Deep placement of P/K fertiliser in WA

- GRDC nutrient management project
- APA Scholarship
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Why place P/K fertiliser deeper?

- Nutrient stratified soil profiles: P,K in topsoil
- Topsoil dries, especially in spring
- P shortage in spring?
- Deeper P/K may remain in wetter soil for longer periods → increased availability
Earlier research in WA

- Research in WA has found improved lupin yields from deep-placed P, but not wheat.

- Phosphorus accumulation pattern of crops?

- Lupin may need continual P supply to maturity, wheat accumulates P prior to flowering.
What about canola ????

- P/K accumulation patterns not known
- Cultivar differences in accumulation patterns unknown
Differential accumulation of P by canola and wheat

![Graph showing the differential accumulation of P by canola and wheat over days after sowing. The graph plots P accumulation (mg/plant) against days after sowing. Canola shows a higher and faster accumulation compared to wheat. Arrows indicate significant differences at specific days.](image-url)
P distribution within the canola plant

b. Boomer canola

Days after sowing

P content (mg/organ)

- senesced leaves
- stem
- seed
- leaf blades
- silique
- petioles
- roots

Days after sowing:

- 20
- 40
- 60
- 80
- 100
- 120
- 140

PZcontent (mg/organ)

PZdistribution within the canola plant (11)

PZwithin the canola plant (5)

PZleaf blades (77)

PZstem (3)

PZpetioles (4)

PZroots (5)

PZseed (11)
Differential accumulation of K by canola and wheat

Days after sowing

K accumulation (mg/plant)

canola
wheat
K distribution within the canola plant

Tribune canola

Days after sowing

Days after sowing

K content (mg/organ)

K content (mg/organ)

0 20 40 60 80 100 120 140

roots

petioles

leaf blades

siliques

seed

senesced leaves

(31)

(9)

(30)

(23)

(7)
Until what growth stage does canola require an external P or K supply?

- The previous study only examined P/K accumulation under well-supplied nutrient conditions: accumulation pattern is influenced by fertility level.

- Continued accumulation of P/K by canola compared to wheat may simply be luxury uptake, and may not be essential for maximum yields.
Sand culture experiment: removal treatments

1. (Adequate or high supply)

2. -P/-K

3. -P/-K

4. -P/-K

early flowering  mid/late flowering  pod filling
Preliminary Experiment

Phosphorus concentrations in sand culture at early rosette stage
Nutrient solution P and K concentrations

- K
  - High - 800 μM K
  - Adequate - 400 μM K

- P
  - High - 500 μM P
  - Adequate - 500 μM P for 10 days, then 200 μM P for duration
Results: K experiment

- No difference in seed yields when K removed from solution at any growth stage, at either adequate or high supply.

- Plants have obtained sufficient K for maximum yields by early-mid flowering, provided an adequate supply is available during vegetative growth.
P experiment: Seed yields

Seed yield (g/pot)

P removal (days after sowing)

GS 4,7
GS 4,9-5,5
GS 6,2
maturity

GSZ4,7, GSZ4,9-5,5, GSZ6,2 
maturity

adequate
high
Seed yield loss on raceme vs branches at adequate P supply

Seed yield (g/pot) vs P removal (days after sowing) for GS 4.7, GS 4.9-5.5, and GS 6.2 maturity stages.
Yield components - summary

- When adequate P supply was removed at GS 4,7 (early flowering), yield loss was predominantly due to pod abortion and fewer seeds per pod on the branches.

- When adequate P supply was removed at GS 4,9-5,5 (end of flowering), yield loss was due to fewer seeds per pod on the branches.
Did P and K accumulation reflect plant demand?

Harvest
Seed P concentrations

- **Seed P concentrations**

  - **Graph:**
    - Y-axis: P concentration (g/kg)
    - X-axis: P removal (days after sowing)
    - Data points show an increase in P concentration with increasing days after sowing.
Pot experiment – deep vs shallow P fertiliser

- access tube for moisture probe
- watering tube
- banded fertiliser
- plastic bead layer
- banded fertiliser
- plug
- 5 cm
- 11 cm
- 3 cm
- 6 cm
- 75 cm
Experimental design

- 3 fertiliser treatments (shallow, deep or 50/50 P)

- 3 watering regimes:
  - topsoil dried at mid-flowering
  - topsoil dried at late-flowering/early pod-filling
  - control – topsoil wet until maturity

- 3 replicates
Results

- No differences in seed yields among watering regimes or fertiliser placements
- Significant differences in total P uptake and seed P concentrations

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a. Total P uptake
Field trial 2006 - Corrigin

- Residual of 4 P fertiliser treatments in wheat in 2005 – shallow (5 cm), deep (20 cm), split (50/50) and control (nil P).

- Very dry year – expected dry topsoil and good results.

- No yield data due to locust devastation.

- Terry Rose devastated by devastation!
No dry matter or P uptake differences between fertiliser treatments at 4 harvest dates during crop growth.

- P uptake had ceased by mid flowering
- Yield differences very unlikely
Field trial 2006 observations

- Topsoil did not dry exclusively in spring – it dried frequently during the winter (vegetative growth phase) as well.

- The largest in-crop rainfall events were 14 mm and 5 mm → favoured shallow P placement.

- Conclusions after 2.5 years? That our assumptions that topsoil drying occurs predominantly in spring, and that subsoil remains moist for longer periods are not necessarily true.
The End