



Questions and answers: Phosphonic Acid / Fosetyl-Al

Derek Donkin
SUBTROP

Adele Mcleod
UNIVERSITY OF STELLENBOSCH

WHY IS PHOSPHONIC ACID USED IN AVOCADO PRODUCTION?

Phosphonic acid (also known as phosphorous acid) is the active ingredient of the chemical formulations most commonly used to control *Phytophthora* root rot (PRR) in South African avocado orchards. Potassium phosphonate (mono- and di-potassium) formulations are registered as stem injections. Fosetyl-Al (Aliette®) is registered as a foliar spray for *Phytophthora* control. Phosphonic acid is the main breakdown product of fosetyl-Al and potassium phosphonates. South African avocado production would not be viable without chemical control of PRR.

IS PHOSPHONIC ACID DANGEROUS TO HUMAN HEALTH?

Phosphonic acid has a low acute toxicity as evidenced by relatively high European Maximum Residue Levels (MRLs) of 75 mg/kg (or ppm) for many commodities (e.g. citrus and tree nuts) and the Australian MRL of 500 mg/kg (ppm) in avocados. The MRL for phosphonic acid is 50 mg/kg (ppm) in both South Africa and the European Union (EU).

WHY IS THE EU MAXIMUM RESIDUE LEVEL (MRL) FOR PHOSPHONIC ACID EXPRESSED AS FOSETYL-AL?

The initial data submitted for setting the MRL was from fosetyl-Al, the first registered phosphonate worldwide. Phosphonic acid is the main metabolite (breakdown product) of fosetyl. The MRL for fosetyl-Al is defined as: sum of fosetyl + phosphonic acid and their salts, expressed as fosetyl.

WHAT DO LABORATORIES MEASURE WHEN TESTING FOR PHOSPHONIC ACID / FOSETYL-AL RESIDUES?

The levels of both fosetyl and phosphonic acid are determined. In the majority of cases in avocado fruit, the fosetyl residue should be zero, because fosetyl-Al is commonly not used. The residue of phosphonic acid is determined and converted to a fosetyl equivalent using a conversion factor of 1.3298 because the EU MRL definition requires the residue to be expressed as fosetyl. The converted phosphonic acid value is then used as the MRL.

HOW IS THE CONVERSION FACTOR OF 1.3298 DETERMINED?

Simply put, fosetyl is 1.3298 times heavier than phosphonic acid. Therefore, to convert phosphonic acid to a fosetyl

equivalent, it must be multiplied by 1.3298. (Molecular masses: fosetyl 109.041 g/mol; phosphonic acid 82 g/mol.)

WHY DO PHOSPHONIC ACID RESIDUES IN FRUIT VARY SO MUCH WITHIN AN ORCHARD?

The movement of phosphonic acid in the tree depends on the sink strength of various parts of the tree. Actively growing parts of the tree are stronger sinks. Young avocado fruitlets are strong sinks, as are actively growing shoots and roots. The sink strength of a fruit is relative to the sink strength of roots and/or shoots at any given time. Therefore, relative sink strength of the fruit will vary from branch to branch and from tree to tree. Another factor determining fruit residues is crop load; trees that have a higher crop load may tend to yield lower fruit residues relative to lighter bearing trees.

WHAT IS THE BEST TIME TO INJECT TREES TO MINIMISE THE RISK OF EXCEEDING THE MRL?

The best time to inject is after the summer flush has hardened off. At this time, the roots should be actively flushing and are therefore a strong sink. Additionally, the fruits are close to full size and are a weaker sink during this time. Phosphonic acid is a very stable and mobile molecule, consequently the tree phenological stage at the time of application has a greater effect on resultant fruit residues than the pre-harvest application interval (withholding period). However, it is still of utmost importance to ensure that the pre-harvest intervals are adhered to before harvesting (consult product label). Therefore, the pre-harvest interval must be considered before injecting.

Injecting just prior to- or during flowering, during fruit set and while the fruit are small and rapidly expanding will increase the risk of MRL exceedances.

WHAT IS SAAGA DOING TO REDUCE THE RISK OF PHOSPHONIC ACID MRL EXCEEDANCES?

For the past five years, SAAGA has been funding research at the University of Stellenbosch to gain a better understanding of the movement of phosphonic acid in avocado trees and to investigate alternative cost effective methods of application to reduce residues in the fruit. It is expected that registrations to allow for spray applications (which result in lower fruit residues than stem injection) will be in place by 2021 or 2022.

SAAGA is engaging with the South African Bureau of Standards (SABS) to carry out trials to generate data which will enable a submission to the EU to raise the MRL on avocados above the current 50 mg/kg. Trials will commence in August/September 2018 and will take approximately two years to complete. A further two years may be required for the EU regulatory process.

REFERENCES

European Food Safety Authority Journal 2014;12(5):3695.
Commission regulation (EU) no 991/2014, 19 September 2014.