Applied Microbiology International

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AMI Submission to 'UK fertilisers: regulatory reform Modernising fertilisers legislation to develop a harmonised regulatory framework for placing fertilising products on the market across the UK'

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1. Benefits and risks of plant bio-stimulants (Section 5.2.2)

The UK defines plant bio-stimulant as "a product stimulating plant nutrition processes independently of the product's nutrient content with the sole aim of improving one or more of the following characteristics of the plant or the plant rhizosphere:

- *nutrient use efficiency*
- *tolerance to abiotic stress*
- *quality traits*
- *availability of confined nutrients in soil or rhizosphere"*

Do you think that there are any issues with this definition?

Answer: The current definition of plant bio-stimulants is useful but may not fully capture the diverse functional roles of microbial products. Microbial inoculants can influence plant productivity not only through nutrient use efficiency and abiotic stress tolerance, but also through:

- Modulation of rhizosphere microbial community structure
- Enhanced nutrient mineralisation and nutrient mobilisation
- Improved soil carbon turnover and aggregation
- Increased resilience of soil ecosystem functions under environmental stress

Recommendations from AMI members include:

- Explicitly recognising microbial mechanisms within the regulatory definitions, as microbial products often act indirectly through ecological interactions rather than direct nutrient delivery.
- Should be restricted to the biologically originated compounds/organisms instead of synthetic compounds.

2. Please name any plant bio-stimulants product(s) that you believe has a negative impact on human health (or mammalian health) and where available provide associated evidence.

Answer: Sea weeds are extracted to develop some bio-stimulants and have been reported to show promising results in terms of overall plant growth. However, they are also known for their capacity to accumulate heavy metals such as arsenic, cadmium,

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lead and mercury (Kumari et al., 2022). This accumulation may cause serious harm to environment and human health.

Pseudomonas fluorescens is used as a biocontrol and bio-stimulant in agricultural settings. Although, *P. fluorescens* is considered as non-pathogenic to mammals, however, literature also indicates its pathogenicity to immunocompromised individuals (Kumari et al., 2022; Taylor et al., 2025).

P. fluorescens based products in market are as follows:

- Utkarsh Sudoz-P
- Katyayani Striker
- BACF Averse

Some strains of *Klebsiella pneumoniae* are also used as bio-stimulants but *K. pneumoniae* is also categorised as a pathogen to mammals. This is because it can cause pneumonia, urinary tract infections (UTIs), septicaemia, and liver abscesses (Abbas et al., 2024). Detailed toxicological assessments should be performed prior to its use in agricultural settings.

3. Please name any plant bio-stimulant product(s) that you believe has a negative impact on the environment including soil health, air quality or effects on water?

Answer: Synthetic nitrophenol based bio-stimulants such as sodium ortho-nitrophenolate, sodium para-nitrophenolate and sodium 5-nitroguaiacolate are known to cause aquatic toxicity and potential groundwater contamination (Xia et al., 2022), and the US Environmental Protection Agency classified p-nitrophenol and o-nitrophenol as environmental pollutants (USEPA, 2014). Additionally, phosphite which is used as a bio-stimulant is of environmental concern as it has shown detrimental effects of phosphite on three algal species (Han et al., 2022).

Seaweed extracts may possess accumulated heavy metals which can further contaminate the soil and water bodies. These heavy metals can alter the soil microbiota and ultimately affect soil health.

Studies have also reported toxic effects of synthetic auxins (which mimic auxin, a plant hormone that regulates many aspects of growth) on wheat seedlings (Lyubushkina et al., 2025).

4. There is less certainty about the risks and benefits of plant bio-stimulants, compared to inorganic fertilisers. Are there any examples of how plant bio-stimulants have been regulated in other countries which have worked well or would work well in the UK?

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Answer:

- The UK can adopt the EU FPR contaminant and heavy metal limits as a minimum standard.
- As per the EU, the UK should look for the statistically demonstrable efficacy claims of bio-stimulant products.
- The UK should use lighter label-claims framework like US/Australia for the bio-stimulants that show lower risk and are natural.
- The UK should invest in studies investigating soil heavy metal accumulation over time following the commercialization and utilization of such products.

5. What are the main barriers that need to be overcome to drive the use and manufacture of fertilising products made from alternative biological sources of nutrients and processing technologies in the UK?

Answer: Novel fertilising products (e.g., synthetic biology-derived microbes, waste-derived nutrient streams, microbiome-engineered formulations) require a regulatory pathway that is:

- Adaptive and evidence-based
- Proportionate to risk
- Supportive of safe innovation rather than restrictive by default

A tiered approval system could help balance safety with innovation.

6. Alternative processing technologies and nutrient recovery (Section 5.4) - What would be the benefits or drawbacks of expanding the scope of UK fertilisers legislation to fertilising products made from compost and digestate?

Answer: Products derived from anaerobic digestion, composting, digestate treatment, nutrient recovery, and microbial bioprocessing represent major opportunities for circular agriculture.

The main barriers to adoption include:

- Inconsistent nutrient composition between batches
- Lack of standardised biological quality indicators
- Limited long-term field performance data
- Uncertainty around contaminants, including microbial contaminants and residual pharmaceuticals or heavy metals

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However, inclusion of these products is critical for reducing dependence on imported synthetic fertilisers and improving nutrient recycling.

7. Contaminants (Section 4.8.6) - Are there any other contaminants not listed above which the UK should consider in relation to straight, compound liquid and solid inorganic fertiliser and liming material consisting of CMC 1?

Answer: Beyond the listed contaminants, the framework should consider:

- Antibiotic resistance genes and mobile genetic elements
- Residual veterinary antibiotics or pharmaceuticals in waste-derived products
- Mycotoxins in biologically processed materials
- Persistent organic pollutants where waste streams are used as feedstocks

These contaminants may significantly affect long-term soil and ecosystem health.

8. Workshops (Section 4.11) - In addition to the suggested workshops, are there any other issues or topics that you think the technical workshops should cover in relation to the first stage of implementation of UK FPR?

Answer: We recommend including workshops on:

- Soil microbiome monitoring and standardisation
- Microbial efficacy testing methodologies
- Long-term ecological impact assessment of bio-based fertilisers
- Standardisation of molecular methods for microbial product characterisation

This would ensure the regulatory framework reflects modern microbiological science

9. Other comments on regulatory design

Recognition of microbial functionality as a core component of fertilisers

Current regulatory frameworks tend to focus on chemical composition (e.g., NPK values), but there is a growing body of evidence showing that microbial consortia play a critical role in nutrient cycling, bioavailability, and soil health. Future regulations should explicitly recognise microbial functionality (e.g., nitrogen fixation, phosphorus solubilisation, carbon sequestration) as part of fertiliser efficacy criteria.

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Need for standards for microbial-based and biofertiliser products

There is a lack of harmonised standards for evaluating the quality, viability, and performance of microbial inoculants. Policy could benefit from:

- Clear definitions of biofertilisers and biostimulants
- Minimum viability thresholds and strain identification requirements
- Context-specific performance validation (field vs lab conditions)

Safety and Risk Assessment

Microbial fertilising products should undergo robust safety assessments, but regulation should distinguish between:

- Naturally occurring beneficial microorganisms with established safety records
- Novel engineered or poorly characterised microbial consortia

Risk assessment should include:

- Persistence in soil ecosystems
- Horizontal gene transfer potential (including antimicrobial resistance genes)
- Effects on native soil microbiomes and biodiversity
- Potential contamination with opportunistic pathogens

Culture-independent and molecular approaches such as metagenomics and functional profiling should be incorporated into efficacy and safety testing frameworks.

Concern on delaying novel biological products

Delaying inclusion of microbiology-based fertilising products in the first phase of regulation risks slowing innovation and adoption of sustainable alternatives.
This may delay:

- Restoration of soil health
- Development of low-C agricultural systems
- Commercial translation of UK microbiology innovation
- Progress toward circular nutrient economies

A phased inclusion model may be appropriate, but microbiological products should be prioritised for early pilot regulatory pathways rather than deferred entirely.

Integration of circular economy principles

Microbiology plays a key role in converting waste streams (e.g., agricultural residues, wastewater, food waste) into valuable fertilising products. Regulations should facilitate

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safe valorisation pathways while ensuring pathogen and contaminant risks are appropriately managed.

Importance of environmental context
Microbial fertiliser performance is highly dependent on soil type, climate, and existing microbiomes. Regulatory frameworks should consider regional adaptability and avoid one-size-fits-all efficacy assumptions.

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About Applied Microbiology International

Applied Microbiology International is a charitable, membership-based organisation for those interested in or working in microbiology. We aim to demonstrate how microbiology can help address global challenges, and our policy work focuses on bringing microbiological evidence and expertise into policy conversations. AMI is solving some of the world's greatest challenges by bringing the applied microbiology community together, across borders and disciplines, to enable meaningful collaboration that delivers scientific impact. With a strong focus on influencing international policy, we are organised around six core UN Sustainable Development Goals and encourage partnership between academia and industry to increase our impact.

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References

Taylor, T. B., Silby, M. W., & Jackson, R. W. (2025). Pseudomonas fluorescens. *Trends in Microbiology*, *33*(2), 250-251.

Kumari, M., Swarupa, P., Kesari, K. K., & Kumar, A. (2022). Microbial inoculants as plant biostimulants: A review on risk status. Life, 13(1), 12.

Abbas, R., Chakkour, M., Zein El Dine, H., Obaseki, E. F., Obeid, S. T., Jezzini, A., ... & Ezzeddine, Z. (2024). General overview of Klebsiella pneumonia: epidemiology and the role of siderophores in its pathogenicity. Biology, 13(2), 78.

List, P. P. (2014). United States environmental protection agency. *Washington, DC, USA*.

Xia, H., Guo, J., Yang, Y., Wang, Y., Wang, Z., Wang, X., & Zhang, W. (2022). Remediation of PNP-contaminated groundwater using a modified CaO2/Fe (II) Fenton system: Reactive principles, degradation performance and potential pathways. *Journal of Environmental Chemical Engineering*, *10*(2), 107305.

Lyubushkina, I. V., Kirichenko, K. A., Polyakova, M. S., Polyanskaya, I. V., Zabanova, N. S., Korsukova, A. V., ... & Grabelnych, O. I. (2025). Synthetic Auxins Toxicity: Effects on Growth and Fatty Acid Composition in Etiolated and Green Spring Wheat Seedlings. *Molecules*, *30*(21), 4208.

Han, C., Ren, J., Wang, B., Wang, Z., Yin, H., Ke, F., ... & Shen, Q. (2022). Ignored effects of phosphite (P+ III) on the growth responses of three typical algae species. *Environmental Pollution*, *294*, 118672.