1988 Summary of Avocado Research, pages 28-35
Avocado Research Advisory Committee
University of California, Riverside

Chemical Control of Avocado Root Rot

M. D. Coffey, S. D. Campbell, G. Creer, D. G. Ouimette, R. Stange
Department of Plant Pathology,
University of California,
Riverside, CA 92521

The chemical control program has continued to slide down to the rocky slopes to oblivion. The drastic reduction in research funding, involving a total loss of $60,000 over the last two years, has caused a great deal of damage. Despite this we have managed to raise a little money this year for the field program. Contributions in 1988 have been:

Rhone-Poulenc $6000
Mr. Joe Illig $1500
Mrs. Betty Spaulding $1000

If possible we hope to maintain some of our fungicide injection plots currently in place at Valley Center, Rancho California, Somis, and Carpintería. The Somis plot (Table 1) was initiated in November 1983, is our earliest experiment with fungicide injections, and is now yielding useful efficacy data. We may be able to obtain some limited production figures later this year from the better fungicide treatments.

Table 1. INJECTION TRIAL - SOMIS, Ventura County

HASS	11-83	3-84	7-84	2-85	8-85	6-86	3-87	7-87	12-87
Control	1.9	3.4	3.5	3.1	3.7 A	4.1	4.2	4.1 A	4.3 A
10.5% H_3PO_3	2.0	3.3	3.3	2.9	2.4 B	2.1	2.1	2.6 B	2.7 B
7.0% H_3PO_3	2.1	3.4	3.3	3.2	2.4 B	2.4	2.8	2.6 B	2.7 B
3.5% H_3PO_3	1.7	3.1	3.2	3.2	2.7 AB	2.5	2.8	2.9 B	2.5 B
5% fosetyl	1.9	3.3	3.4	3.1	2.7 AB	2.6	2.7	2.7 B	3.2 B
Aliette WP	1.9	3.3	3.2	3.2	2.3 B	2.1	2.3	2.6 B	2.8 B
Ridomil EC	1.6	3.1	2.9	3.1	2.5 AB	3.4	3.5	3.9 A	4.8 A

0= healthy 5= dead
Hass - 12 replicates
10.5%, 7.0%, 3.5% phosphorous acid buffered; injection
5% Fosetyl Al; injection
Aliette and Ridomil; commercial formulations; applied as ground drench

The fungicide injections consist of 4 x 16 ml per tree for each application, made in June and August of each year. Only Ridomil® is registered at present for use on bearing avocados. Hass grove planted 1977. Treatments started 11/83 but trees subsequently declined to 3.1 to 3.5, before responding.

Quantitative analysis of organic phosphonates, phosphonate and other inorganic anions in plants and soil using high performance ion chromatography. The current analytical method for quantitation of the systemic fungicide aluminum tris-O-ethyl phosphonate (Aliette®) and its anionic metabolite phosphonate ($HPO3^{-2}$) in plants is extremely tedious and requires the use of both HPLC and GLC. We report here a simple and improved method which employs high performance ion chromatography, using eluent suppression and conductivity detection, to determine residues of ethyl, diethyl and dimethyl phosphonate as well as the inorganic anions $HPO3^{-2}$, $HPO4^{-2}$, NO3- and $SO4^{-2}$ in aqueous extracts of plants and soil. The method has proved sensitive, reproducible, and requires only simple sample preparation. Two types of column and eluent are employed, one for inorganic anions and the other for organic phosphonate compounds. The efficiency of aqueous extraction of ethyl phosphonate and $HP03^{-2}$ from plants is about 70%. Aqueous extraction efficiency of organic phosphonate from soil is 90% while that of $HP0_3^{-2}$ using 0.5 M $NaHC0_3$ is 85%. Under the conditions employed, the limits of detection of the organic phosphonates from plants and soil are 2.0 µg/g and 5.0 µg/g, respectively; while those of $HPO3^{-2}$ and other inorganic anions in plants and soil are 0.5 µg/g and 0.2 µg/g, respectively.

TABLE 2. Extraction efficiency from soil of organic phosphonates and inorganic phosphonate using either water or sodium bicarbonate[a]

Compound	Extractant	% recovery[b]
Monoethyl phosphonate	water	91.2 ± 8.7
Diethyl phosphonate	water	86.6 ± 13.4
Dimethyl phosphonate	water	90.0 ± 5.9
Phosphonate	water	67.6 ± 7.6
Phosphonate	0.5 M $NaHCO_3$	84.4 ± 0.5

[a]Soil was a sandy loam and the percent recovery values are the mean of five replicates.

[b]Soil was extracted by placing 5 g of soil into a 15 ml vial to which 10 ml of extractant was added. The samples were shaken for one hr on a reciprocal shaker at 180 strokes/min.

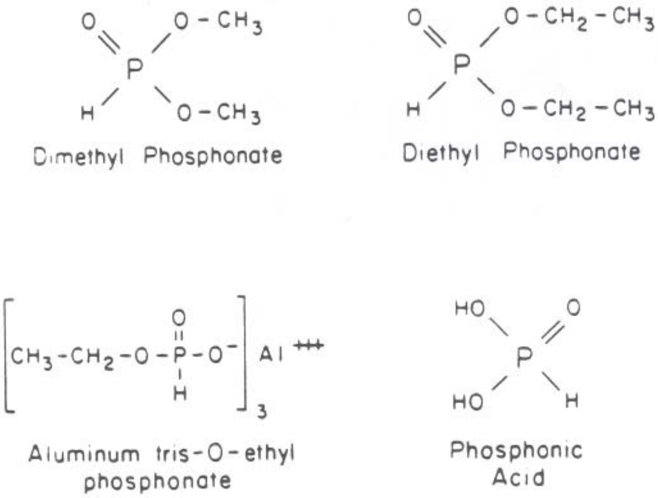

Fig. 1. Chemical structures of phosphonic acid and organic phosphonate compounds (monoethyl, diethyl, and dimethyl phosphonate).

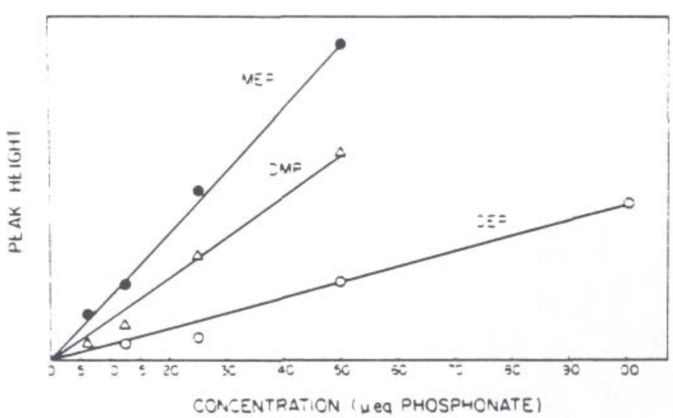

Fig. 2. Standard curves of monoethyl, diethyl and dimethyl phosphonate (MEP, DEP and DMP, respectively). Standards were prepared in glass distilled water and detector response was 3 µS.

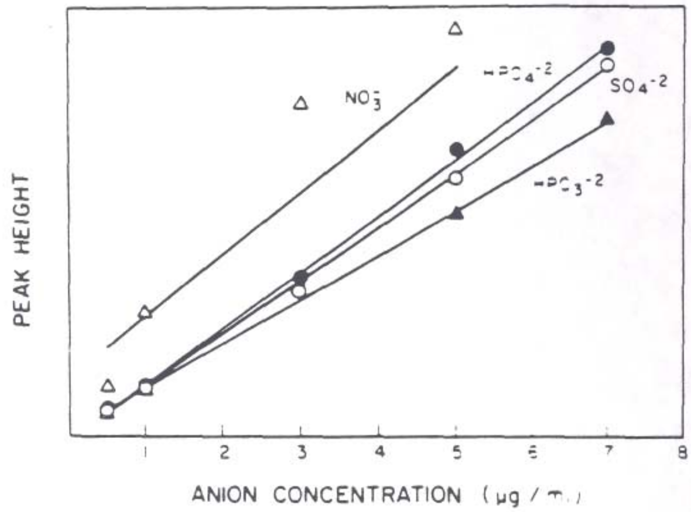

Fig. 3. Standard curves of phosphonate (HPO_3^{-2}) and the major plant anions nitrate (NO_3^-), phosphate (HPO_4^{-2}) and sulfate (SO_4^{-2}). Standards were prepared in glass distilled water and the detector response was 3 µS.

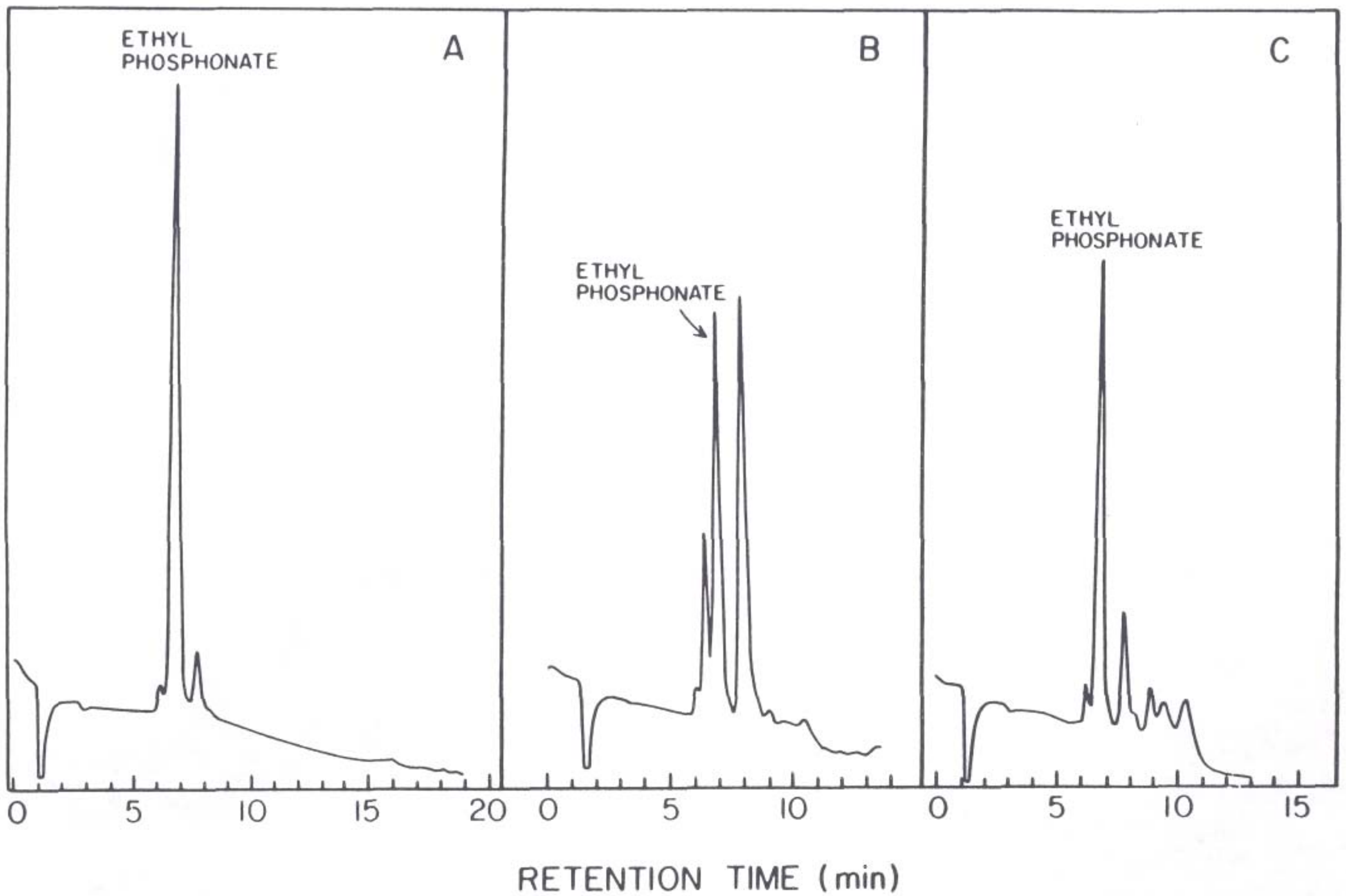

Fig. 4. Chromatograms of (A) 5 µg/ml ethyl phosphonate standard prepared in glass distilled water, (B) aqueous extracts of a sandy loam soil to which ethyl phosphonate was added and extracted with 2 ml water/g soil and (C) aqueous extracts of plant stems after treatment with 5.0 mM fosetyl-Al for 24 hr. Pepper tissue was extracted with 5 ml water/g fr. wt. Both soil and plant tissue was extracted for one hour, the extracts diluted 10:1 with water and passed through a 0.22 µm filter and a Sep-Pak® C_{18} cartridge prior to injection into the HPIC. The conductivity detector was set at 3 µS.

Comment

The ion chromatography procedure developed for analysis of phosphonate fungicides will prove useful in determining residue levels in the four injection plots already in place. A critical need is to improve the efficacy of these injection methods under California conditions. Results to date have been dissappointing when compared to data coming out of Australia and South Africa, where they report restoration to full health after 18 months of injection treatment.

The timing of injection treatment, the amount to be injected, and the number of injections required are critical factors that have yet to be evaluated under California conditions. More research using sophisticated analytical procedures for fungicide residue determination and more injection plots are desperately needed.

<u>Section 18 update</u>

A Section 18 has been requested for the Aliette® 10% formulation, using the injection methods on bearing avocados. If the application is successful, the emergency registration should take place by June of this year and would last 12 months. Full registration of ALiette® 10% and Aliette 80WP for bearing avocados is anticipated sometime in 1989.

<u>Research Directions</u>

More data is need on the behavior of ALiette® and phosphonate residues in avocado trees. The impact of repeated injection on the health of avocado trees, as this relates to trunk injury, needs long term and effective assessment. The current poor efficacy of this method relative to results obtained in South Africa and Australia should be of great concern. The likelihood of resistance to Aliette® or Ridomil® occurring needs to be assessed. Resistance of *P. cinnamomi* (P.c.) to Ridomil® has been reported in South Africa and resistance of *P.c.* to Aliette® in France. Since long term usage of these fungicides for control of avocado root rot is envisaged it is important to design control strategies which reduce the risks of resistance occurring.

Summary

Vital issues in chemical control research are currently being neglected. The critical needs of improved fungicide efficacy and risk assessment of long-term resistance developments to *P.c.* should not be ignored. Chemical control is currently a necessary and irreplaceable supplement to rootstocks in the fight against avocado root rot. Improvement in efficacy and effective evaluation of the risks of *P.c.* resistance occurring are vital to the future health of the Californian avocado industry.