European Biostimulants Industry Council

Date:	3 January 2022
Author:	Kristen Sukalac
Status:	For circulation (v4)
Distribution:	Public
Classification:	Public

FREQUENTLY ASKED QUESTIONS (FAQ)

FAQ about phosphite-based plant biostimulants

Background: There is compelling science today that certain phosphite[1] products (defined by the function under specific use cases) provide plant biostimulant effects improving nutrient use efficiency and tolerance to abiotic stress. Moreover, the use of phosphites in fertilising products has been demonstrated to be safe for both humans and the environment by the long history worldwide of safe application of phosphite-based agricultural products with other functions. However, when presented with the scientific evidence, stakeholders often ask the questions answered in this FAQ document. This list will be updated as needed.

Table of questions covered in this document

Has the benefit to farmers been measured under real-world conditions, or only under controlled, experimental conditions?

Researchers from Christian Albrechts-Universität (Kiel, Germany) conducted more than 20 open field trials over 15 years looking at the effects of foliar applications of phosphite plant biostimulants in oilseed and both foliar applications and seed treatments in wheat. On average, the oilseed applications resulted in a 5.6% increase in yield and 5.5% increase in nitrogen use efficiency compared to controls. Working with local farmers, the application in wheat was studied in comparison to an untreated control and a control representing “current farm practice”. Adding phosphite to the current farm practice resulted in 1.35 t/ha higher yield

[1] Although they are technically different substances, the terms “phosphonates” and “phosphites” are now used interchangeably because the two substances cycle constantly back and forth between the two forms. In this paper, we use “phosphites” to distinguish products that have plant biostimulant functions and that have been formulated with the phosphite salt forms.

[2] These questions could be asked about any substance that can be found in both fertilising products and plant protection product, but they have always been addressed by instructions for use and appropriate management. Question 1.3 in the Commission FAQ document on the Fertilising Products Regulation refers.

using 40 kg/ha less nitrogen fertiliser and a 32 % improvement in nitrogen use efficiency. Studying the effects of seed treatment, Kiel researchers also found important gains in root mass (+7.4 % mean increase at GS20[3] and +50 % mean increase in root mass at GS29).

In addition, eight plant biostimulant manufacturers have published data that prove the agronomic benefits of phosphite plant biostimulants from field trials over four years, across 13 countries and eight different crops. With 178 individual trials analysed, the aggregated data shows agronomic benefits in terms of root weight, tissue analysis and crop yield. About 50% of the data come from field-scale trials and 30% from small plots; around 20% comes from glasshouse or other arable trials.

Furthermore, phosphite plant biostimulants are currently used by cereal and oilseed rape farmers in Germany and the United Kingdom, who consistently experience similar gains to those documented above.

How do we know that researchers are observing a plant biostimulant effect and not an unobserved fungicidal effect?

Researchers at the University of Nottingham conducted experiments to exclude an unobserved fungicidal effect of phosphite plant biostimulants. Using fungal pathogens relevant for cereals, they studied whether the phosphite products would control them, and no effect was detected. Moreover, they found phosphites to be ineffective as elicitors of plant defense pathways (mediated by phytoalexins) under the plant biostimulant use cases. They presented this work at the 2015 Biostimulants World Congress, and it was published in the peer-reviewed conference proceedings in Acta Horticulturae: https://www.actahort.org/books/1148/1148_7.htm.

However, the EU Fertilising Products Regulation (FPR) does not require that manufacturers demonstrate an absence of effects outside of the claimed product function. The Commission FAQ on the FPR published 20 July 2021 states “If a fertilising product, which complies with all requirements set in the FPR, happens to contain a substance or microorganism known to have a pesticidal or other plant protection effect, it could still be covered by the FPR, as long as this fertilising product does not have a pesticidal or other plant protection function[4] within the meaning of the PPPR.”

To this end, the plant biostimulant function of phosphite plant biostimulants applied at early growth stages to cereals and oilseed rape have been demonstrated through robust scientific research.

How can farmers manage maximum residue limits (MRLs) if a phosphite plant biostimulant and a phosphonate fungicide are used in the same season?

In cases where both a phosphite plant biostimulant and a phosphonate fungicide could be used on a crop in a single season, labelling requirements allow farmers to avoid exceedances. In addition to the general FPR requirements to inform farmers of the maximum concentration of substances subject to residue limits, phosphite plant biostimulants could be subject to a specific labelling requirement stating that specific care should be taken if using phosphonate fungicides on the same crop in the same season in order not to exceed maximum residue levels.

[3] The extended BBCH scale was used to define the growth stages.

[4] Article 2 of Regulation (EC) 1107/2009 states, “This Regulation shall apply to products**, in the form in which they are supplied to the user**, consisting of or containing active substances, safeners or synergists, and **intended for one of the following uses**…” [emphasis added to underscore what “function” entails].

It should be noted that in many of the cases where phosphite plant biostimulants are effective, there is no phosphonate fungicide authorised (precisely because the pathogens that can be controlled by phosphonates do not affect these crops).

Are there environmental concerns for the use of phosphite plant biostimulants alone or in combination with phosphonate fungicides?

There is no harmonised classification for human health or ecotoxicology under Regulation (EC) 1272/2008 for potassium phosphite.

In 2013, the European Food Safety Authority (EFSA) concluded that phosphonate fungicides -- which are applied at much higher rates than phosphite plant biostimulants -- pose a low risk to the aquatic environment, honeybees, non-target arthropods, earthworms, other soil macro-organisms, soil micro-organisms and non-target terrestrial plants after 6 applications of potassium phosphite as a vine fungicide (rate equivalent to 2016 kg /ha of phosphonic acid) with a 60-day preharvest interval. In contrast, phosphite plant biostimulants are generally applied at less than 500 g per hectare.

There is little likelihood of an environmental risk emerging from accumulation of phosphite and phosphonate in the soil, because they oxidise to phosphate as a result of microbial activity[5] (with times varying from around three months to just over a year, depending on specific soil conditions). Bacteria that oxidise reduced phosphorus and the genes required for the oxidation of phosphite are abundant in the environment. Of course, these products should be used as part of an integrated nutrient management plan to prevent phosphorus losses to the environment, but with typical phosphorus applications to wheat at about 30-35 kg/ha, the amount of phosphate added to the system from phosphite plant biostimulants applications and subsequent oxidation would be very low.

This risk assessment is consistent with the ecotoxicological analysis done for the REACH registration of potassium phosphite for use in fertiliser products.

On the other hand, there are significant environmental benefits from the appropriate use of phosphite plant biostimulants, as they increase both nutrient and water use efficiency. Furthermore, the enhanced root development stimulated by phosphite plant biostimulants will increase carbon capture and increase soil organic matter (SOM) with subsequent fertility benefits, although this increase in SOM has not been explicitly quantified. Details on the environmental benefits of using phosphite plant biostimulants can be found in the EBIC Explainer "Phosphite-based plant biostimulants: an overview of the science and farmer value."

Can phosphite plant biostimulants be used while respecting maximum residue limits?

In 2014, the European Commission was asked to consider whether phosphonate could be legally used as a fertiliser. At that time, the regulatory framework indicated that anything that was not a plant nutrient (as defined in Regulation (EC) 2003/2003) fell under the scope of the

[5] Fred Adams and John P. Conrad, "Transition of Phosphite to Phosphate in Soils," *Soil Science* 75, no. 5 (May 1953): 361; L. E. Casida, "Microbial Oxidation and Utilization of Orthophosphite during Growth," *Journal of Bacteriology* 80, no. 2 (August 1960): 237–41; George Malacinski and Walter A. Konetzka, "Bacterial Oxidation of Orthophosphite," *Journal of Bacteriology* 91, no. 2 (February 1, 1966): 578–82; T. L. Foster, L. Winans, and S. J. Helms, "Anaerobic Utilization of Phosphite and Hypophosphite by Bacillus Sp.," *Applied and Environmental Microbiology* 35, no. 5 (May 1, 1978): 937–44; Amaya M. Garcia Costas, Andrea K. White, and William W. Metcalf, "Purification and Characterization of a Novel Phosphorus-Oxidizing Enzyme from Pseudomonas Stutzeri WM88*210," *Journal of Biological Chemistry* 276, no. 20 (May 18, 2001): 17429–36, https://doi.org/10.1074/jbc.M011764200.

plant protection Regulation (EC) 1107/2009. In the meantime, plant biostimulants have explicitly been moved out of the plant protection regulation and under Regulation (EU) 2019/1009, the Fertilising Products Regulation. Today, the phosphite plant biostimulant products described above clearly meet the criterion outlined in the Commission's January 2015 memo on phosphonates: that the use of phosphonate was regulated by the plant protection regulation "unless it can be proven that the product is intended to be used solely for purposes other than those listed in Article 2(1) of the PPPR (that is, other uses than that of protecting plants through the fungicidal properties of that active substance)…"

In the research done on the plant biostimulant mode of action, the phosphite product was applied at rates of just **450 g/ha** at wheat growth stages 12 (two leaves emerged on the seedling) and 13 (three leaves emerged on the seedling). These are very different conditions of use (in terms of crop, rate and growth stage) than those that raised concerns about exceedances from misuse of phosphonates in fertilising products in 2014. Applying phosphite plant biostimulants at up to 500 g per hectare in an early growth stage - typical for plant biostimulant applications - allows growers to respect maximum residue limits (MRLs) in crops where those limits have been set to reflect product use. Crops with a default MRL (assuming no pesticide use) are a different case, where finding any trace of phosphite even after a legitimate application of a phosphite plant biostimulant could be misconstrued as misuse of a plant protection product. This problem needs to be resolved for crops where a plant biostimulant application of phosphite has a scientific basis. However, it should not prevent the recognition of the scientific demonstration of plant biostimulant modes of action for phosphites under certain conditions in the meantime.

EBIC member companies have conducted 39 monitoring studies, 8 under good laboratory practice (GLP) and 31 non-GLP, on phosphonate residues in cereals and oilseed crops treated with phosphite plant biostimulants. In all cases, the level of phosphonate residues was well below the presumed safety level of 75 mg/kg indicated by EFSA in its 2013 opinion on phosphonates. In almost all cases, the residues were also below defined MRLs, where those were set to reflect a commercial use on that crop.

- 2 GLP studies on maize. Range of residues: 0.21-0.59 mg/kg (depending on application rate)
- 1 GLP study on wheat. Residues: 17.1 mg/kg
- 5 GLP studies on wheat. Range of residues: <LOQ-3.6 mg/kg
- 15 non-GLP monitoring studies on wheat. Range of residues: <0.05-12 mg/kg
- 8 non-GLP monitoring studies on oilseed rape. Range of residues: <0.05-10 mg/kg.
- 8 non-GLP monitoring studies on barley. Range of residues: <0.05-3.3 mg/kg

These data and the historical use of phosphite plant biostimulants around the world (and of phosphonate products as plant protection products) demonstrate the safety of phosphite and phosphonate salts.