A STOCK TAKE OF KNOWLEDGE ON SOIL AMELIORATION TOOLS

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AIM

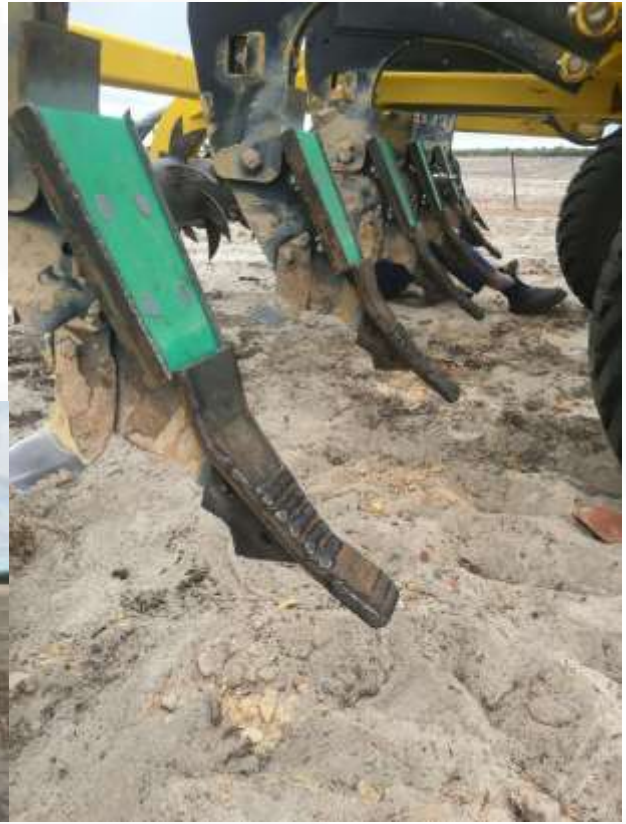
- Understand benefits, costs and risks of soil amelioration tools for WA grain growers
- Based on current research literature and survey of farmers
- Includes trials and on-farm experience on all soil types

BACKGROUND

- 70% of cropping land in WA susceptible to subsurface compaction
- 53% susceptible to water repellence (Van Gool, 2016)

DEEP RIPPING

- Deep ripping (30-45cm)
- Deep ripping with inclusion
- Very deep ripping (45-70cm)



DEEP MIXING (SPADER AND OFFSET DISC)

SOIL INVERSION (MOULDBOARD, SQUARE, MODIFIED ONE-WAY PLOUGH)

CLAY SPREADING WITH INCORPORATION

CLAY DELVING WITH INCORPORATION

Deep Ripping

Tillage depth 35-70cm

Subsoil loosening

Topsoil burial 5-15%

Rotary Spading

Tillage depth 35-40cm

Deep mixing

Topsoil burial 50-60%

Modified One-way Plough

Till. depth 30-35cm

Partial inversion

Topsoil burial 60%

Mouldboard Plough

Till. depth 30-35cm

Full inversion

Topsoil burial 80-90%

LITERATURE REVIEW

- Articles were selected if they met all of the following criteria:
  - → included one or more of the relevant tools
  - → covered one or more target soil types
  - → located in the Western region
  - → research conducted post 2009
  - → and research included a control site
- 30 articles were reviewed

FARMER SURVEY

- Data collected in-person and via phone from 10 farmers
  - → four farmed in the Mid West
  - → two in East Moora to Kojonup
  - → two in the South Coast
  - → one in Central Northern Wheatbelt
  - → one in Salmon Gums to Mallee
  - → one in West Midlands
- All had implemented more than one soil amelioration tool

Small sample.
A range of perspectives,
but results not definitive.

FARMER SURVEY – SOIL CONSTRAINTS

- Main constraints
  - → Soil compaction
  - → Water repellence
  - → Acidity
  - → Sodicity
- Additional constraints
  - → Organic matter, water logging, shallow soils, organic carbon, Rhizoctonia and boron toxicity

RESULTS

- Classified results into …

	Profit	Environment	Risk
Benefits			
Disadvantages			

- A series of detailed tables in the paper

PROFIT BENEFITS

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- Increased yield (all) – a catch-all category including the following
- Remove soil compaction (all)
- Nutrition availability (all)
- Reduced non-wetting (all)
- Incorporation of inputs (e.g. lime) (for deep ripping with inclusion, very deep ripping, deep mixing and soil inversion)
- Improved effectiveness of chemicals (deep mixing, soil inversion)
- Improved weed control (deep ripping, deep mixing, soil inversion, clay spreading)

PROFIT DISADVANTAGES

- Benefits not guaranteed (yield, crop estab., non-wetting) (most)
- Variable yield response across soil type (most)
- Poor crop establishment (most)
- Time lag for benefits to occur (clay spreading or delving)
- Cost can be high (esp. claying) and highly variable
- Time-consuming operation (deep mixing, soil inversion, clay spreading)

RISK BENEFITS

- Increased root depth (deep ripping, very deep ripping, deep mixing, soil inversion, clay delving and incorporation)
- Better access to sub-soil moisture (deep ripping, DR with inclusion, very deep ripping)
- Reduced frost damage (deep mixing, clay spreading/delving + incorporation)
- Improved crop establishment (deep mixing, soil inversion, clay spreading/delving + incorporation)
- Increased time to herbicide resistance (soil inversion)

RISK DISADVANTAGES

- Poor crop establishment (most)
- Short-term wind erosion (deep mixing, soil inversion)
- Increased soil evaporation (deep mixing, soil inversion, clay spreading + incorporation)
- Yield response depends on growing-season weather (deep ripping, deep mixing, soil inversion)

KNOWLEDGE GAPS

- A comprehensive analysis of the return on investment
- Effects of different ripping tyne depths and spacings, in different soil types and seasons
- The effect of soil amelioration on soil microbes
- Longevity of the effects from different tools
- New mechanical capabilities to increase the speed of operation
- Implications for crop nutrition, in different soil types and rainfall zones

TAKE-HOME MESSAGES

- Complex mix of benefits and disadvantages
- Yield improvement (from various causes) was the key benefit reported in the research literature and farmer interviews
- Return varies by tool, due to capital and variable costs, constraints overcome, and risks
- Risks vary across farming systems and tools
- Information gap: detailed analysis of return on investment

ALL GROWERS …

- Could clearly explain the benefits of their amelioration actions
- Were willing to trial and test the options they were interested in
- Were willing to adapt the implements/techniques
- Were willing to overcome or work around the difficulties and risks
- Were using multiple soil amelioration implements/techniques and practices
- Were looking at what opportunities were next in soil amelioration – mainly in terms of soil types and implements

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