



Dr. Bruce Knight

*Founder and Managing
Director*

Introduction from the CEO

If there's one thing I've learnt from more than twenty years at the helm of Legume Technology, it's this: don't underestimate the power of the microbe.

These tiny organisms, too small to be seen without a microscope, were among the first to evolve on Earth; they'll probably be the last to survive. Incredibly diverse and present in even the harshest planetary environments, many of them remain a mystery to science: we've classified perhaps just one per cent of the total.

In agriculture, of course, we've long recognised the dependence of plants on bacteria such as *Rhizobium* for fixing nitrogen. But that example of plant:bacteria interaction increasingly appears to be just the tip of the symbiotic iceberg: the launch of our new ROOTFiX formulation, due later this year, is a good example. Incorporating three strains of *Bacillus*, we've found it not only improves phosphate solubilisation and hormone generation in cereals, but also induces plant immune responses that are highly deserving of further study.

Such discoveries add to the mounting recognition that, properly understood and effectively harnessed, microbes - as part of the wider category of 'biostimulants' - could be the key that will unlock a new era of more productive, more sustainable global agriculture. News of the introduction of the Plant Biostimulant Act in the US, one of the world's largest agricultural producers, is especially encouraging - particularly when it comes not just on the first anniversary of our partnership with Green Universe but as we appoint a new US-based business development manager, too.

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” Welcome to the latest newsletter from Legume Technology. We're excited that you're with us on our journey to harness the power of the microbe for modern farming.

FROM THE LAB



Dr. Mike Thomas

*Research and
Development
Manager*

Installation of the new fermenter hasn't only been of interest to our production manager, as R&D manager Dr Mike Thomas explains.

Installation of the new 'stirred-tank' bioreactor arguably marks the beginning of a new era for Legume Technology. There will always be advantages and disadvantages between bioreactor designs such as the airlift - our previous design - and the stirred-tank, but the latter is the most common type and its

acquisition reflects Legume Technology's growing status as not just a major supplier of biostimulant products but also one of the most innovative.

David's understandably excited about our ability to increase our production output and fulfil the ever-growing demand of our customers for extra material.

” I'm excited about that too, of course, but I'm especially looking forward to how the new fermenter can help us further progress our innovative ambitions.

We'll soon be launching our new ROOTFiX product, an improved formulation incorporating multiple strains of Bacillus. A particular characteristic of the bacillus bacteria is its ability to form a highly robust spore, a state in which it can effectively and reliably hibernate for extended periods, even many years, before springing back into life when conditions are right. Obviously, this is of huge significance for us: with our focus on product shelf-life and quality control, it's our goal to achieve consistent sporulation in every batch of Bacillus. Sporulation is closely correlated to the vessel conditions the bacteria are grown in, so our new tank, with the ability to more carefully control variables like oxygenation will give the team the opportunity to explore this important biological process in more detail.

Of course, that's not all. We now have two fermenters! So expect to hear more from me about how I'm using the smaller vessel for R&D purposes. Until now, I've rarely had the chance to try out new ideas and formulations as Nicola is working with us on a three-month project to further characterise our understanding of Bacillus. We're



Nicola Walter, PhD student at the University of Nottingham

taking a molecular approach to better understand the mechanisms by which ROOTFiX is promoting plant health. Using transcriptomics, we are looking to catalogue which plant genes are being activated. This means we can see what's going on in a plant at the molecular level, and how external stimuli and interactions - such as between Bacillus and the plant's roots - are inducing a response. We already know some of the key benefits of ROOTFiX, its ability to solubilize phosphate for example. But there may be a lot going on in the background that is not immediately obvious and a more detailed understanding at the molecular level will better help us inform the best uses for the product.

The team grows...

We're always delighted to welcome new members to our growing team, as interest in our expanding portfolio continues to increase.

This time we're expanding the business development team and it's Marcos Hori in the joiners' spotlight. Based in Illinois, in the United States of America, Marcos has been tasked with advancing our market across North America.

“ I'm excited and eager to share with everyone the importance of microbes in agriculture,” explains Marcos. “It's essential that we bring their applications, benefits and key role in a more sustainable agriculture to a wider audience, and present them as a valid alternative to synthetic agrochemicals.

Marcos brings more than 15 years of experience from the food and agricultural sectors to his business development role with us, and will also represent our partner, Green Universe, in the same region.

If you're in North America, don't hesitate to reach out to Marcos - he'll be delighted to spark a conversation!



Marcos Hori
*Business
Development
Manager*



FROM THE FACTORY

With the installation of the fermenter now completed, Production Manager David Hosking can't wait to get his hands on it.



Dr. David Hosking

*Production
Manager*

It had to come in through the roof, but the fermenter is now in the building. Even though we've still to complete the commissioning of our shiny new 10,000l unit, it feels like it's always been there.

Despite nearly all the connections - pipes, wiring, monitoring and control systems - having been made, there's a lot still to do before the fermenter properly comes online. We'll have to break into

the production cycle to tap the live utilities and then we can begin full commissioning.

A unit of this size is always bespoke; you don't go and buy something like this 'off the shelf'. From the size and design of the unit itself, to the software that will control it, everything is built to our specification. Right now, there's a control systems software engineer putting the finishing touches to that software, before it's tested and certificated.

With the connection of the utilities, we'll test all the valves and the electronics and only then will the control systems be connected. That's when we start wet commissioning, with the engineering team on-site to run through the system while I look over their shoulders to understand how the new software runs on our existing control hardware. When we're all happy that it does what it's supposed to, mechanically, we'll sign it off. And this is when things get really interesting.

” The new tank is not only ten times the volume, but of a different design to our previous 1,000l fermenter.

That was an 'airlift' bioreactor, whereas the new one is a 'stirtank'. The terms describe the way in which the tank is aerated, the degree of aeration being a critical factor in the fermentation process. Understanding how much aeration is required for processes in the new tank will be a crucial element during commissioning.

We'll also validate the sterility. Customers will know the absolute importance we place on sterility during our production processes,



working to axenic standards: ensuring our products contain only the intended bacteria and nothing else.

Once we're happy with the new reactor, and understand its characteristics, we'll put it into production. What a difference that will make, with a ten-fold increase in output:

- We'll be able to significantly reduce the time taken to produce orders, not only making our factory more efficient but also be in the position to offer customers greater volumes.
- We'll also further increase our already market-leading shelf-life; with material spending less time in the warehouse before it ships, customers will get the full benefit of our products' longevity.

The installation of the new fermenter comes just as we've reached the end of our main production period, when the factory is working at full capacity to turn out product for the spring season. Farmers will be drilling, or already drilled, by the time this newsletter drops into your inbox, but we don't stop there. We then move on to the African growing season. Here, we have large numbers of much smaller customers, which necessitates a different mindset in the factory: we're creating tens of thousands of much smaller units for despatch to distributors. Again, we'll be pleased to have the new fermenter in place - we'll be able to fulfil one of these multiple orders from one batch, so there'll be greater uniformity in each order and our throughput will be increased.

Given that we've already sold more product this year than ever before, the increased capacity that the new fermenter brings couldn't have come at a better time.

From the media

It's not just this Newsletter where you'll see mention of Legume Technology, our projects, products and partnerships.

Beans in toast?

Eagle-eyed readers might have spotted an article published in *The Guardian* (<https://theguardian.com>) and elsewhere online, detailing the results of a project designed to encourage British consumers to eat more broad beans (fava beans).

Led by scientists at the University of Reading - with Legume Technology as a project partner - the study found that flour made from broad beans could directly replace imported soybean flour, thus meeting sustainability goals, and deliver key nutrients that are often lacking in British diets, such as protein, fibre and iron.



Inoculate to accumulate

Arable Farming magazine is read by nearly 10,000 British farmers, many of them the country's largest: it reaches nearly three-quarters of British farms that crop more than 400 hectares.

So we were excited when the February 2023 issue carried a double-page spread all about the abilities of *Bacillus*-inoculated wheat to deliver a 7.5 per cent yield increase. The inoculant in question, of course, was none other than our very own **ROOTFiX**.

The article detailed the results of a Canadian trial, as well as glasshouse experiments with our long-term research partners the University of Nottingham.

Go to

<https://www.fginsight.com/arable-farming-magazine>

to read the article online.



OUT IN THE FIELD...

It's already shaping up to be a busy 2023. Not surprising, given this is the first full year since 2019 that we've been back out in the field, attending open days, doing the rounds on the exhibitions, attending events, and meeting customers all around the world.

TÜRKIYE

Have you heard of AgriExpo? Held in the Aegean port of Izmir, it's the largest agricultural fair in Türkiye and the fourth largest in Europe. Anything and everything related to agriculture is on show here, from livestock and crops to tractors and greenhouses. So it was exciting for **Legume Technology** to be one of the exhibitors, represented by business development manager **Agnese Kromane**, as part of a delegation led by the United Kingdom's **Department of Business and Trade** (DBT).

Türkiye is Europe's largest agricultural economy and, worldwide, the tenth largest. With \$50bn of agricultural production and nearly three million farmers, it's easy to see why. What's more, any agricultural show in Türkiye reflects the country's historic traditions as a crossroads between east and west, these days acting as a strategic stepping stone to convey European ideas and technologies with emerging farming economies in MENA and Central Asia.



Agnese Kromane
Business
Development
Manager

KAZAKHSTAN

A whole country the size of Western Europe? That's how the world's ninth largest nation measures up. Agriculturally, it's also the region's biggest producer of grain. Again, partnering with the UK's DBT, Legume Technology exhibited at AgriTek Astana, the most important agricultural exhibition in the country, at the end of March. We joined more than 200 exhibitors from 19 countries - besides the UK, visitors came from Austria, Canada, Switzerland, the Netherlands and the United States.

An absorbing visit, we came away with a good insight into local trends and innovations, valuable discussions with potential partners and customers, and an even better set of contacts.



Bruce Knight

Founder and Managing Director

GERMANY

We'll be visiting more familiar territory in May, when we travel to Frankfurt for the Non-GMO Soya Summit (www.nongmosummit.com). Organised by Donay Soja, this international gathering will bring together producers and traders from South America and Europe to share information about the availability and production needs of non-GMO crops.

With retailers and food brands also in attendance, it will be a fascinating event. We're looking forward to hearing how factors such as sustainability and deforestation commitments are playing out, and how everyone involved in the industry can help to build stable, fair and long-term value chains that meet consumer demand for sustainably produced crops not just in Europe, but around the world.



SOUTH AFRICA

Another month, another continent. In June, the LT team will head to Cape Town for the International Seed Federation's annual Congress (www.congress.worldseed.org). Recognised as the seed industry's premier global event since 1924, we'll join more than 1500 delegates from leading seed organisations and companies around the world. Most exciting of all, we'll take the opportunity afforded by this showcase event to officially launch the latest addition to the LT portfolio: our new formulation of ROOTFiX. This is the first product to launch since we struck our new partnership with Green Universe; we'll be delighted to share its launch with such a valuable audience.



UNITED KINGDOM

Are you planning to come to the Cereals Event in June, in the UK? It's long been the key event in the country's arable and tillage calendar, recognised for both its networking and educational opportunities. Around 20,000 visitors - farmers, agronomists, advisers - visit the outdoor event over two days in June, exploring, sharing and collecting ideas, innovation and good practice from nearly 400 exhibitors. There are also working machinery demonstrations, including sprayers, drills, robotics and more.

We're not exhibiting this year - the focus is more on cereal crops than those relevant to our portfolio. But the event's well-attended by overseas visitors, as well as those from the UK. If you're planning to be one of them, why not arrange to call in at Legume Technology HQ? We're just 30 minutes from the event site!



Suggestions?

Is there a show, event or exhibition in your region or country that you'd like to see Legume Technology attend? As our business development team grows (welcome Marcos Hori!), we're always open to new suggestions or opportunities to partner with customers. Let us know!

Field Days

We've a host of field days organised by our customers that we'll attend in June and July - perhaps we'll see you there? Look out for reports and a round-up in the next newsletter issue!

US introduces Plant Biostimulant Act

” In a move backed by more than a dozen of the country’s major agricultural groups, March saw the Plant Biostimulant Act 2023 introduced in both the Senate and the House of Representatives in the United States of America.

Among those endorsing the Act are the Biological Products Industry Alliance, the Humic Products Trade Association, and the American Seed Trade Association. The Act has been touted as ‘critical’ for the future of the biostimulant industry in the USA, as it will set down in law a recognised definition for ‘plant biostimulants’, thus opening up a more robust market for such products.



The United States currently has no framework to regulate biostimulants as plant nutrition products, and the new Act seeks to amend the Federal Insecticide, Fungicide and Rodenticide Act to take plant biostimulants outside its remit. In addition, it would require the Environmental Protection Agency to include the definition within its Code of Federal Regulations, and for the US Department of Agriculture to study the effect of biostimulants on soil health.

Agricultural groups in the US have been calling for action on biostimulants, pointing out that the lack of a regulatory framework hinders research and has put the US behind the EU - which enacted its first biostimulant directive in 2022 - in pursuit of opportunities for product development.

The bill has been co-introduced by Senator Alex Padilla, who represents California - the most agriculturally important state in the US. He says the Act will ensure:



proper oversight and regulatory standards for plant biostimulants;



they have the potential to reduce or even replace the use of synthetic pesticides and fertilisers;



improve crop health, yields and tolerance to abiotic stresses.

Don't forget to follow us across our social channels for regular industry updates and to find out more about what we're up to.

