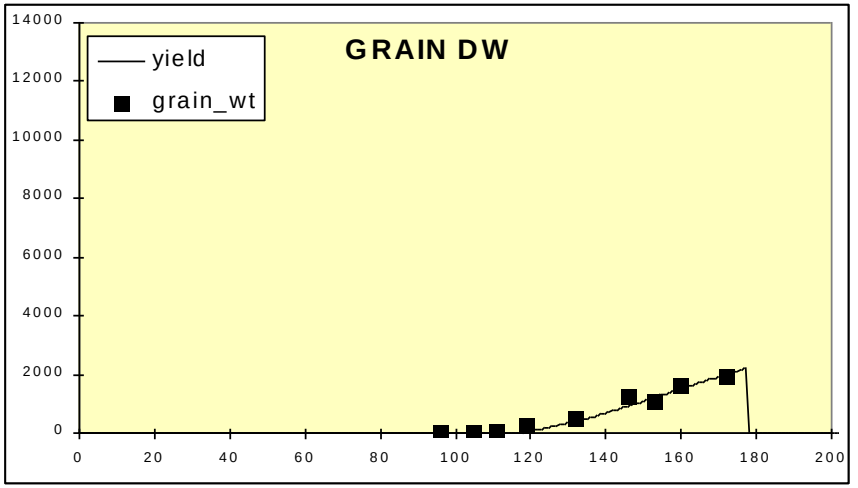
- **cereal-legume** rotations **(Probert et al.1995)**
- ley farming **systems (Carberry et al. 1996)**
- intercropping **systems (Carberry et al. 1996)**
- alley **farming systems (Nelson et al. 1998)**
- drought **policy formation (Keating & Meinke 1998)**
- erosion **impacts (Connolly et al. 1998)**
- **genetic** trait **identification (Robertson et al. 1999)**
- **seasonal** climate forecasting **(Hammer et al. 1999)**
- on-farm trial **analyses (Robertson et al. 1999)**
- agribusiness **value chain (Brennan et al., 2000)**
- climate change **impacts (Howden et al., 1999)**
- **tree** windbreak **systems (Carberry et al. 2001)**
- **deep** drainage **assessment (Keating et al., 2001)**
- **soil** acidification **(Verburg et al., 2001)**
- **risk assessment of** GMO **(Smith et al. 2001)**
- effluent **irrigation (Brennan et al., 2002)**
- agroforestry **systems (Huth et al., 2002)**
- crop-weed **competition (Keating et al. 1999)**
- parasitic weeds ***Orobanche*** (**Manschadi et al. , 2004)**
- smallholde**r farming systems (Carberry, 2004)**

...crop growth & development



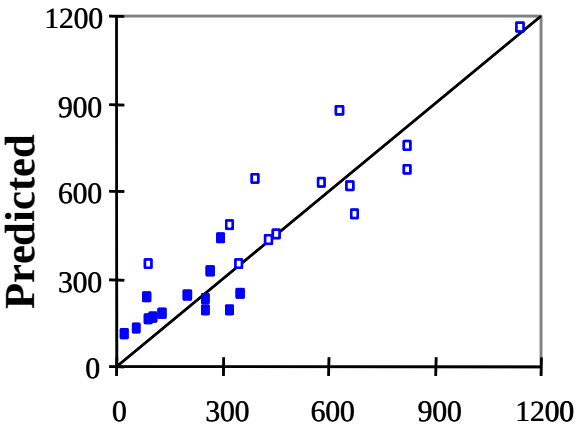




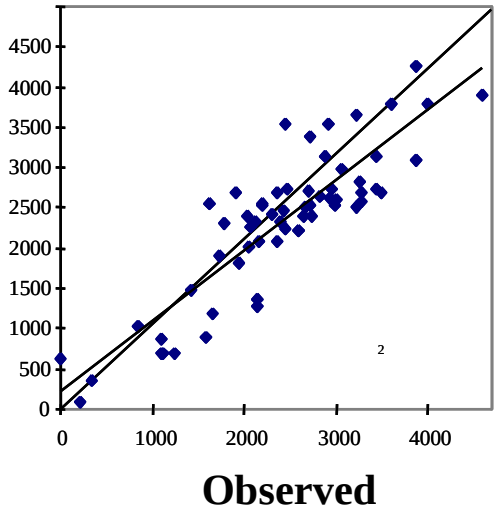


- **…yield of experimental crops**

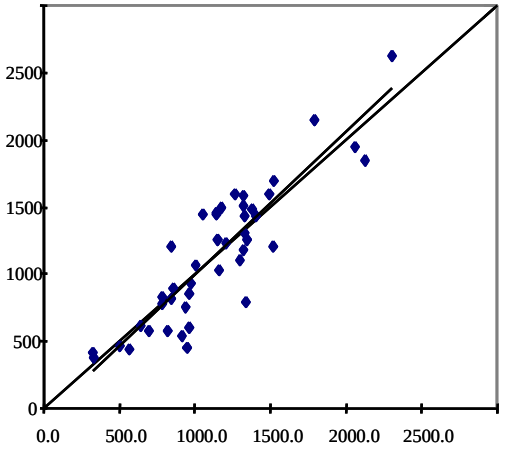
Cowpea



Chickpea

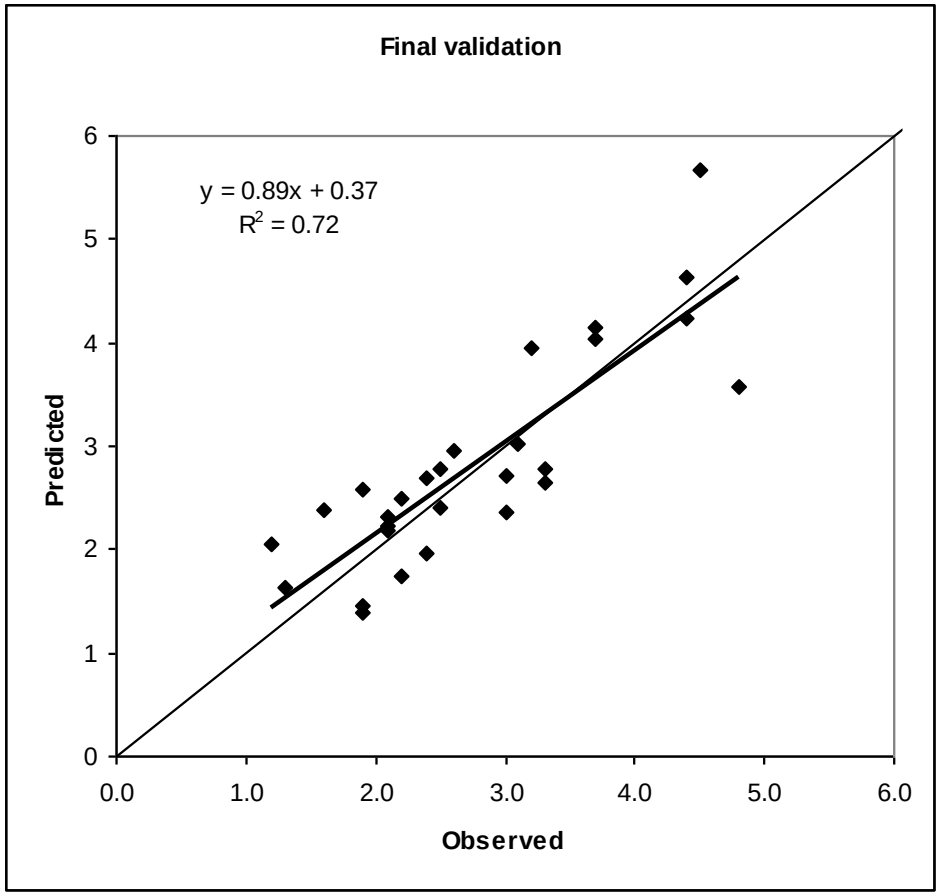


Mungbean



Prediction	n	regression line slope	regression line intercept	R^2
wheat grain	43	1.07	-13.0	0.79
maize grain	111	0.98 (± 0.04)	-5.5 (± 240)	0.85
chickpea grain	60	0.90 (± 0.07)	163 (± 172)	0.76
mungbean grain	47	1.07 (± 0.10)	-27.2 (± 128)	0.72
cowpea grain	15	0.93 (± 0.08)	-31.6 (± 34.6)	0.91
stylo biomass	63	0.84 (± 0.06)	-131.7 (± 171)	0.78

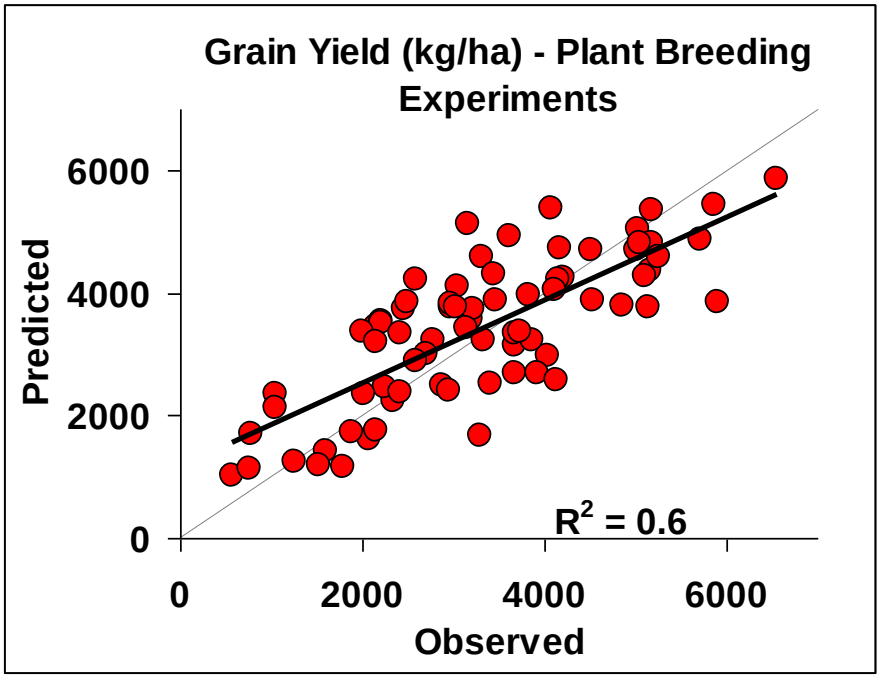
…yield of commercial crops

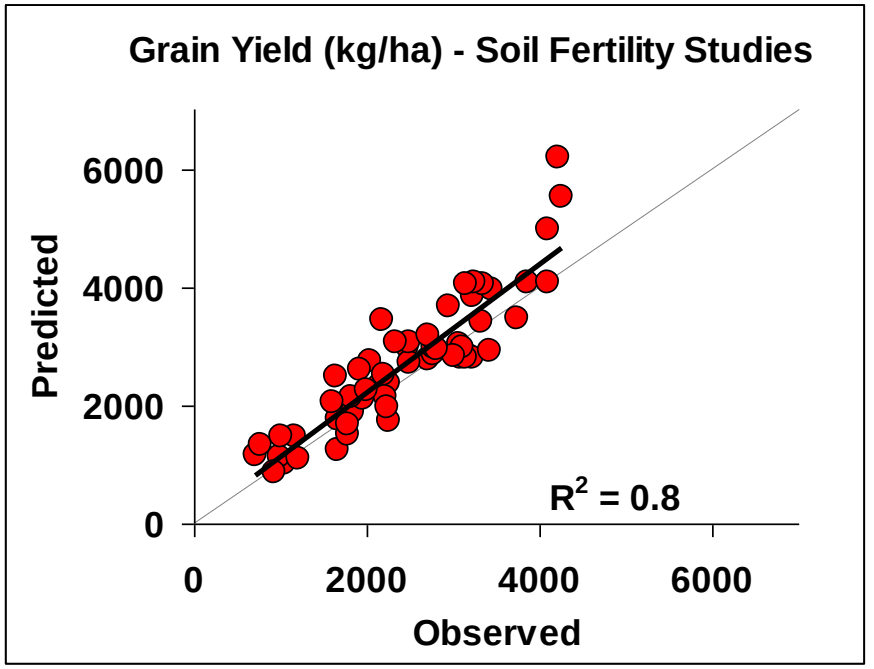


- **Vic Mallee / Wimmera**
- **Wheat in 31 paddocks**
- **Yields ranging from 1 – 5 t/ha**
- **APSIM simulated >70% variation**

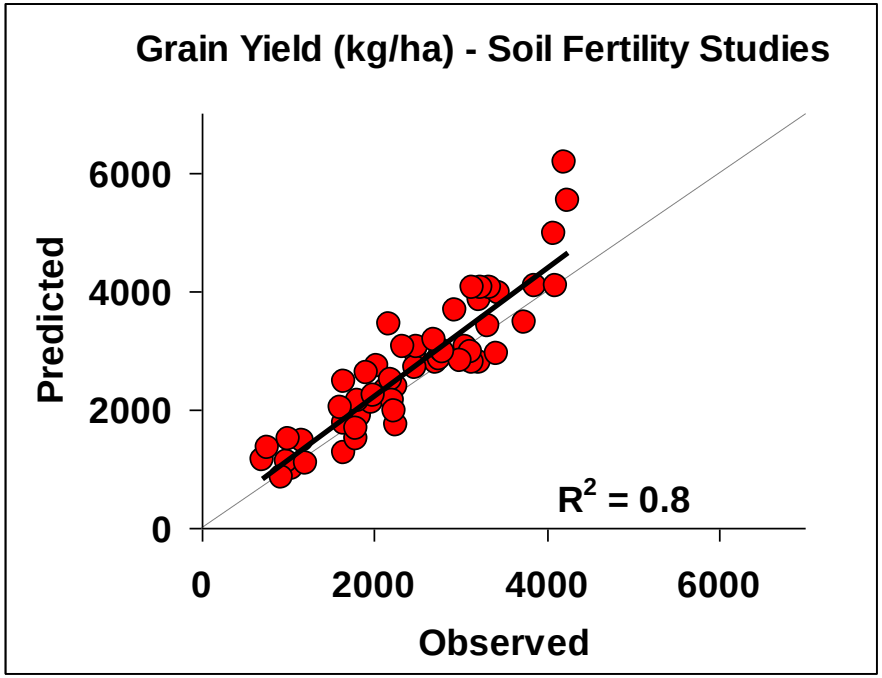
=> confidence to promote as a commercial service in 2004

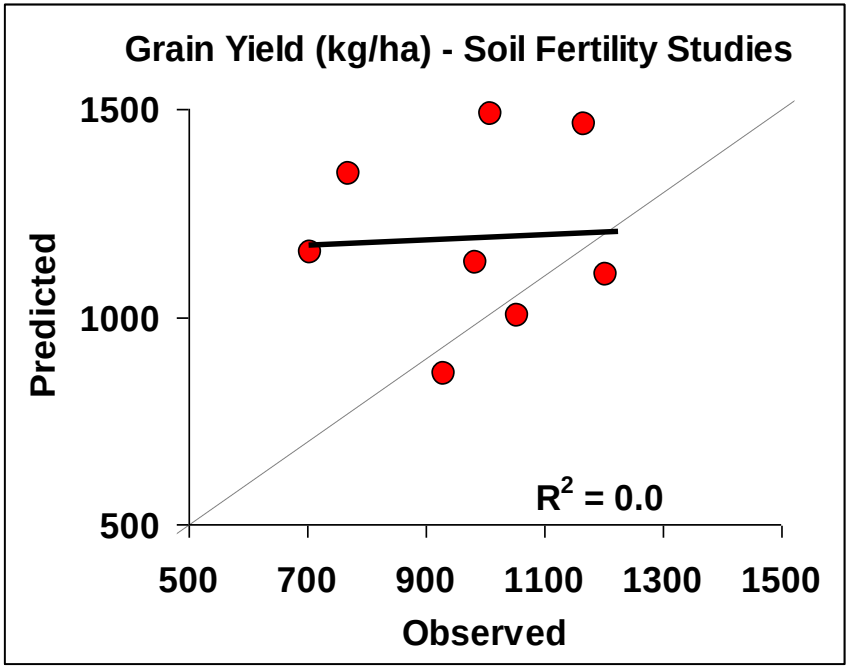
…performance of wheat module



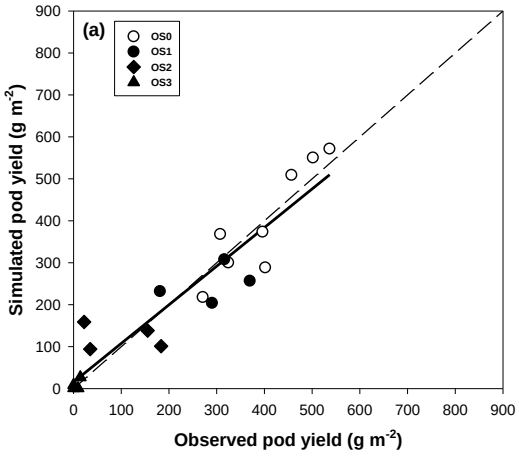


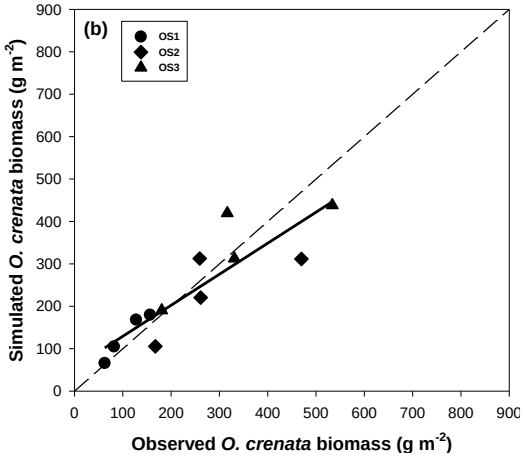
…performance of wheat module

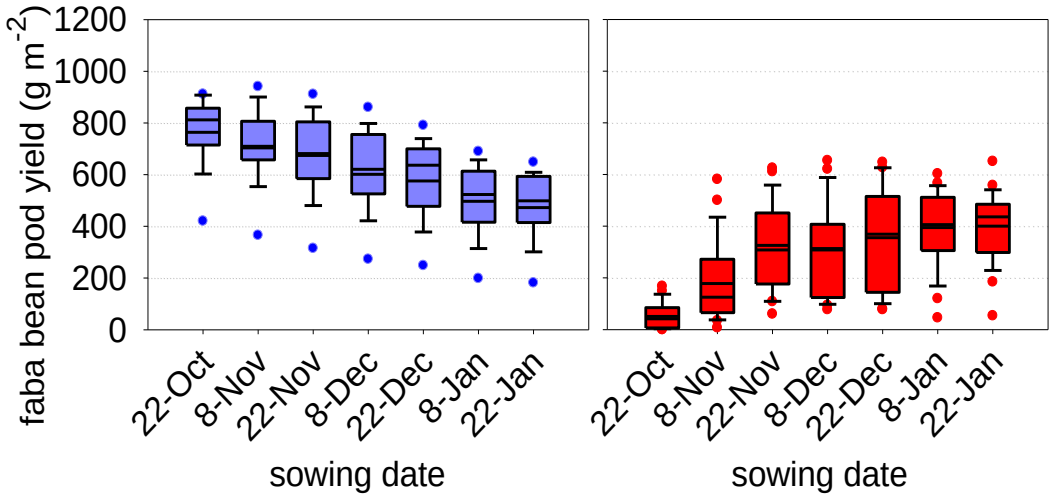




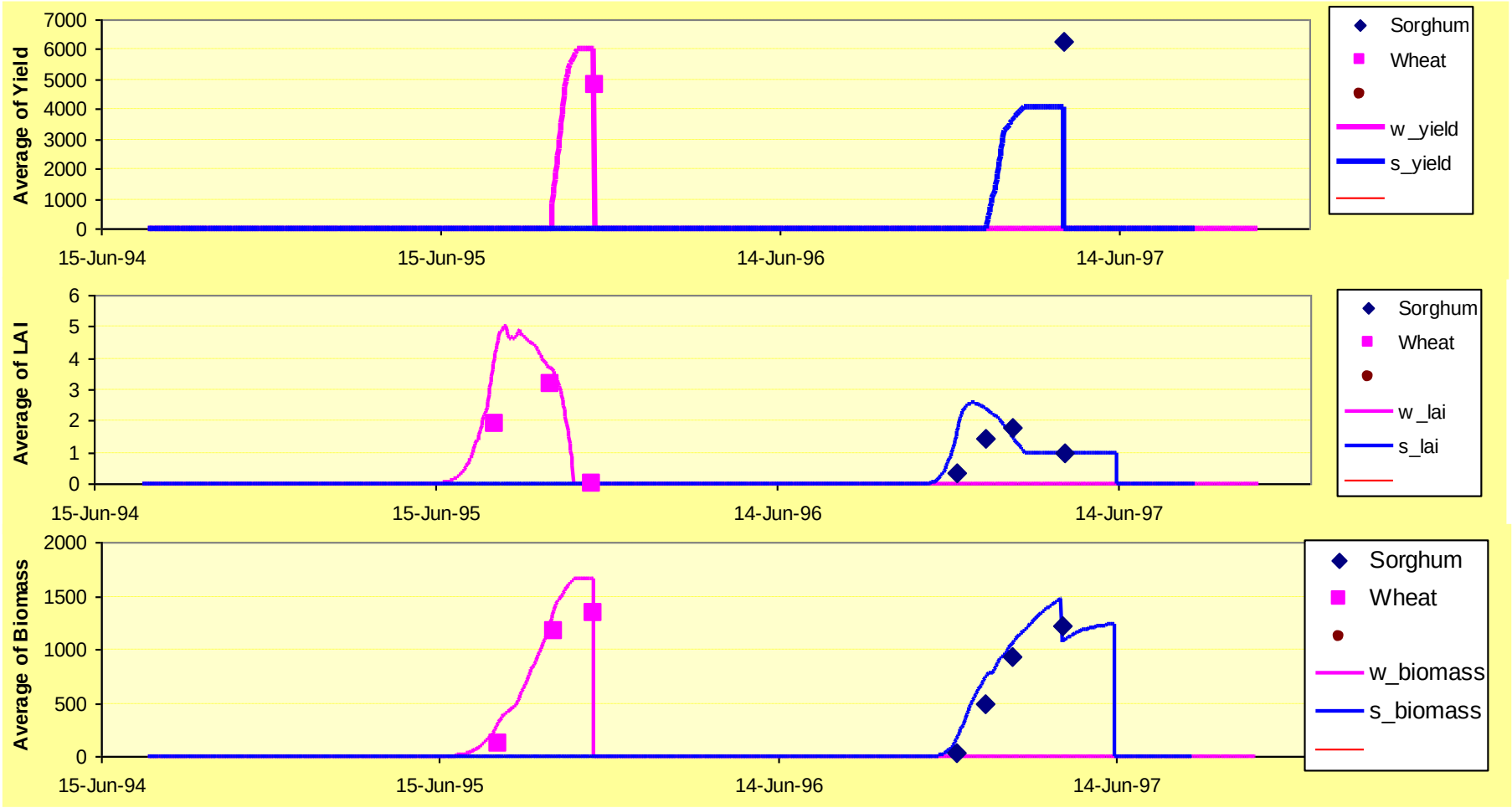
... yield responses to biotic stresses



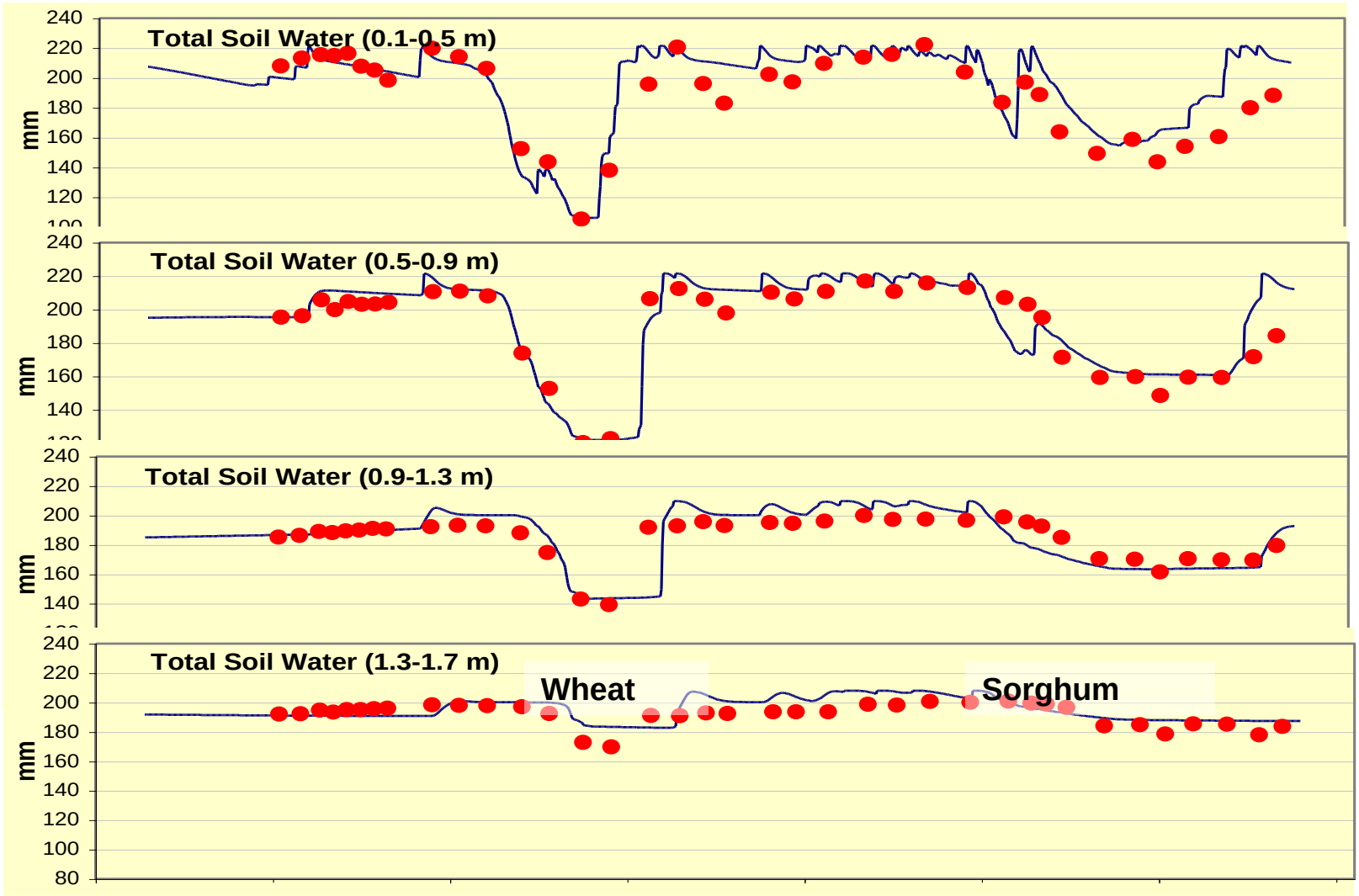




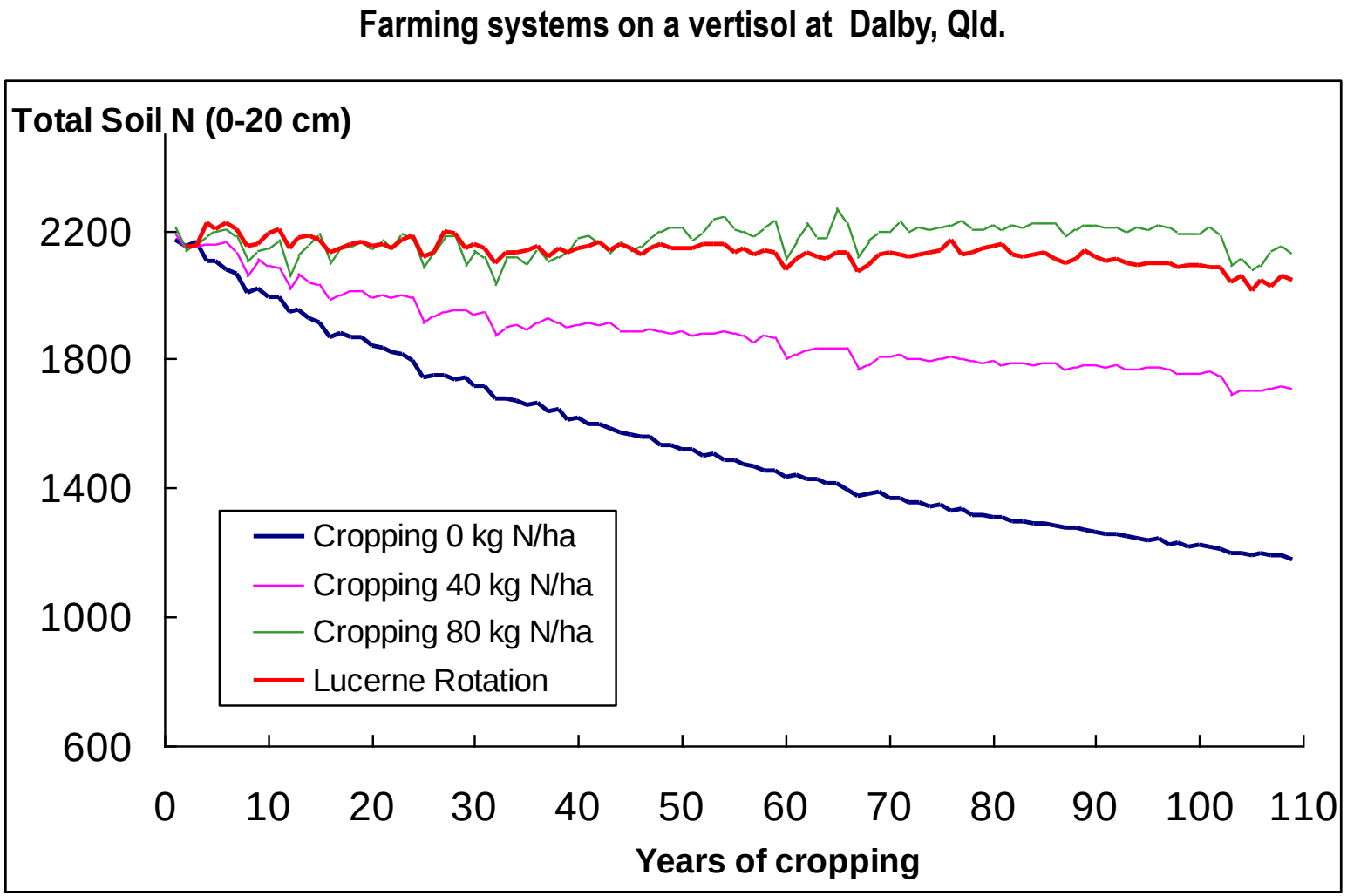
… yield of crops in rotation



… soil water of crops in rotation



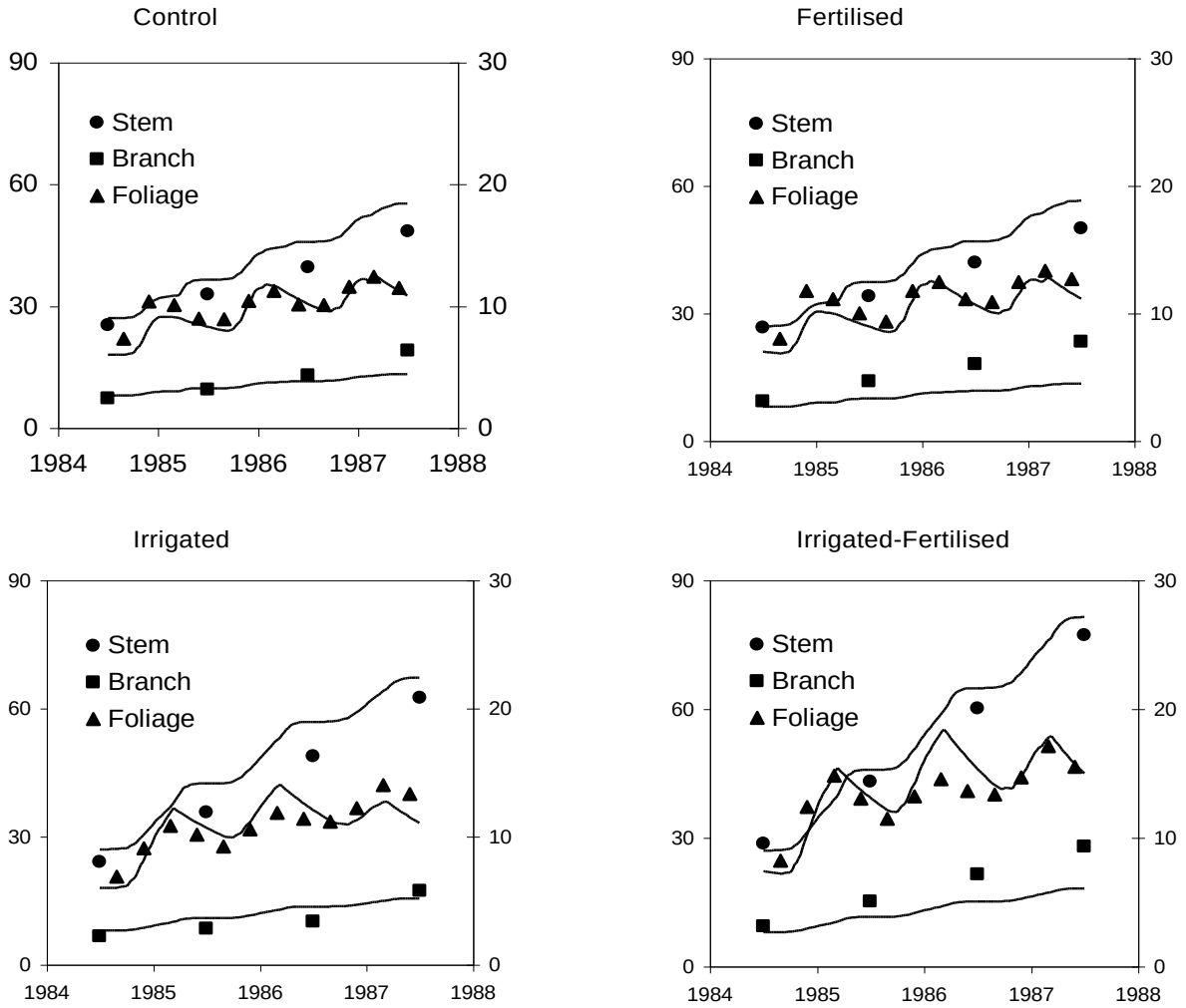
… soil organic matter changes



… tree growth

- Pierces' Creek
- near Canberra
  (35^{o} 21'S, 148^{o} 56'E)
- Annual Rainfall 790mm
- 10 y.o. **Pinus Radiata**
- Stocking Rate 700/ha

Forest productivity in response to management



Further information:

Keating, Carberry, Hammer, Probert et al. (2003). "An overview of APSIM, a model designed for farming systems simulation." European Journal of Agronomy 18(3-4): 267-288.

APSIM Homepage (https://www.apsim.info)