BIOLOGICAL INPUTS—WESTERN GRAIN-GROWING REGION

Key points

- When evaluating a biological input for grain production, it may be useful to consider whether the input will alleviate yield constraints.
- The major yield constraints in the western grain-growing region are the low available water capacity, acidity and salinity of soil.
- The biological inputs with the most potential to help alleviate these yield constraints are manure, compost, vermicompost, biochar and some biostimulants.

Evaluating biological inputs

There are a wide range of biological inputs on the market including inocula, various biostimulants, composts, manures and biochar. It can be difficult to evaluate their potential effectiveness and return on investment for broadacre grain production for a number of reasons.

First, the properties of biological inputs are highly variable, even within a single type of input. This makes it difficult to evaluate whether one particular product is likely to be effective. Second, few previous scientific studies have been field experiments in broadacre grain cropping. Instead many were laboratory or glasshouse experiments with horticultural crops and farming systems. Finally, many of the mechanisms claimed by manufacturers have not been assessed by scientific investigations yet.

When considering using a biological input in broadacre grain production, it may be helpful to first consider what constrains yield on your property. A biological input is unlikely to improve crop growth or yield unless it alleviates a yield constraint. Previous scientific investigations can help determine which biological inputs have the most potential to alleviate particular yield constraints (table 1).

Yield constraints in the western grain-growing region

Although conditions vary across western grain-growing region (figure 1), it has broad similarities in its soils, management and climate. Soil fertility in the western region is generally low or very low. No-tillage practices are widely used because of their capacity to improve soil structure and increase the organic matter content of soil. Liming to decrease soil acidity is also widespread.

Grain yields in the western region are greatly influenced by the amount of winter and spring rainfall. In many parts of the region, yields are low by world standards and inland areas experience more variability in seasonal rainfall and yield than the coastal areas.

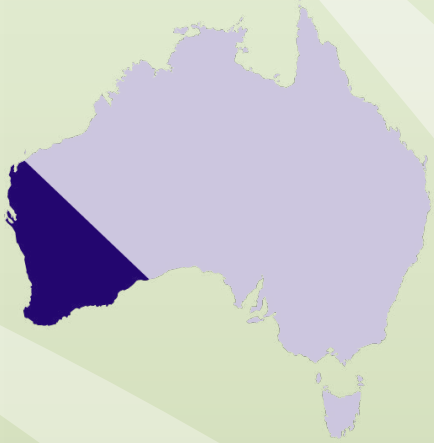

Figure 1: *The western grain-growing region includes all of the cropping areas in Western Australia. Image: GRDC.*

In the western region, the most significant yield constraints are the low available water capacity, acidity and salinity of soil. Low water storage in soil and low pH each affect 26% of agricultural land in the western region and low pH may cause the largest decreases in yield (Beeston et al 2005, van Gool 2011).

Alleviating yield constraints using biological inputs

When yield is constrained by the low available water capacity of soil, applying manure, compost, vermicompost or biochar may increase crop growth and yield. These biological inputs are largely composed of organic matter, which is highly porous and therefore able to store water. Also, organic matter can improve the structure of soil so that it has more pores that can store water that is available for plants.

When soil acidity constrains yield, applying compost or biochar may increase crop growth and yield. Compost and biochar both have the potential to increase the pH of acidic soils. Compost can also have a strong pH buffering capacity, which can help minimise future changes in soil pH. Although compost and biochar can increased soil pH,

when soil acidity constrains yield the simplest and most economic way of alleviating this constraint is applying lime to soil.

When salinity constrains yield, applying some biostimulants may help alleviate this constraint. Biostimulants do not actually decrease the salinity of soil, but some have been shown to increase the tolerance of plants to salinity. However, the mechanism for this effect remains unclear.

Table 1: *The potential of different types of biological inputs to overcome particular yield constraints based on the findings of previous scientific investigations. (Black ticks indicate one or more studies observed the effect. Grey ticks indicate that the effect is widely claimed.)*

	YIELD CONSTRAINT POTENTIALLY OVERCOME	INOCULA	BIOSTIMULANTS					MANURE	COMPOST	COMPOST TEA	VERMI-COMPOST	BIOCHAR
			HUMIC SUBSTANCES	SEAWEED EXTRACTS	OLIGO-SACCHARIDES	AMINO ACIDS	PLANT EXTRACTS					
BIOLOGICAL CONSTRAINTS	Poor nutrient uptake	✓	✓	✓				✓	✓			✓
	Poor root growth	✓	✓	✓		✓		✓	✓	✓	✓	✓
	Disease	✓		✓	✓			✓	✓	✓		✓
	Frost or cold stress			✓		✓						
	Waterlogging		✓									
	Drought or heat stress	✓	✓	✓		✓						
	Salinity		✓	✓		✓	✓					
	Low activity of microbes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
	Limited habitats for beneficial microbes								✓			✓
CHEMICAL CONSTRAINTS	Low macronutrients			✓				✓	✓		✓	✓
	Low micronutrients			✓				✓	✓		✓	
	Adverse soil pH								✓			✓
	Low soil CEC							✓	✓			✓
	Sodicity											
PHYSICAL CONSTRAINTS	Low water storage in soil							✓	✓			✓
	High density of soil							✓	✓			✓
	Low soil organic matter							✓	✓		✓	✓

Further reading and references

Beeston G, Stephens D, Nunweek M, Walcott J and Ranatunga K (2005) 'GRDC Strategic planning for investment based on agro-ecological zones', Grains Research and Development Corporation.

van Gool D (2011) 'Wheat yield potential and land management constraints in the South West of Western Australia', Department of Agriculture and Food, Western Australia, Resource Management Technical Report 376.

Author: **Jennifer Carson** (Ghost Media)

The National Soil Quality Monitoring Program is being funded by the Grains Research and Development Corporation, as part of the second Soil Biology Initiative.

Soil Biology Initiative II
Supported by the GRDC

GRDC Grains Research & Development Corporation
Your GRDC working with you

The University of Western Australia

CSIRO