Independent Trial

USA Wheat Trials 2019 - 2020

Memphis Tennessee, USA	2019 - 2020
Location	Year
Agricenter International	Wheat
Conducted by	Crop
Small plot replicated	
Trial Type	

Aim

To evaluate the impact on wheat yields when applying BioAg liquid biostimulants to fertiliser regimes representing Grower Standard Practice (GSP).

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Introduction

In-field use and demonstrations in Australia's cropping regions had identified positive yield responses when applying BioAg's fermented liquid cultures on a range of crops.

Agricenter International was engaged to perform a range of trials for BioAg, to evaluate the impacts of applying BioAg's liquid biostimulants over a range of crop and fertiliser regimes. In 2019 and 2020 wheat trials were included.

This report details the outcomes of trials performed on wheat.

Each year, a full biostimulant treatment was applied to a fertiliser application representing GSP.

Method

Trial Design

The analysis was done using small plot replicated trials. The first treatment was always "Grower Standard Practice" (GSP) with additional treatments incorporating BioAg biostimulants at and post planting.

The table below summarises the basic trial information. A known sized strip within the plot was harvested and yields measured.

Table 1: Summary of Trial Parameters

Year	2019	2020
Crop	Winter wheat – Triticum aestivum	
Study Design	Randomise Complete Block	
Plot Size	6 x 30ft	
Number of treatments	3	
Plots per treatment	4	

Soil Characteristics

Each year new sites were utilised. Soil parameters for each year are provided in the table below:

Table 2: Summary of Soil Parameters

Year	2019	2020
% Sand	13.6%	29.6%
% Silt	61.6%	51.6%
% Clay	24.6%	16.8%
% Organic Matter	2.4%	1.8%
pH	6.3	6.1
CEC	8.7	7.8
Fertility	Good	
Drainage	Good	

Treatments

Fertiliser rates were based on Grower Standard Practice (GSP) in the Tennessee area.

As part of GSP no fertiliser was applied at planting or pre-plant. This is standard for the region as wheat is planted late in the rotation and utilises residual fertiliser from previous crops.

As part of GSP a maintenance application of urea was applied post-planting. In both years a rate of 195 kg of urea per hectare was applied after planting, the applied day after planting is provided below in table 3.

In each year the same treatments were performed.

Treatment 1 (T1)
This was GSP.

Treatment 2 (T2)
This was GSP with the addition of *Soil & Seed* at planting. *Soil & Seed* was applied to the soil using a boom spray at a rate of 3.04 L/Ha (2.6 pt/A).

Treatment 3 (T3)
This was GSP with the addition of *Soil & Seed* at planting. *Soil & Seed* was applied to the soil using a boom spray at a rate of 3.04 L/Ha (2.6 pt/A).

This was followed by the application via boom spray of two foliar biostimulants at specified stages of growth. The foliar biostimulants applied were *Balance & Grow* and *Fruit & Balance* both at 1.75 L/Ha (1.5 pt/A). The timing of the applications is provided in table 3.

Table 3: Summary of Applications performed for each treatment

	Day Applied	Growth Stage#	Product !	T1	T2	T3
Fertiliser	0	00		GSP*	GSP	GSP
Application 1	0	00	*S&S*		3.04 L/Ha	3.04 L/Ha
Application 2	108 to 126		Urea	195 kg/Ha	195 kg/Ha	195 kg/Ha
Application 3	104 to 129	25 to 26	*B&G*			1.75 L/Ha
Application 4	160 to 170	43 to 45	*F&B*			1.75 L/Ha

Notes:

! *S&S* is *Soil & Seed*, *B&G* is *Balance & Grow*, and *F&B* is *Fruit & Balance* all given as litres per hectare.

* GSP had solid fertiliser applied

\# Growth stage is defined by BBCH – scale for cereals; refer to appendices for more details.

Background to Treatment Selection

Treatments T1 and T2 are based on programs utilised successfully in Australia. T1 is a soil only treatment and in poorer / drier seasons may be the only biostimulant applied. Treatment T2 represents a full biostimulant program and is recommended when growing conditions, in particular moisture levels, support the ongoing development of a crop.

Results

Yield results for treatments are provided below in tonnes per hectare:

Table 4: Yield results per treatment per year (T/Ha)

Year	T1	T2	T3	LSD (P=.05)	Std Dev
2019	2.41	2.83	3.34	0.33	0.19
2020	3.46	3.99	4.68	0.34	0.20

GSP (T1) v GSP with Soil & Seed (T2)

This treatment provided a 17% and 15% yield increase in 2019 and 2020 respectively.

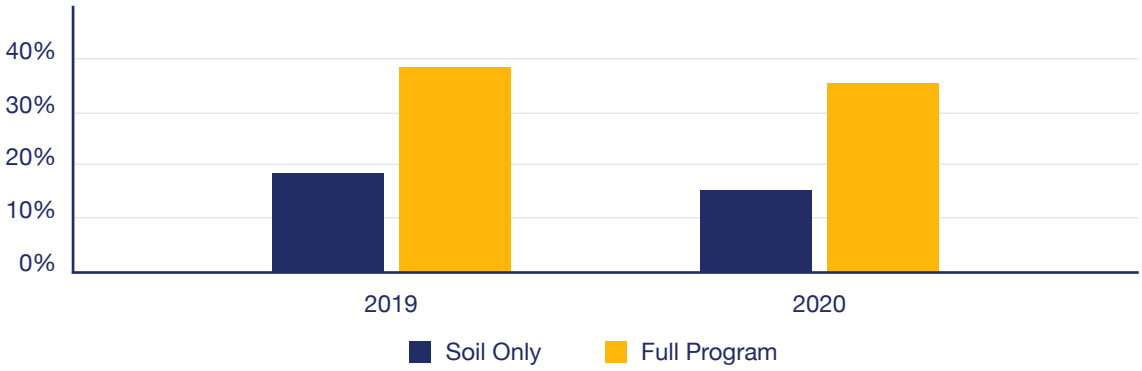
The increases are above the LSD (Least Significant Difference) in both years.

GSP (T1) v GSP + Full Program (T3)

This treatment provided a 38% and 35% yield increase in 2019 and 2020 respectively.

The increases are above the LSD (Least Significant Difference) in both years. The additional yield achieved with the full program was supported by good growing seasons where the vegetative biostimulant and the fruiting biostimulant were applied in periods of good to excellent soil moisture.

Yield Improvement over GSP
Soil Biostimulant and Soil and Foliar Biostimulants



Economics

The following is evaluated in the context of the Australian market utilising a conservative price for wheat of $200 ex farm.

Table 5 shows the financial returns for each year and treatments T2 and T3.

As can be seen, even in a year with low yield response, there was a significant positive financial outcome in each year and for each treatment.

Table 5: Economic benefit of biostimulant programs on GSP

	2019 T2 Soil Program	2020 T2 Soil Program	2019 T3 Full Program	2020 T3 Full Program
Cost of Biostimulant	$21.30	$21.30	$45.80	$45.80
Yield Benefit T/Ha	0.42	0.53	0.93	1.22
Yield Benefit $/Ha	$84	$106	$186	$244
Net Return $/Ha	$62.70	$84.70	$140.20	$198.20

#Based on a delivered cost of $7 per litre; %based on ex farm price of $200 per tonne.

Conclusion

The use of either a soil biostimulant, or a full program of soil and foliar biostimulants, delivered yield increases over grower standard practice (GSP).

These increases were not only statistically significant (being greater than the Least Significant Difference at a P = 0.05) but also provided a significant economical return.

While a full program delivered the greatest yield benefit, it was supported by good to excellent soil moisture levels, this is not always the case in Australian conditions and should be considered prior to use.

Additional Background – About BioAg

BioAg is an Australian manufacturer of liquid biostimulants and natural phosphate fertilisers. BioAg's liquid biostimulants are a range of proprietary microbial cultures, specifically formulated to support different plant growth stages by improving plant and soil performance.

Each culture/product contains:

- A balanced food supply of carbohydrates, amino acids, enzymes, vitamins, essential nutrients and growth promoters, that feed both plants and beneficial micro-organisms.
- Large and diverse population of beneficial micro-organisms, including fungi, bacteria, yeast and protozoa.

Each product has been developed to:

- Stimulate soil biology and plant processes.
- Feed soil biology to ensure it is active and able to interact with the plant.
- Improve the balance of beneficial microorganisms in soils, and
- provides microbial food and microorganisms into soils that are low in microbial activity or diversity due to factors such as, stress (cold, heat or water-logging), lack of plant activity (fallow) and/or due to a lack of plant diversity (monoculture).

Applying the appropriate product at the requisite growth stage will support and enhance:

- Structured vegetative growth and enhance root development.
- Nutrient cycling and improved plant availability of nutrients –
    - Chelation of nutrients, via amino bonds
    - Conversion of in-organic nutrients into a microbial form (becomes part of the biomass)
    - Helps to unlock nutrients previously bound in soil complexes
    - Improves the flow of nutrients through the plant.
- Water retention and uptake, and
- plant vigour and tolerance to abiotic stresses.

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The benefits of biostimulants can be depleted with time. In addition, as plants develop and reach their next growth stage, the nutritional needs of the plant also change. Applying the appropriate biostimulant, soil inoculant or foliar application at the right time, is a key attribute of any program.

BioAg's three core biostimulant products are:

1. *Soil & Seed* is a broad-spectrum microbial inoculant that assists; nutrient accessibility, nutrient solubilisation, nutrient cycling, enhanced seed germination, root development, disease and drought resistance and residue breakdown.
2. *Balance & Grow* is a broad-spectrum source of foods and stimulants for balanced plant functions, plant health, and vegetative growth including calcium and phosphate, vitamins, minerals, proteins, enzymes, amino acids and carbohydrates.
3. *Fruit & Balance* is formulated to increase flowering, fruit set and soil microbial activity. It delivers a rich source of plant-available phosphate when the plant is under peak load, stimulating strong fruiting and enhancing yield potential. *Fruit & Balance* contains a rich source of vitamins, minerals, proteins, enzymes, amino acids, carbohydrates, and growth promoters.

Each product is also available as an organic variant.

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Appendices

BBCH Cereal growth staging scales

https://en.wikipedia.org/wiki/Cereal_growth_staging_scales

Growth Stage	Code	Description
0: Germination	00	Dry seed (caryopsis)
	01	Beginning of seed imbibition
	03	Seed imbibition complete
	05	Radicle emerged from caryopsis
	06	Radicle elongated, root hairs and/or side roots visible
	07	Coleoptile emerged from caryopsis
	09	Emergence: coleoptile penetrates soil surface (cracking stage)
1: Leaf development [1,2]	10	First leaf through coleoptile
	11	First leaf unfolded
	12	2 leaves unfolded
	13	3 leaves unfolded
	1.	Stages continuous till ...
	19	9 or more leaves unfolded
2: Tillering [3]	20	No tillers
	21	Beginning of tillering: first tiller detectable
	22	2 tillers detectable
	23	3 tillers detectable
	2.	Stages continuous till ...
	29	End of tillering. Maximum no. of tillers detectable
3: Stem elongation	30	Beginning of stem elongation: pseudostem and tillers erect, first internode begins to elongate, top of inflorescence at least 1 cm above tillering node
	31	First node at least 1 cm above tillering node
	32	Node 2 at least 2 cm above node 1
	33	Node 3 at least 2 cm above node 2
	3.	Stages continuous till ...
	37	Flag leaf just visible, still rolled
	39	Flag leaf stage: flag leaf fully unrolled, ligule just visible

continued overleaf

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Growth Stage	Code	Description
4: Booting	41	Early boot stage: flag leaf sheath extending
	43	Mid boot stage: flag leaf sheath just visibly swollen
	45	Late boot stage: flag leaf sheath swollen
	47	Flag leaf sheath opening
	49	First awns visible (in awned forms only)

Conversions factors:

1 Bushel / A = 0.06725 T / Ha

1 Pint / Acre = 1.1692 Litres / Hectare

1 Lb / Acre = 1.12 kg / Hectare Litres

Raw Data

The trial data is available from the website **www.bioag.com.au**. For any questions or enquiries please contact your local BioAg Sales Representative.

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