Canola Physiology, Tactical Agronomy and Simulation
GRDC Canola Initiative

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SUSTAINABLE AGRICULTURE FLAGSHIP
www.csiro.au

GRDC Grains Research & Development Corporation

GRDC Investment Plan 2013/14

Optimised Canola Profitability

Understanding the relationship between **physiology** and **tactical agronomy** for effective response to **production variables**

- $1M pa for 5 years (June 2014 to 2019)
- All NVT regions (9) sth QLD to Eyre Peninsula – low to med rainfall
- CSIRO (Physiology/phenology/modelling)
- NSWDPI/SARDI (Field sites and Tactical Agronomy)

GRDC Investment Plan 2013/14

"....robust information explaining specific adaptation of canola varieties to make more profitable variety, input and management decisions..."

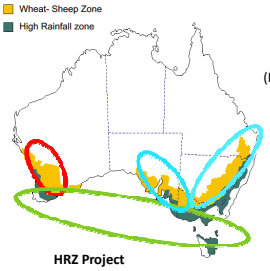
Breeders NVT — G x E x M — Agronomists Growers groups

X

R_{isk}

Farmers

Integrated National Projects

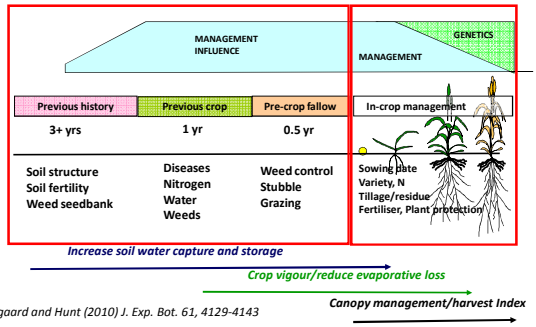


"Eastern" Project
NSW/SARDI
(McCaffrey/Brill/Ware)
CSIRO Team
Kirkegaard/Lilley
Whish
McBeath

WA Project
Mark Seymour DAFWA
Heping Zhang CSIRO

HRZ Project
Penny Riffkin

A recent example – improve WUE in wheat



Kirkegaard and Hunt (2010) J. Exp. Bot. 61, 4129-4143

Summer fallow management - valuable?

- Pre-experimental modelling (37 sites)
  Summer rainfall contributes **33% (1 t/ha)** to yield (0.1 to 2.0 t/ha)
  Hunt and Kirkegaard (2011) Crop and Pasture Science 62, 915-929.
- Experimental validation (20 experiments, 6 regional groups)
  Strict weed control, stubble > 70% cover = **Extra 37mm water and 44 kg N**
- **Synergies with other management and varieties**
  Platform for earlier sowing, and improved distribution of water use
- Rapid adoption
  Low risk strategy, **$5.70 return on $1 investment**; Widely and rapidly adopted

G x M to capture benefits

- Strict summer weed control, stubble >70% cover

  In 20 experiments, extra 37 mm water and 44 kg/ha N = ($5.70 return)

- **Early sowing of later-maturing wheat (same flowering window)**

  Deeper roots, reduced evaporation, higher yield potential

- Wider rows/lower density and deferred N to maintain high HI

  Avoid excessive early biomass from early sowing

- Whole-farm multiplying effect from improved timeliness

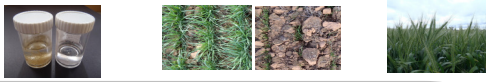
  Increases in whole farm wheat yield of **11 to 47%**

Experiment Junee 2012 (177 mm rainfall)

- Yield increase 0.6 to 1.9 t/ha, $562/ha increase in gross margin

Grain yield (t/ha)	50 plants/m²	100 plants/m²
EGA Eaglehawk (18 April)	5.9*	6.1
Bolac (26 April)	5.8	5.5
EGA Gregory (8 May)	5.1	5.2
Lincoln (17 May)	4.3	4.0
P-value	0.034	
LSD (p=0.05)	0.3	

- Deeper roots, less evaporation, better water use, higher yield potential



Experimental Focus

- Review (with WA and HRZ teams) to focus on what is new.....

  e.g. Recent *"Better Oilseeds"* guides recently developed

- Focus on trajectory of biomass in relation to water/N supply

  Sowing date, density, N, variety

- "New physiology" in varieties underpinned by hypotheses

  RUE, NUE, Stress

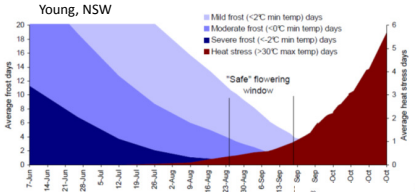
- Canola in a "system"

  Pre-crop management vital; systems benefit drive sound decisions

Meeting with GRDC re CSIRO Canola proposal

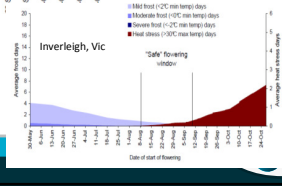
Applying modelling and simulation

Young, NSW



- Optimum flowering windows
- Frost and heat risk

Inverleigh, Vic



Example of possible output

Summary of:

4 cultivar phenology types

Safest sowing window

Sowing opportunity in window

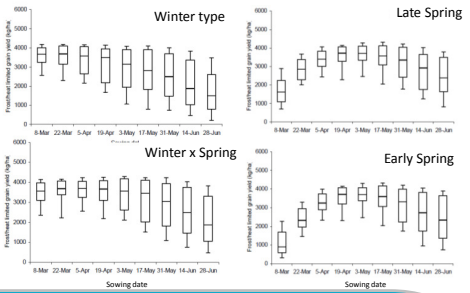
Potential yield

Data presented for:
crop density of 60 plants/m²
150 kg N/ha available at sowing
100 kg N/ha (added at bud visible).

Location	Cultivar – phenology type	Sowing window intervals							Mean potential yield (t/ha)
		8 Mar	22 Mar	5 Apr	19 Apr	3 May	17 May	31 May	14 Jun	28 Jun	
Kojonup	Taurus	16%									3.5
	CBI406		33%								3.5
	46Y78					59%					3.5
	Hyola 50					93%					3.3
Esperance	Taurus	7%									3.8
	CBI406		20%								3.7
	46Y78				44%						3.6
	Hyola 50					57%					3.6
Cummins	Taurus	10%									4.1
	CBI406		15%								4.0
	46Y78					70%					3.9
	Hyola 50					70%					3.7
Naracoorte	Taurus	15%									3.6
	CBI406		42%								3.5
	46Y78					85%					3.4
	Hyola 50					77%					3.4

Variability and risk

Variability in frost-heat limited canola yield for 4 cultivar-phenology types



Implications and opportunities

- Links to existing GRDC Initiatives
  - **National Pathology Program**
  - Break-Crop Initiative
  - Stubble Initiatives
- Links to breeding companies, NBGIP and NVT
  - Road-testing G x M ideas under relevant/contemporary agronomy
  - Test new physiological hypotheses
  - Early chance to investigate physiology behind variety performance

Timeline and details

- Western and HRZ projects commenced in 2013
- Eastern Project contract in March 2014
  - Review of existing data (June to Dec 2014)
  - Preliminary experiments at selected sites in 2014
  - Workshop early 2015 - full plan endorsed by GRDC
- By Feb 2015 – Integrated National Project

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Canola growth and development

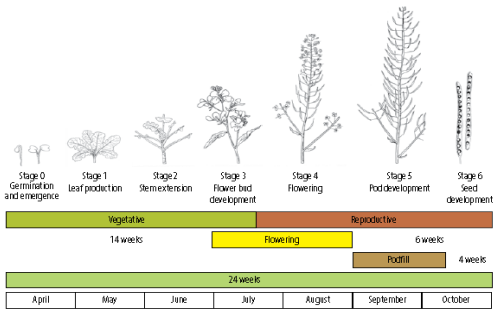


Figure v. Growth stages of canola. Source: DPI

Recent CSIRO Modelling and Simulation

- **CSP00132 (2009-2012)**
  - **GxExM in the HRZ**
    - 13 sites
    - 9 sowing dates (March to June)
    - 4 cultivars (spring / winter, early / late)
    - 4 Densities (20, 40, 60, 80 pl/m2)
    - 3 N rates (50, 150, 250 kg/ha)
    - 432 combinations per site
  - **Outcome**
    - Frequency of sowing opportunity
    - Optimal flowering window (frost and heat stress)
    - Yield variability, optimising cultivar choice
  - **Deficiencies in the APSIM model**
    - Biomass accumulation of modern cultivars
    - Phenology parameters for modern cultivars
    - Heat and frost impacts on grain filling
    - Crop N accumulation
    - Grain quality

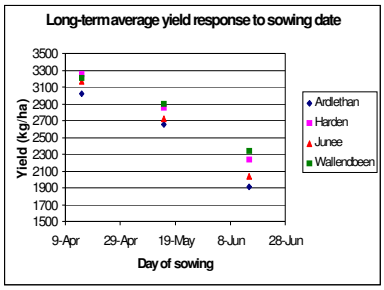
Experimental Variables

- **Years** 4 (2014-2017)
- **Locations** Main 9 regions
- **Sowing date** Very early, early (*timely*), mid-late
- **Variety**
  - Maturity (early, early-mid, mid, mid-late)
  - Growth/Vigour (Conventional, TT, hybrid)
  - Herbicide (TT, Roundup Ready, Clearfield, Conventional)
  - Company (PacSeeds, Pioneer, Nuseed, others…)
- **Density** Row spacing, Seeding rate
- **Nitrogen** Rate, Timing, Form
- **Irrigation** Pre-sowing soil water; In-crop irrigation

Minimum data sets for APSIM (and physiology)

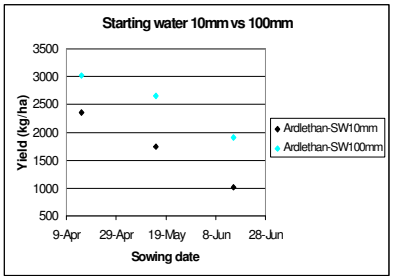
Measurements	Importance	Notes
Soil characterisation	Essential	Paddock characterisation or appropriate soil from APsoil database. Drained upper limit, lower limit Starting water, N are essential
Daily Max, min temp, rainfall	Essential	
Biomass		
6-8 leaf biomass sampling	Important	Stem & leaf components ideal, leaf area ideal
Bud visible biomass sampling	Important	Stem & leaf components ideal, leaf area ideal
50% 1st flower	Important	Stem & leaf components ideal, leaf area useful
End of flowering	Useful	
Maturity	Essential	Yield essential, total biomass important
Phenology		
Emergence	Important	Date, estimate of density
Bud visible	Important	Date
50% plants have at least 1 flower	Essential	Dates from 2x weekly visits
End of flowering	Useful	Date
Maturity	Important	Date
Other		
Stress indices	Essential	Assessment of frost damage if it occurs
N accumulation	Useful	N analysis of tissue at detailed sites
Light interception	Useful,	• Approx Fortnightly (depending on growth rate) until full interception • may substitute / for leaf area measurements • Some locations will benefit from light interception measurements to compliment leaf area measurements
Date of reaching full light interception	Important	Weekly assessment close to canopy closure
Management notes	Essential.	

Modelling output - site and sowing date



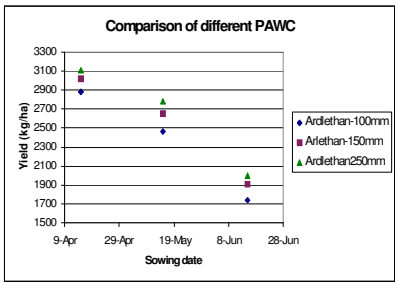
**150mm PAWC. 100mm Starting soil water. April 15, May 15, June 15 Sowing dates. Average yield across 23 year model run.*

Modelling output – effect of stored soil water



**150mm PAWC. Cv Oscar. Ardlethan. Average yields across 23 year model run.*

Modelling output – effect of PAWC



**Cv Oscar. Ardlethan. Starting soil water 100mm. Average yields across 23 year model run.*