## Effectiveness of fungicides in reducing *Phytophthora* root rot losses in Christmas tree plantations

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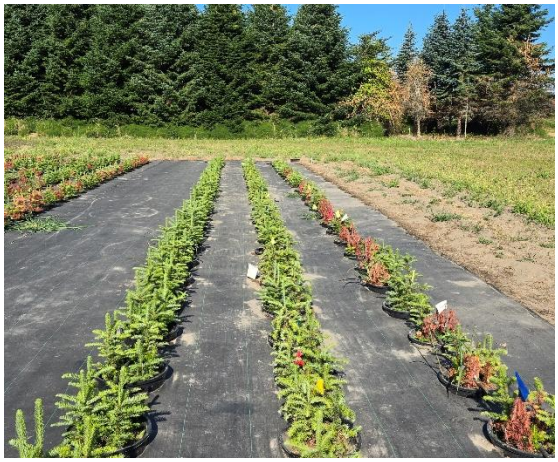

Managing *Phytophthora* root rot (PRR) in noble and Fraser fir plantations is a significant challenge for U.S. Christmas tree growers. In the Pacific Northwest, PRR frequency and mortality of mature trees have increased, likely due to changing precipitation patterns and potential shifts in *Phytophthora* species. Disease development is now observed beyond low-lying, waterlogged areas. Cultural methods such as site selection, improving soil drainage, and planting resistant species help manage PRR, but chemical fungicides offer another potential solution to reduce losses. However, there is limited research on fungicides' efficacy and residual activity in conifers.

Root rots caused by *Phytophthora* species are often not noticed until foliar symptoms of wilting, branch flagging, and stunting are observed. Chemical control of *Phytophthora* root rots is difficult since there are multiple species of the pathogen with potentially differential sensitivities to fungicides. Furthermore, *Phytophthora*s can have a propensity to develop resistance to single site mode of action fungicides, such as Subdue Maxx. Additional challenges include the spotty nature of where the disease occurs, the lack of good solid information on the residual activity of fungicides, and the need for a better understanding of the timing and number of fungicide applications that are needed to limit disease development in Christmas tree plantations.

In nursery situations, a combination of cultural practices in conjunction with applications of fungicides are typically used to manage PRR. When fungicides have been tested in Christmas tree plantations, applications are typically limited to one or two per year. Data from the field trial by Benson et al. (2006) also suggests that fungicide treatments are not very effective when conditions are favorable for disease development, such as after soils have been flooded during extreme rainfall or flooding events. The spotty nature of the disease also creates a challenge in trying to obtain good, reliable efficacy data. Often disease development is so variable that it is very difficult to obtain statistical differences between treatments.

Last year we initiated a project utilizing mini rice paddy field and greenhouse trials at WSU Puyallup to better understand the potential effectiveness of using fungicides to mitigate losses due to PRR. Isolates of four *Phytophthora* species, including *P. cinnamomi*

recovered from PNW Christmas trees are used to optimize disease development. In these trials we are assessing fungicides with different modes of action for their ability to control the development of PRR on noble and Fraser fir. The objectives include evaluating root dips versus soil drenches and foliar applications, comparing spring and fall applications, and testing post-infection treatments. Residual activity will be measured to determine how long treatments remain effective.Fungicides used in the trials.

| Trt | Name | Active ingredients | FRAC | Mode of action |
|---|---|---|---|---|
| 1 | Adorn | Fluopicolide | 43 | B: Cytoskeleton and motor proteins, benzamides |
| 2 | Fenstop | Fenamidone | 11 | C: Respiration, QOI |
| 3 | Orvego | Ametoctradin/ Dimethomorph | 45/40 | C: Respiration, QioSI/ H: Cell wall biosynthesis, CAA |
| 4 | Segovis | Oxathiapiprolin | U15 | Inhibits the oxysterol-binding protein (OSBP). |
| 5 | Sparra | Phosphorous acid | 33, P07 | P: Host plant defense induction |
| 6 | Stature | Dimethomorph | 40 | H: Cell wall biosynthesis, CAA |
| 7 | Subdue Maxx | Mefenoxam | 4 | A: nucleic acids metabolism, phenylamides |
| 8 | Check | n/a | n/a | n/a |

https://www.frac.info/media/ljsi3qrv/frac-code-list-2025.pdf

Field trials were established in 2025 to evaluate fungicides and application timing for managing *Phytophthora* root rot on Christmas tree seedlings. The study used seedlings of noble fir and Fraser fir grown in large nursery pots installed directly into field soil. Each pot received drip irrigation, and the pathogen was introduced using rice colonized with four *Phytophthora* species and mixed into the soil. After inoculation, pots were flooded for 48 hours to encourage infection. Fungicides were applied at labeled rates to evaluate their ability to prevent or reduce disease.

Since results from these field trials were highly variable, greenhouse trials are being conducted in 2026 using the same treatments to confirm results. Initial results showed that some fungicides reduced disease development compared to untreated plants. The product Segovis has provided the most consistent reduction in disease in the root-dip trials in both greenhouse and field. Experiments evaluating residual activity suggested that protection from some products may decline about four weeks after application.

In another project we are planning on evaluating the effectiveness of Phosphite fungicides in controlling PRR in conifers. Phosphite fungicides, including fosetyl-Al and salts of phosphorous acid, have become important tools for managing diseases caused by *Phytophthora* species in numerous horticultural and forestry crops. Commercially available products include fosetyl-Al and mono- and di-potassium salts of phosphorous acid. Unlike many conventional *Phytophthora* fungicides, phosphites exhibit both direct activity against oomycetes and indirect effects through stimulation of host defense mechanisms. When applied as a foliar application they can move within the plant from the foliage into the roots. In a study on avocado phosphite applications made in summer and fall, after foliage had hardened and root growth was occurring, were the most effective in preventing PRR. The potential efficacy of foliar applications of phosphite fungicides would make it possible for growers to use drones to map high risk PRR areas in fields and then target healthy-appearing high-risk trees that are in close proximity to diseased trees to reduce losses due to this disease.

Preliminary evaluations indicate that plants treated with the phosphite fungicide Sparra showed decreasing mortality between one and three weeks after treatment, followed by an increase at four weeks, suggesting that the protective effect declines after approximately four weeks. We plan to investigate the following additional phosphite materials in an upcoming project, examining foliar vs soil treatments and seasonal applications.

| Treatment | Name | Active ingredient | Supplier |
|---|---|---|---|
| 1 | Aliette | FOSETYL AL (ALUMINUM TRIS (O-ETHYLPHOSPHONATE)) 80.0% 2.5 lb rate | Envu |
| 2 | Aliette | FOSETYL AL (ALUMINUM TRIS (O-ETHYLPHOSPHONATE)) 80.0% 5 lb rate | Envu |
| 3 | Rampart 6.8 | MONO- & DIBASIC SODIUM, POTASSIUM, & AMMONIUM PHOSPHITES 50.6% | Nutrien |
| 4 | Nutrol | MONOPOTASSIUM PHOSPHATE 100% | Performance Nutrition |
| 5 | Sparra | MONO- AND DI-POTASSIUM SALTS OF PHOSPHOROUS ACID 57.0% | Wilbur-Ellis |
| 6 | Subdue Maxx | Mefenoxam 22% (industry standard) | Syngenta |
| 7 | Check | none | n/a |