Phosphonic (phosphorous) acid controls *Plasmopara viticola* the cause of downy mildew of grapevines

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Abstract

Phosphonic (phosphorous) acid (Foli-R-Fos 200) has been extensively evaluated in glasshouse and field trials since 1986. This new fungicide (at 600 mL/100L) demonstrated a high level of efficacy in the post- but not pre-infection control of *Plasmopara viticola*. Control equivalent to Ridomil MZ 720WP was achieved up to 17 days post-infection reducing sporulation and hastening oilspot necrosis. A tank-mix with copper oxychloride offers potential to complement existing fungicides in Australian anti-resistance management strategies.

Until recently the only fungicide registered in Australia for post-infection control of grapevine downy mildew (caused by *Plasmopara viticola* (Berk. & Curt.) Berl. and de Toni) was the phenylamide metalaxyl (Ridomil Plus). Tests of the efficacy of phosphonic acid (H_3PO_3 on *P. viticola* were of interest because another phosphonate fungicide, fosetyl-Al was an effective inhibitor of *P. vitticola* (Cohen and Coffey 1986). Also H_3PO_3 had shown high levels of efficacy against *Phytophthora* species, a related pathogen (Pegg *et al.* 1985; Cohen and Coffey 1986).

Glasshouse and field evaluation of H_3PO_3 began in South Australia in 1986 and is summarised here. Phosphonic acid was applied as a foliar spray of Foli-R-Fos 200 (UIM Agrochemicals (Aust.) Pty Ltd, Brisbane, Qld) at 600 mL f.p./100 L.

Post-infection efficacy Phosphonic acid reduced disease incidence when a single spray was applied up to 3 days after infection and reduced the area of leaf affected when applied up to 13 days after infection. A single application at least 7–9 days post-infection significantly reduced sporulation in numerous experiments (Magarey and Wachtel 1987; Magarey *et al.* 1987; Wicks *et al.* 1990). In three experiments when the incubation period for downy mildew was 10 days, the disease was controlled when sprays were applied as late as 17 days post-infection. The efficacy in these experiments was mainly through significant reduction in sporulation and hastening of necrosis of oilspots which dried out and died more quickly, thus more effectively eradicating the disease (Magarey and Wachtel 1987; Magarey *et al.* 1987; 1990).

Sporangia that developed from foliage sprayed up to 17 days post-infection were reduced in viability, resulting in further reduction in the potential for epidemics to develop (Magarey *et al.* 1987; 1990). Spread of *P. viticola* from active lesions sprayed 4 days post-infection, was prevented (Magarey and Wachtel 1987).

Generally, in post-infection application Foli-R-Fos 200 has performed as well as, if not better than recommended rates of Ridomil MZ 720 WP (metalaxyl + mancozeb, Ciba Geigy (Aust.) Ltd).

Pre-infection efficacy In 16 experiments, H_3PO_3 alone gave poor pre-infection (protectant) control of downy mildew, controlling the disease only if applied 1 to 7 (usually 3) days before infection (Magarey *et al.* 1989). These experiments failed to confirm previous glasshouse tests (Magarey and Wachtel 1987). Weekly applications did not improve the efficacy of H_3PO_3.

The hydrolysis product of H_3PO_3 in plants is phosphonate (Ouimette and Coffey 1988) and is extremely mobile within vine tissues moving from leaf to leaf, both up and down shoots. Phosphonate residue levels in leaf tissues were determined efficiently and quickly (Glenn *et al.* 1990). Levels declined rapidly within the first 5 days from application. This rapid movement of phosphonate probably accounts for the lack of pre-infection control of *P. viticola* by H_3PO_3.

In glasshouse experiments H_3PO_3 was taken up by the roots of potted vines and controlled infection by *P. viticola* but application of the fungicide to the soil via drip-irrigation systems for control in vineyards was not successful.

Foli-R-Fos 200 can be mixed with mancozeb, copper oxychloride, the powdery mildew fungicides Bayleton, Tilt, and sulphur, and with the foliage nutrients zinc/manganese (proprietary mixture) and nitrogen (as urea), without affecting its activity. Tank mixes with copper oxychloride were effective. They both eradicated existing infection and provided protection, demonstrating the potential to increase growers' spray efficiency with a single tank-mix application. Fermentation and wine taste studies showed Foli-R-Fos 200 was safe to use on wine grapes and should leave no harmful residues to cause concern on export markets.

Rates of Foli-R-Fos 200 above 5 L/100 L were phytotoxic and until low volume and other methods of application are evaluated, care should be taken to avoid rates approaching 5 L Foli-R-Fos 200/100 L of water.

Summary

Foli-R-Fos 200 is a safe and effective fungicide for

post-infection control of downy mildew. It is now registered for use in south-eastern Australian viticulture, but its use should be restricted to applications made as soon as possible after infection, preferably within 7–10 days.

The addition of copper oxychloride in a tank-mix should give good pre- and post-infection control of downy mildew. This mix offers significant potential to complement existing phenylamide fungicides in anti-resistance strategies for Australian viticulture.

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The control of black pod, canker and seedling blight of cocoa, caused by *Phytophthora palmivora*, with potassium phosphonate

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Abstract

Trunk injected potassium phosphonate (8 or 16 g a.i. per tree every 6 months) controls black pod and stem canker of cocoa. Foliar sprays of potassium phosphonate (20 g a.i. per tree every 6 months) or Ridomil Plus 72WP (0.72 g a.i. per tree every 6 weeks during the wet season) do not control black pod. Trunk injection is less weather dependent than foliar sprays, and is a more effective application method for mature trees in the cocoa growing areas of Papua New Guinea. Single Ridomil Plus 72WP (0.8%) or potassium phosphonate (4%) sprays control artificially inoculated seedling blight more effectively than either a lower rate of potassium phosphonate (0.5%) spray or a soil drench of potassium phosphonate (1%).

Introduction

Phytophthora palmivora (Butl.) Butl. is the most destructive pathogen of cocoa (*Theobroma cacao* L.) in Papua New Guinea. The disease affects all parts of the plant, but the major losses are due to fruit rot (black pod), bark canker and seedling blight. Yield losses of up to 39% have been attributed to black pod, and canker and blight cause further losses in PNG (McGregor 1982). In this paper we present the results of three experiments using potassium phosphonate and Ridomil Plus 72WP to control these diseases.

Methods

All trials were conducted on Kar Kar Island, Madang Province in Papua New Guinea, a cocoa growing area with high rainfall and black pod incidence.

Fungicides Potassium phosphonate was prepared by titrating a solution of phosphonic acid