Phosphate availability and green manures

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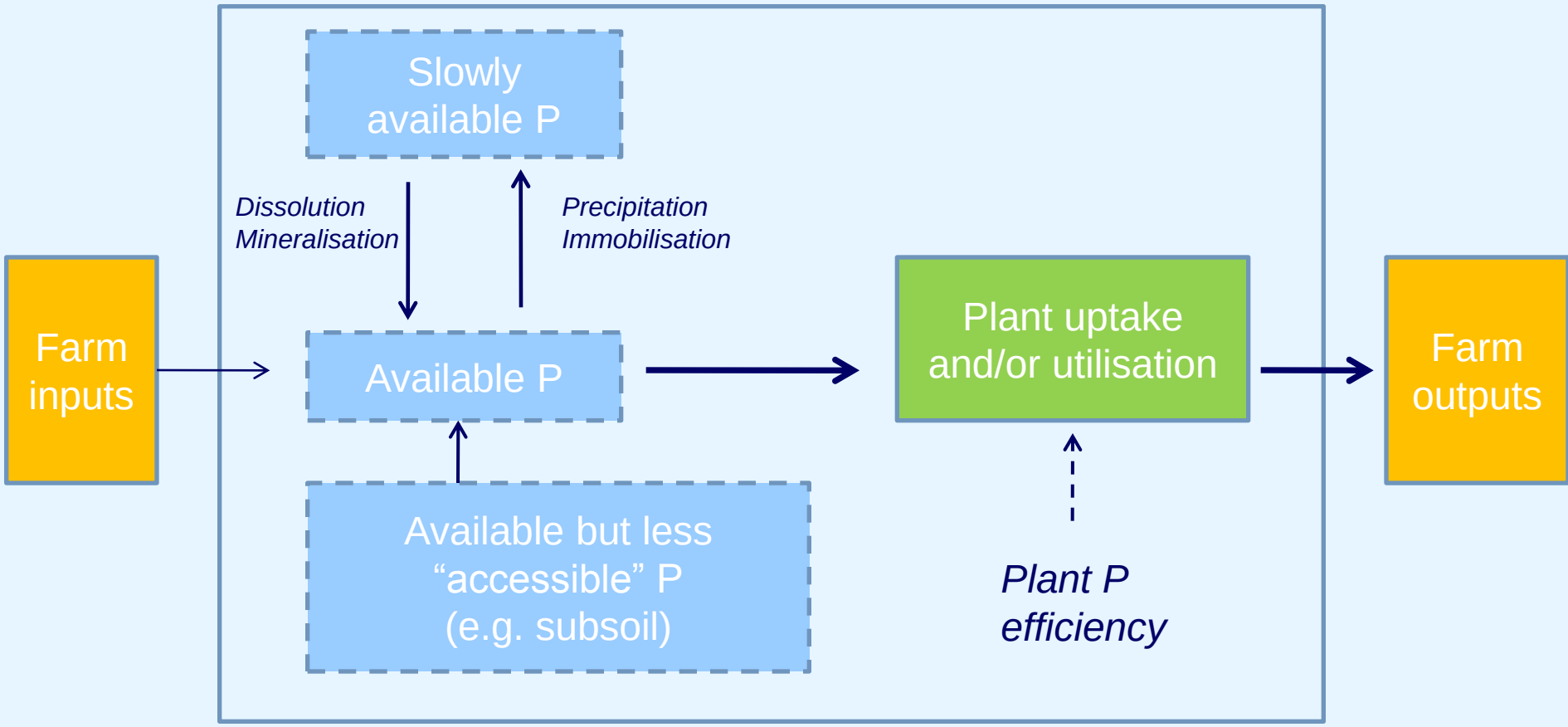
LINK collaborative research



From Cornish (2009)

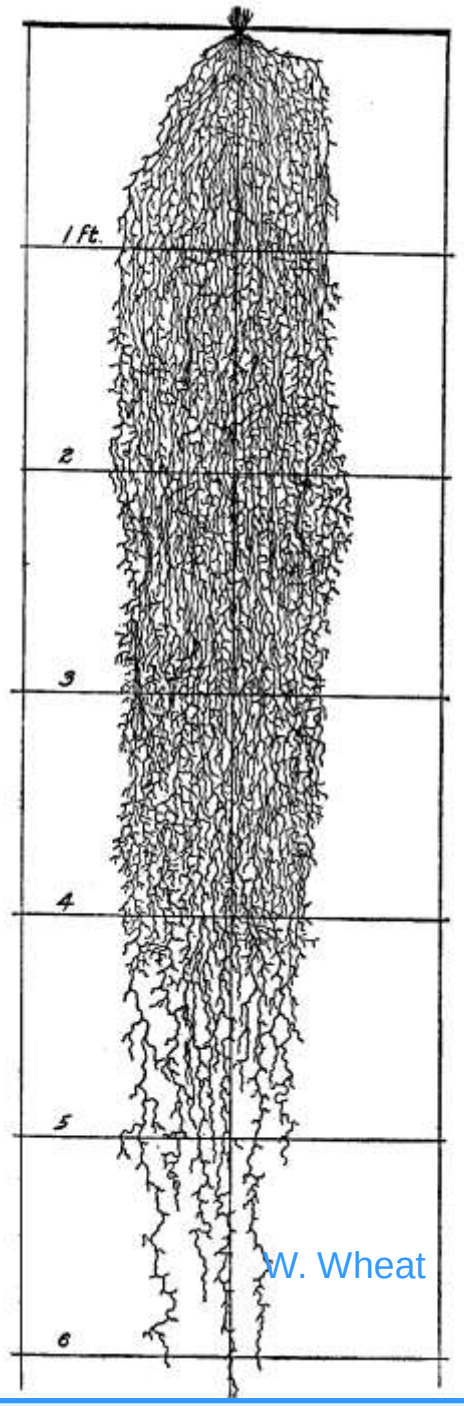
A spectrum of P management options

PHYSICAL	**Good soil structure**
CHEMICAL	**Phosphate source (fertilizer)** **pH**
BIOLOGICAL	**Add enzymes**
	Add fungi (increase effective root length)
	Plant efficiency (varieties, root architecture, translocation, phosphatases, anion secretion etc)
ECOSYSTEM	**Rotations, green manures, cover crops, long pastures**

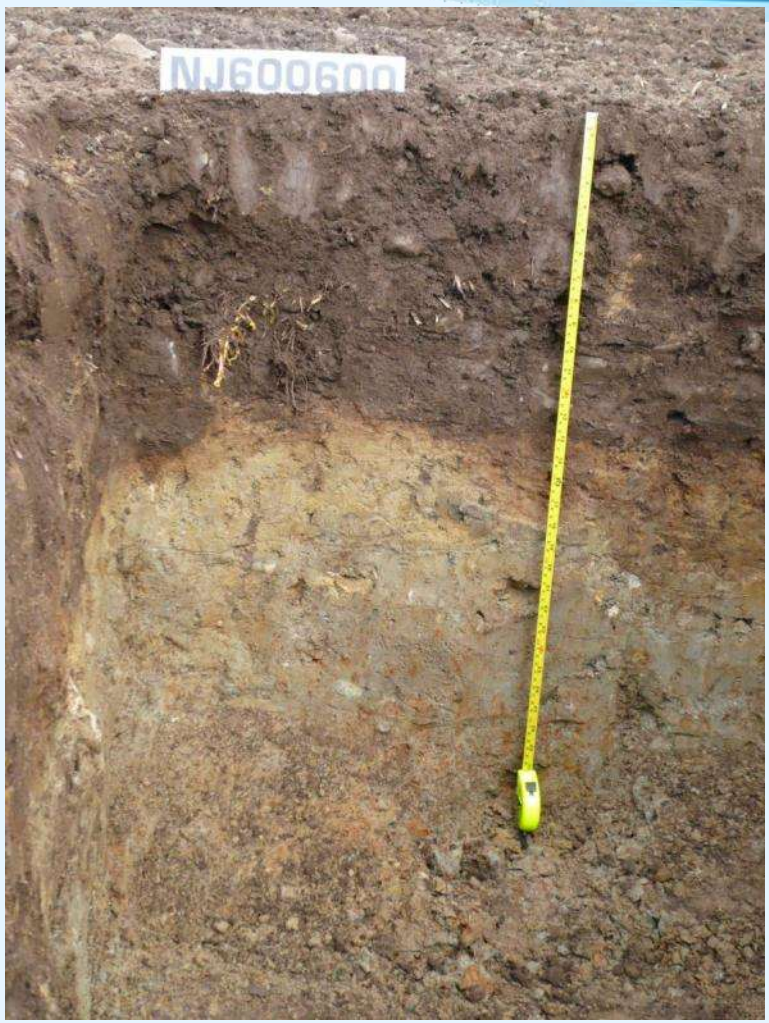
Adapted from Conyers & Moody (2009)

CROP ROOT SYSTEMS

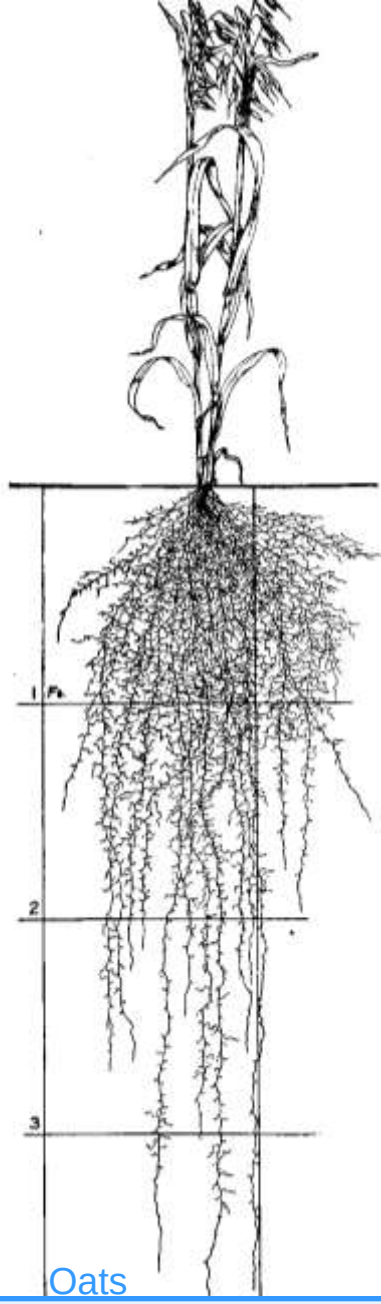
(Weaver 1926; Weaver & Bruner 1927)



W. Wheat

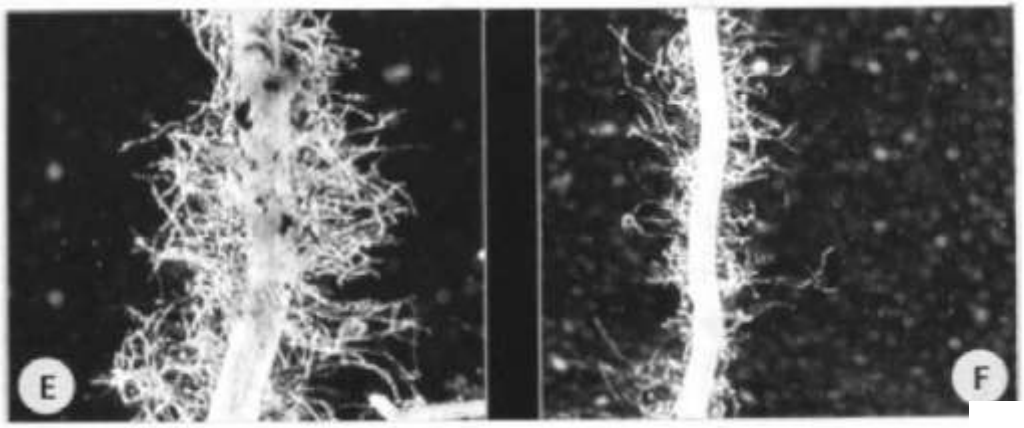


(MLURI W Towers)



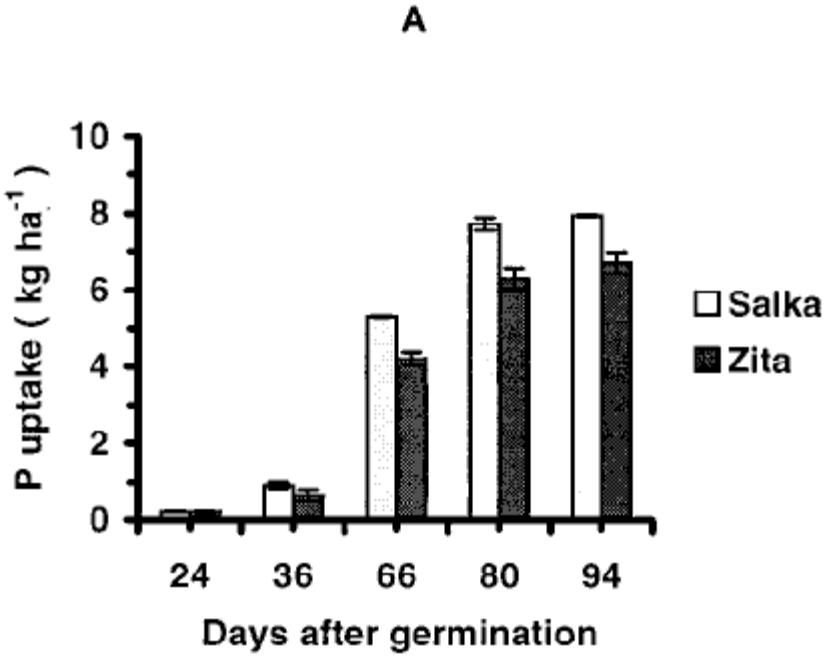
Oats

Root hairs and P uptake of barley varieties in the field



Salka Zita

Gahoonia et al. 1999



So can we design rotations to use P efficiently?

Green manures/cover crops

- Traditionally regard them as either adding N (through fixation) or preserving N (preventing leaching)
- But they also have potential as biological engines for P – they don’t add P but they can change both the amount and forms of P for the following crop

Rotational Aspects

- Autumn sown green manures (GM)
  - GM crops chosen for their perceived ability to liberate P
  - GM established in the autumn
  - Incorporated prior to spring crop
- Spring sown crops
  - Crops grown for their perceived ability to liberate P and use it directly themselves
  - Potential P benefits later in the rotation

Autumn sown green manures

GM yield in spring (Dry tonnes / ha)

Crop	+PR	-PR	% Change from -PR
Fallow	0.70	0.46	152
Mixed Brassica	0.78	0.51	152
Field Beans	0.98	0.82	120
Forage Rape	0.58	0.37	157
Forage Rye	0.68	0.48	142

GM P Uptake (kg / ha)

Crop	+PR	-PR	% Change from -PR
Fallow	2.32	1.39	167
Mixed Brassica	2.49	1.57	159
Field Beans	3.39	2.77	122
Forage Rape	1.91	1.14	168
Forage Rye	2.09	1.32	158

Data from Abbey Home Farm site

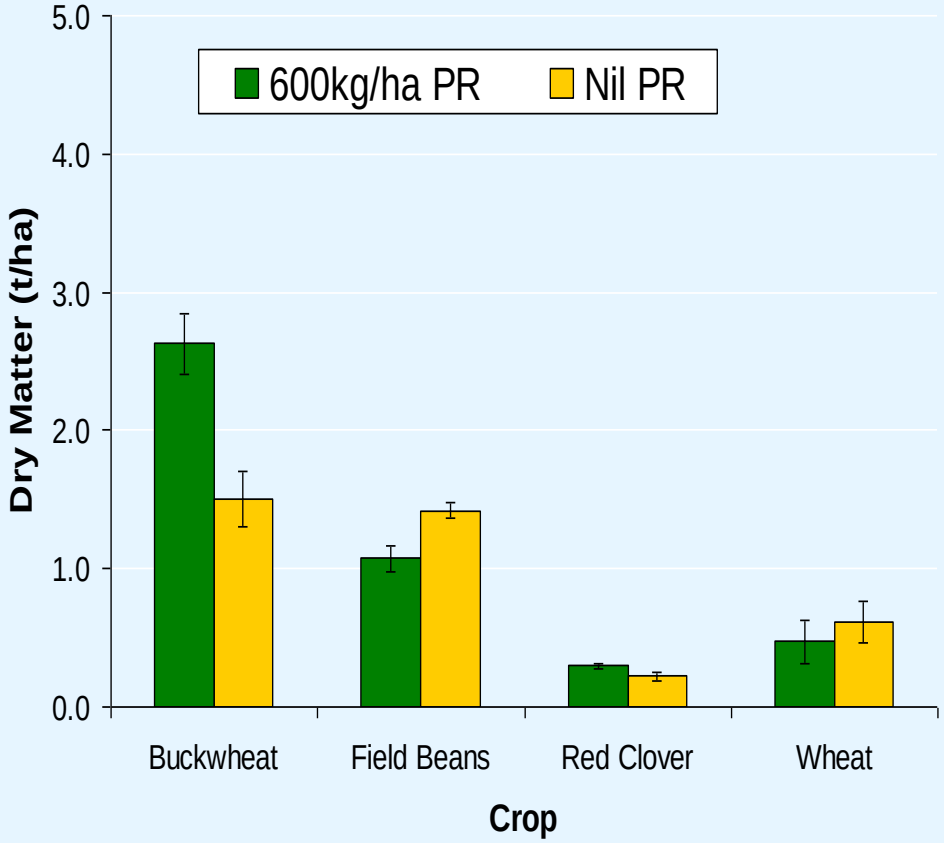
Spring sown crops

Windshiel Farm

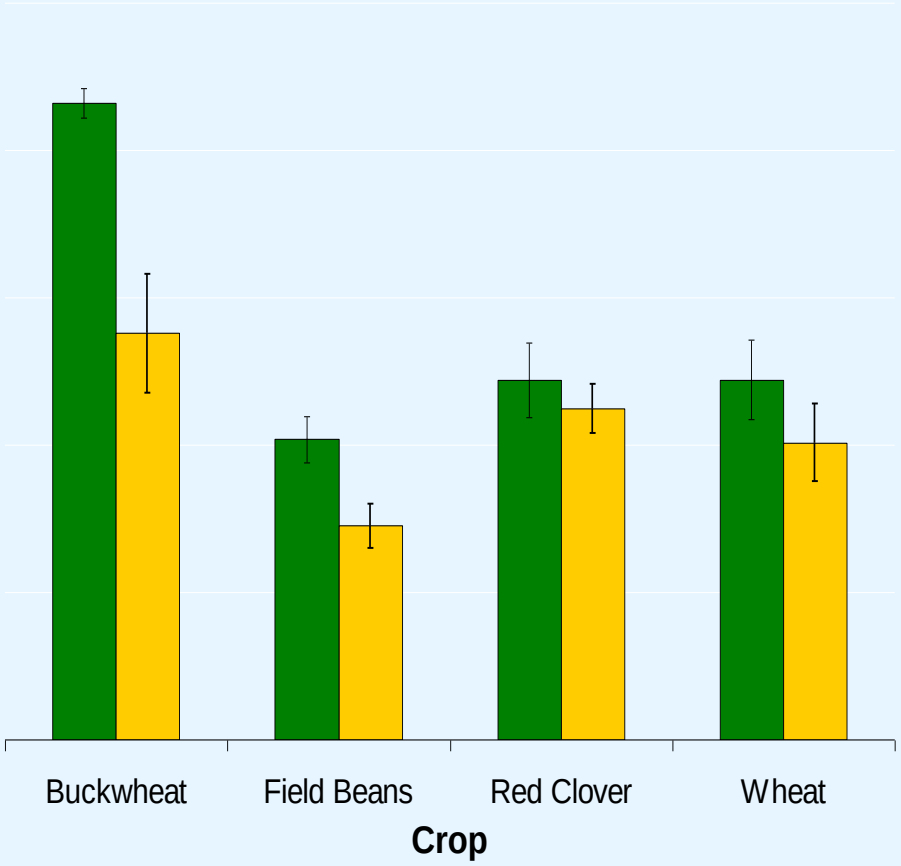
Buckwheat

Spring sown crops: Crop biomass

Mid season sample

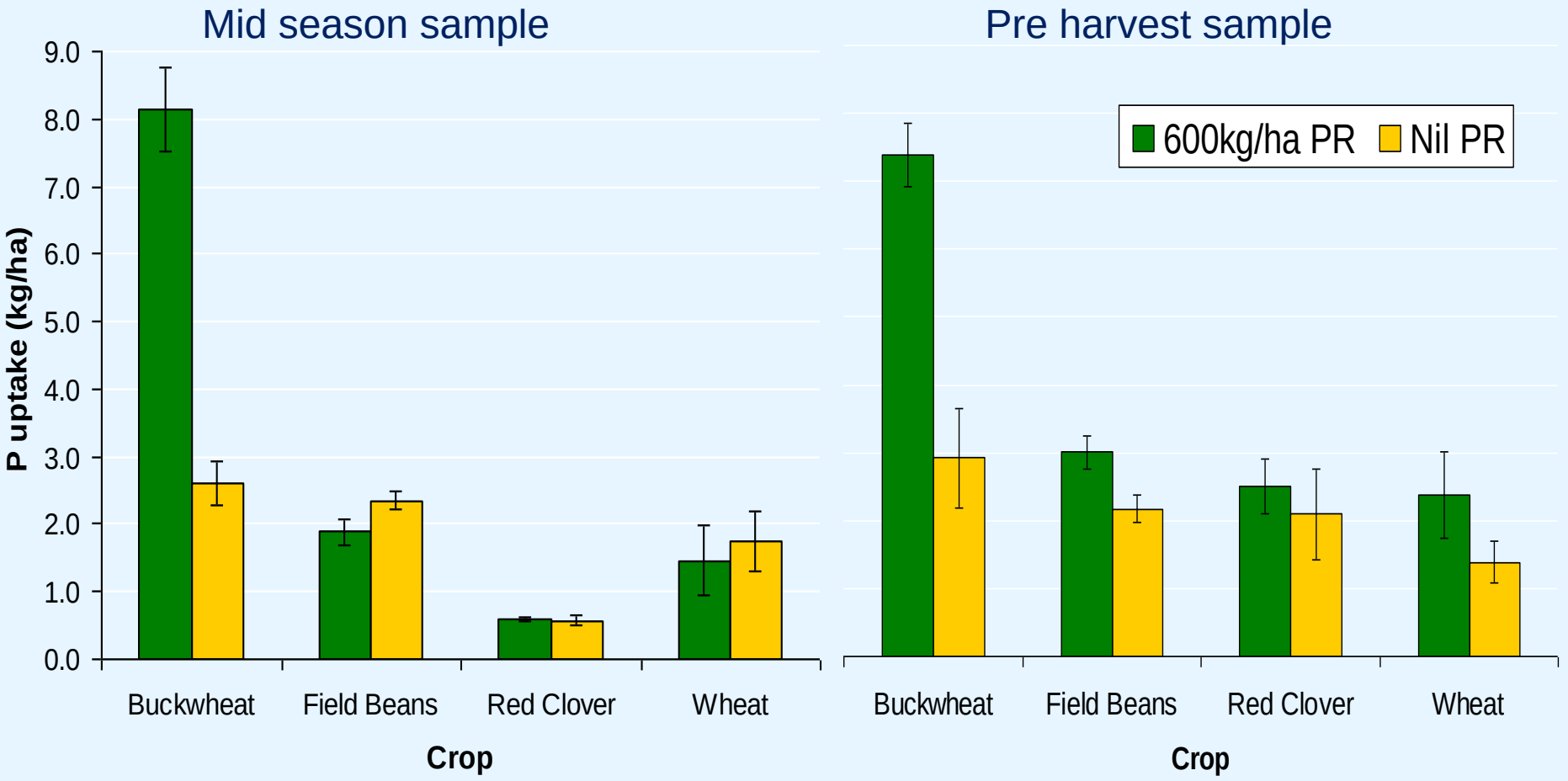


Pre harvest sample



Data from Windshiel Farm

Spring sown crops: P uptake



Data from Windshiel Farm

Compost field trial 2009

Compost

- Composting started 16th January 2009
  - Organic Recycling Limited on concrete pad
    - uncovered
  - PAS100 standard
  - Substrate
    - 2 tonnes wheat straw
    - 6 tonnes cabbage leaf and brussel sprout waste
  - PR treatments (granular formulation)
    - 0 kg (-PR) and 250 kg (+PR)

Application of compost to trials

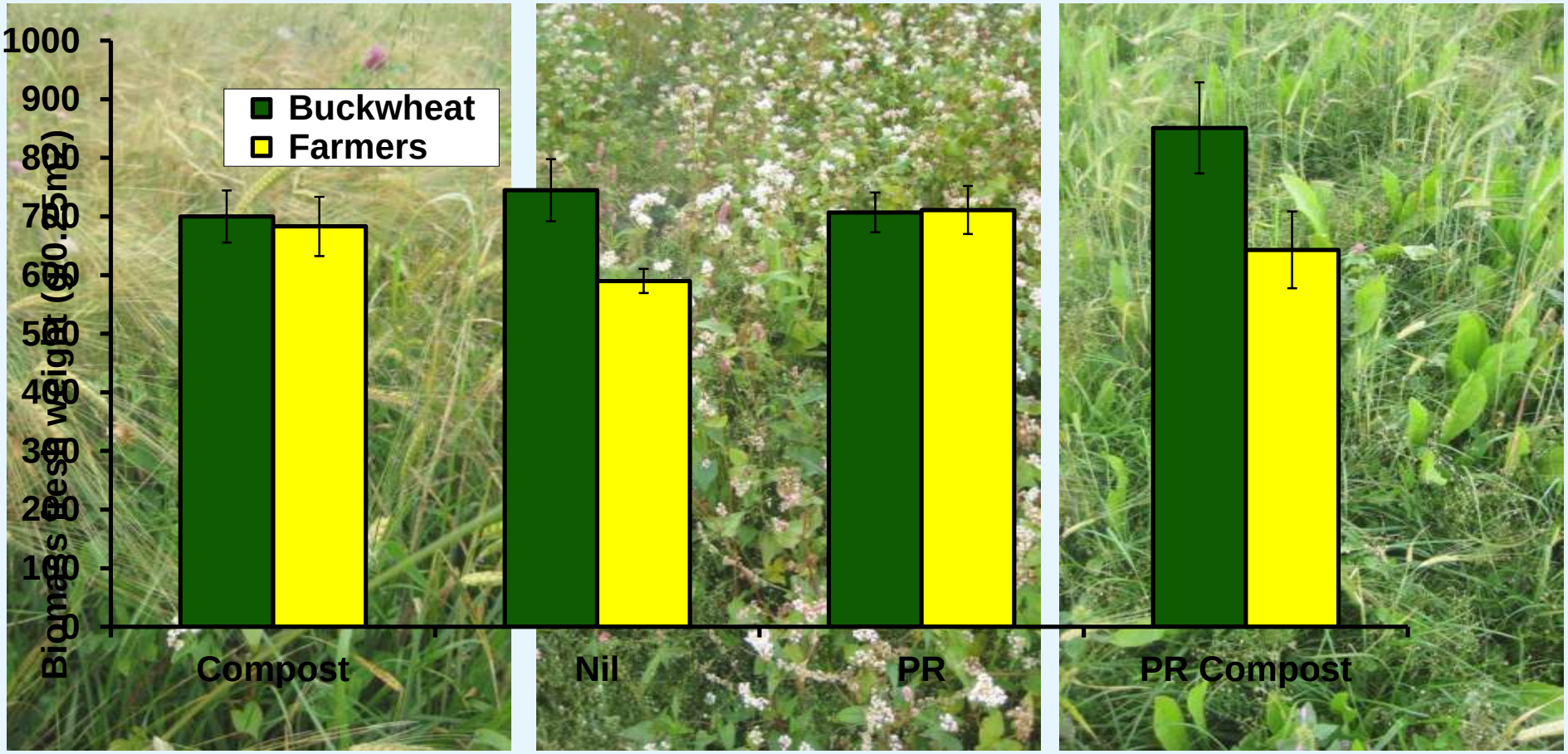
- Plot size 120 m^2
- 96 kg compost applied per plot
  - Based on 8 t/ha application rate
  - Estimated to supply 100 kg P per ha (+PR) and 20 kg P per ha (-PR) based on previous data
- Total P actually applied (kg P per ha)
  - From compost
    - Around 50% of expected amount (due to losses)
  - From PR ~ 72 kg P per ha

Composting 2009

- Predicted P in compost not as high in reality
  - variability shown between batches sent to each site, although all from same compost
    - Total P as well as AEM P
- Factors that influenced P?
  - Environment
    - Temperature
    - Rainfall
  - Chemistry
    - Ca / P interactions

Compost field trial

- Windshiel
  - Farmer's crop: Barley silage mixture



Summary: Compost

- Co-composting can have beneficial effects on P availability
  - Results not always consistent
  - Longer term benefits may be possible
- Adding more PR to compost does not always increase P availability in the short term
  - AEM-P affected by citric acid levels
    - High CA levels can reduce AEM-P
  - Importance of Ca?

So, what did we learn?

- Crop choice influences P use
- Green manures and cover crops are not only about N
- P from PR can be available in short term – even a 10% increase in available P can make a difference
- Crops good at extracting P e.g. buckwheat may have other benefits e.g. attracting pollinators
- Think about intercropping options – use your imagination!

Acknowledgements

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- Organic Farm Foods Ltd
- Organic Green Orchards Ltd
- Mark Measures Associates

SAC

Success through Knowledge

Amounts of organic matter returned by crop residues

	kg/ha	Estimated P kg/ha	% increase in top 20cm soil BEFORE decomposition
1 yr ley	4900	5	0.2
3 yr ley	7850	8	0.4
Winter cereal	2400	2.5	0.1
Spring cereal	1400	1.5	<0.1
Red clover	2200	2	0.1
Potatoes	300	0.5	<0.1
10t FYM	4300	6	0.2

Residue figures from Davies et al. 1972