FIG Report: Amino Acids 2018 & 2019

FIG members

Participating Farmers:	*Trial hosts 2018*	*Trial hosts 2019*
David Hoyles (*Lead Farmer*)	✓	✓
John Billington	✓	✓
Andrew Melton	✓	✓
Mark Means	✓	✓
Tim Parfitt/Sam Maycock	✓	✓
Sam Markillie	✓	
George Robson	✓	
Lottie Grant	✓	

ADAS Facilitator & Technical specialist: Kate Storer

Technical Specialist: Bob Bulmer, Hutchinsons

The Concept & Hypothesis

AHDB recently published a review on proposed mechanisms and claimed effects of biostimulants on crop performance (Storer *et al*., 2016). Commercially available amino acid mixtures marketed as biostimulants often consist of plant or animal proteins hydrolyzed into their constituent amino acids, but some also include unhydrolyzed polypeptides and non-protein amino acids. Such exogenous amino acid mixtures have been reported to stimulate growth, both of roots and leaves, particularly when plants were suffering from abiotic stresses such as are caused by salinity, drought, extreme temperatures or anoxia. Generally, the applied amino acids are thought to influence inherent metabolic control processes in plants, especially those involving amino acids metabolism (hence nitrogen assimilation and protein synthesis), but they may also influence the intermediary metabolism of sugars that supports amino-acid synthesis and they may also influence microorganisms that are closely associated with plant growth.

This FIG was formed at a YEN Ideas Lab held in June 2018 in which farmers and researchers met to discuss yield enhancing ideas that could be tested on farm. The group were interested in biostimulants as they had been widely covered in the farming press. Amino acid biostimulants in particular had received a lot of coverage and so these farmers wanted to test whether these products would show any benefits on their farms.

It was agreed that any amino acid based product would be eligible for inclusion in the trials, as long as it claimed its activity based on the amino acids it contained and that it did not contain other biostimulants or nutrients.

The Approach

Each farmer selected a product and applied it twice (or more) to their selected treatment areas.

In 2018, eight trial sites were established and, of these, seven were taken to harvest. Application timings were either in autumn or autumn & spring (targeting tillering and stem extension).

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As there were no benefits from autumn applications in the 2018 harvest season, timings for the 2019 harvest were modified to be at T1 (early stem extension) and/or T2 (final leaf emerged), or in response to drought stress; three out of five sites established were taken to completion.

Each farmer set up a tramline trial based in a design discussed with the ADAS facilitator. The trial design was carefully considered to ensure practicality for the farmer applying the treatments and harvesting the area, but also to ensure that reliable results were obtained. This included selecting fields which would reduce the risk of treatments being compromised by underlying soil variation, and where possible, trying to replicate some treatments, and randomizing the position of treatments within the field.

Figure 1. Harvest of one of the amino acid tramline trials.

The Results

In 2018, autumn plus spring applications resulted in a significant negative effect at one site out of four (-0.71 +/- SE 0.21 t/ha), whereas application in spring only resulted in a statistically significant positive effect at one out of seven sites (+0.5 +/- SE 0.21 t/ha; Table 1). Perversely these two significant results were from the same field (Site 2), where the trial included no replication of treatments. These results may have been compromised by the Agronomics analysis estimating a spuriously high level of precision from the yield map of the trial. This emphasized the need for good trial design and where possible, replication of treatment areas across fields using a randomized plan. The experience in 2018 helped the group to improve trial design for 2019. There were no statistically significant individual effects of amino acids in any of the three trials that were completed in that year. When trials from 2018 (spring only timings) and 2019 (T1 timing) were grouped in a cross-site analysis (9 sites in total) there was no overall statistically significant effect of amino acid application on grain yield (mean weighted effect = +0.11 t/ha, SE = 0.086; Figure 2).

Table 1. Effects of amino acid treatments on yield in 2018.

Site	Farm standard average yield† (t/ha)	Spring application		Autumn & Spring application	
		Modelled yield difference from the Farm Standard +/- SE (t/ha)	Yield difference for 95% confidence (t/ha)	Modelled yield difference from the Farm Standard +/- SE (t/ha)	Yield difference for 95% confidence (t/ha)
1	13.25	-0.15 ± 0.22	0.42	-0.19 ± 0.21	0.42
2	13.59	+0.50 ± 0.21*	0.42	-0.71 ± 0.21*	0.41
3	8.55	+0.06 ± 0.31	0.60	-	-
4	16.14	+0.17 ± 0.27	0.53	+0.32 ± 0.29	0.56
5	12.14	+0.12 ± 0.20	0.39	-	-
6	13.00	+0.29 ± 0.36	0.70	-	-
7	9.41	-0.26 ± 0.59	1.15	+0.27 ± 0.53	1.04

†The farm standard yield values are arithmetic averages from cleaned combine yield maps.

Table 2. Effect of amino acid treatments on yield in 2019.

Site	Farm standard average yield† (t/ha)	T1 application		T2 application		T1&T2 application	
		Modelled yield difference from the Farm Standard +/- SE (t/ha)	Yield difference for 95% confidenc e (t/ha)	Modelled yield difference from the Farm Standard +/- SE (t/ha)	Yield difference for 95% confidence (t/ha)	Modelled yield difference from the Farm Standard +/- SE (t/ha)	Yield difference for 95% confidence (t/ha)
8	10.51	+0.14 ± 0.24	0.48	+0.18 ± 0.24	0.48	-	-
9	10.47	-0.11 ± 0.23	0.44	-	-	+0.14 ± 0.23	0.44
10	11.62	-	-	-0.47 ± 0.61	1.19	-	-

†The farm standard yield values are arithmetic averages from cleaned combine yield maps.

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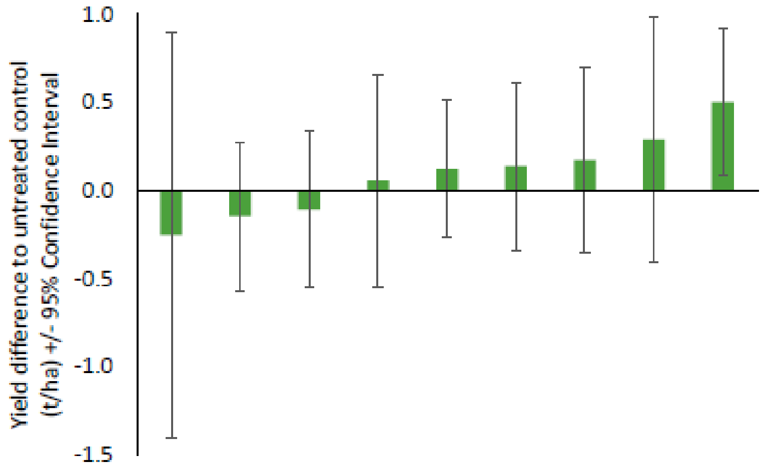

Figure 2. Yield effects of amino-acid biostimulants applied in spring-only in 2018 or at T1 in 2019. Bars show the modelled yield differences from the untreated Farm Standard. Error bars show the +/- 95% confidence interval (CI) for each site. Farm Standard plots received all the same inputs as the treated plots, except for the amino acid product. The 95% CI across all 9 sites was 0.17 t/ha.

Discussion & Conclusions

Findings from these trials suggest that under these conditions of relatively high yielding wheat crops on fertile sites the application of amino acids was not beneficial for yield and did not provide an economic benefit. If considering use of biostimulants, growers should seek independent evidence for claimed product effects and consider testing products on their farm first. However, farms should note that the precision of individual farm trials (best = 0.39 t/ha; worst = 1.19 t/ha; average CI = 0.62 t/ha) was much less than the joint precision of trials by the FIG as a whole (CI = 0.17 t/ha). If the cost of buying and applying this biostimulant (say twice) were equal the value of 0.1-0.3 t/ha grain, there is a strong case for several farms collaborating to develop a precise answer to such questions.

Figure 3. Amino Acid FIG discussions after the YEN Awards meeting, November 2019.

The group (Fig. 3) worked well discussing trial design development and management, considering both practicalities and scientific robustness, and learning the importance of assessing these factors carefully when designing tramline trials on farm. There was enthusiasm to continue with the group, potentially testing an alternative biostimulant type, but this would be dependent on availability of funding.

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