Bundesverband Naturkost Naturwaren

**BNN factsheet**

Phosphonic acid, potassium phosphonate (potassium salt of phosphonic acid), fosetyl-aluminium

Summary of current knowledge, September 2020

*The last BNN fact sheet on phosphonic acid released in 2017 was based on the reporting limit for phosphonic acid at the time. Recent years have seen significant improvements in terms of both analytical methods and measurement accuracy, so BNN has decided to review the value that was specified at the time and base it on solid data.*

*The **recommendations in this fact sheet** are based on an evaluation of a total of 7,257 anonymised data sets that were generously made available to BNN by three BNN-approved laboratories[1]. We calculated the percentiles of the data and discussed and evaluated them together with the BNN academic advisory board.*

*It is expressly stressed that the values given under Point 8 represent neither regulatory guidelines nor limits, thresholds or other similar action thresholds, but solely a recommendation by BNN as to how findings of phosphonic acid in organic products could be classified.*

*The next review of the values is expected to take place in autumn 2022.*

## 1. Introduction

Since autumn 2013, phosphonic acid has regularly been detected in conventionally and organically grown fruit and vegetables, ever since a number of state and private laboratories established the analytical methods. The suspected origins are primarily the use of potassium phosphonate (formerly approved in organic farming, see *Legal Classification*) or fosetyl-Al (trade name e.g. "Aliette"), given that the actual active substance in both cases is phosphonic acid (see next section for details). Potassium phosphonate can be a declared or an undeclared component of (foliar) fertilisers or plant strengtheners that were authorised in organic farming in certain EU countries. These (hitherto



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approved) applications can still result in positive detections even after several years due to the retention of phosphonic acid in vegetative plant parts.

## 2. Potassium phosphonate, phosphonic acid, and what they both have to do with fosetyl-aluminium

Potassium phosphonate is the potassium salt of phosphonic acid ($KH_2PO_3$). Potassium phosphonate is an inorganic phosphonate, for which reason it was formerly named potassium phosphite (now obsolete, but having the advantage that this term facilitated the distinction from organic phosphonates, to which potassium phosphonate does not belong). Potassium phosphonate, or rather the actual active substance phosphonic acid, is an agent that acts systemically to control fungal diseases, particularly downy mildew. Potassium phosphonate has a natural character. Organic phosphonates (to which potassium phosphate does not belong, see above) occur in all life forms. In addition to potassium phosphonate there are also other salts of phosphonic acid, such as disodium phosphonate, which has likewise been authorised in the EU as an active substance in pesticides since 1 February 2014.

Degradation of the fungicide fosetyl-aluminium (chemical formula: $(C_2H_6PO_3)_3$ Al), which is **not authorised for organic farming**, is also a source of phosphonic acid via the intermediate fosetyl ($C_2H_6PO_3$ H, where three "individual groups" of fosetyl arise from one fosetyl-Al since aluminium is trivalent). For this reason, the residue definition of fosetyl-Al pursuant to Regulation (EC) No 396/2005 is: Fosetyl-Al (sum of fosetyl and phosphonic acid and their salts, expressed as fosetyl).

This often causes confusion since a sum of fosetyl-Al is given in laboratory reports although no fosetyl was detected, but rather in most cases solely phosphonic acid. The requirements of the BNN orientation value apply, of course, to fosetyl-Al.

## 3. Potassium phosphonate in organic farming

Potassium phosphonate was long used in Germany (one well-known product was "Frutogard") to minimise dependency on copper in **organic viticulture**. Applying potassium phosphonate to leaves triggers resistance mechanisms. This promotes the natural resistance and resilience of vines and other plants to fungal diseases, particularly peronospora ("downy mildew"). This use of potassium phosphonate was authorised until 30 September 2013 for organic farms in many EU States (e.g. Germany, Greece, Austria, Spain, the Czech Republic, Hungary). Apart from its use in organic viticulture, it was also used in particular for **organic vegetable farming** (e.g. for cucumbers and tomatoes), **organic pomaceous fruit and organic citrus fruit**. However, positive detections are not limited to the aforementioned crops. With its classification as a plant protection product in April 2013, which came into effect in October of the same year, any future use of the substance for organic farming in the EU would require (renewed) authorisation. Unauthorised use of fosetyl-Al in organic farming is unlikely, since potassium phosphonate is similarly effective and much less expensive.



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## 4. Legal classification

Until 30 September 2013, there were still plant strengtheners and fertilisers containing salts of phosphonic acid (e.g. potassium phosphonate) that were authorised for use in organic farming in Germany and other EU States. As of 1 October 2013, potassium phosphonate and as of 1 February 2014, disodium phosphonate have been authorised as pesticides in the EU and therefore may no longer be used in plant strengtheners or fertilisers. Grace periods allowed for use even after this date. Phosphonates could only continue to be used in organic farming if they were listed in the EU Organic Regulation (currently still Annex II = List of Authorised Plant Protection Products in Regulation [EC] No 889/2008). **Use of phosphonates in organic farming is not allowed in any EU Member State at present!**

BNN, together with the *Bund Ökologische Lebensmittelwirtschaft*, BÖLW (German umbrella organisation for organic food and farming), is advocating for them to be included in the EU Organic Regulation. This should be limited to viticulture and up to the end of flowering in order to minimise residues. According to information available to BNN, the southern European countries are not seeking authorisation of potassium phosphonate. In non-EU-countries, equivalent standards could provide for authorisation of potassium phosphonate in organic farming, though BNN monitoring is not aware of any such case to date.
As of July 2020, the legal maximum residue level for fosetyl-Al, including the metabolite phosphonic acid, is 100 mg/kg for wine and table grapes, and only 2 mg/kg for certain other products (Regulation [EC] No 396/2005 in the currently valid version).

## 5. Toxicology

Phosphonates and specifically phosphonic acid have such low toxicity that the EFSA has not set an acute reference dose for potassium phosphonate ("ARfD: Not relevant"). The acceptable daily intake (ADI) is 2.25 mg/kg body weight per day.

## 6. Analytical methods

The laboratories apply reporting limits (RL) for phosphonic acid ranging from 0.01 mg/kg to 0.05 mg/kg, depending on the type of food. Analysis is done by aqueous and/or methanol extraction and subsequent measurement by LC-MS/MS (ESI in negative ion mode). Chromatographic separation precludes any possibility of confusion. However, the analytical method does not reveal the "origin" of the phosphonic acid. Phosphonic acid and fosetyl cannot be analysed using the known multi-methods.



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## 7. Positive detections and their origins

**Residues from pesticides must be minimised to the greatest extent possible.** According to experience thus far, positive detections of phosphonic acid can be attributed to the use of phosphonates (or alternatively fosetyl-Al). However, particularly in the case of permanent crops, application could date back to some time ago and thus have taken place at a time when its use in organic farming was still approved. A pilot study conducted by Bögli and Speiser (2019) in organic viticulture shows that phosphonic acid can still be detectable in wine 5-6 years after application and that concentrations in the samples tested did not fall below 0.1 mg/kg until the sixth year.

Apart from the use of phosphonates, the Julius Kühn-Institut (JKI) and others consider contaminations in phosphorus fertilisers a possible source, though experts believe this does not apply to the soft ground rock phosphate authorised for organic farming. The rumour that phosphonates could be naturally present in algal products is probably based on the – at best ambiguous – list of the ingredients of the plant strengthener Frutogard, which also contains brown algae extract. The potassium phosphonate listed, however, is added, which also tallies with the fact that, within the scope of the BÖLW expert opinion of "natural materiality", no potassium phosphonate could be found in nature, or only as an intermediate that is always very rapidly converted.

Furthermore, there are also cases of often **undeclared additives of phosphonic acid in farm inputs authorised for organic farming**. Farm inputs generally constitute a critical source of possible phosphonic acid findings in organic foods and should therefore form part of an appropriate risk management strategy.

## 8. Evaluating positive detections of phosphonic acid

BNN recommends the following procedure:

If phosphonic acid is detected, the farm inputs **<u>should</u>** definitely be checked:

- for **annual and biennial*** crops when levels are 0.05 mg/kg or above
- for **perennial** crops when levels are 0.1 mg/kg or above.

However, even lower concentrations should be further reduced as far as possible. For permanent crops in particular, the goal in the medium term should be a target range of 0.05 – 0.1 mg/kg.

Until 31 December 2022, the BNN orientation value is considered to have been met with regard to phosphonic acid and its salts if levels do <u>not</u> exceed

- for **annual and biennial*** crops 0.05 mg/kg
- for **perennial** crops 0.1 mg/kg.



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* Includes biennial plants, known as winter annuals, whose life cycle in the botanical sense requires two vegetation periods for seed formation. However, these are mostly cultivated only annually as often no seeds or fruit are harvested. These include, for example, the various beets.

An expanded measurement uncertainty of **30 %** (of the analytical result) can be factored in here.

Note: The standard expanded measurement uncertainty of 50 % does not apply here, as this applies only to pesticides determined using multi-methods. Analysis of phosphonic acid is based on the use of a specific single or group method, which has much lower measurement uncertainty than a multi-method.

**If no fosetyl is detected, there is no reasonable cause to suspect that the phosphonic acid detected is the result of unauthorised use of fosetyl-Al.** Until 1 October 2013, the use of phosphonates as a plant strengthener or in fertilisers was authorised in organic farming in many EU countries. Such applications, particularly in the case of permanent crops, are often analytically detectable for quite some time. In non-EU countries, farm inputs or fertilisers containing phosphonates may be authorised, or not explicitly prohibited, in accordance with national standards for organic farming. In these cases, explicit confirmation by the third country inspection body must be provided to confirm equivalence. The BNN orientation value is then also considered to have been met. The relevant inspection body/authority is responsible for evaluating residues that can be traced back to the use of products containing undeclared phosphonates as an active substance. In BNN's view, the organic foods concerned should still be marketable with an organic farming label as long as steps have been taken to prevent the future use of these products.

## 9. Further recommendations and notes on investigating origins

It is recommended that an assessment is carried out in the context of self-monitoring as to which, if any, products should be tested for the presence of phosphonic acid. **We strongly recommend conducting a critical review of the inputs**, especially when investigating the origins of unexpected detections of phosphonic acid.

We call upon all those concerned to take positive detections of phosphonic acid seriously and to investigate and, if necessary, remedy the causes. **At the same time, we urge that any response be judicious**, so as not to wrongfully discredit goods produced correctly in compliance with organic farming regulations.



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- Trinchera A, et al. (2020): Assessing the Origin of Phosphonic Acid Residues in Organic Vegetable and Fruit Crops: The Biofosf Project Multi-Actor Approach. Agronomy 10: 421


**[1] Data source**

- Analytica Alimentaria GmbH, Kleinmachnow, Germany
- Labor Friedle GmbH, Regensburg, Germany
- Labor Greit s.r.l, Bologna, Italy



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