# Potting mixes for control of Phytophthora root rot

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*Phytophthora cinnamomi* and *P. parasitica* cause root rot and crown rot on many ornamental plants, including azaleas, in California and elsewhere. This three-year study was conducted to develop nursery potting mixes that, when properly amended with nitrogenous organic fertilizers and other organic wastes of agricultural and municipal origins, would not only allow good growth of azalea and other ornamentals but also suppress Phytophthora root rots. In addition to nitrogenous organic substances, inorganic calcium and magnesium compounds and antagonistic microorganisms (beneficial fungi inimical to *Phytophthora*) were added to the study as promising amendments about halfway through the project.


Rooted 'Chimes' azalea cuttings after five weeks in noninfested potting mix (left) and in potting mix infested with *Phytophthora cinnamomi* (right).

### Suppression properties

Four potting mixes from southern California commercial nurseries, one from Ohio, and one from Georgia showed properties of *Phytophthora* suppression. Extracts from moistened potting mixes and from various mix components inhibited the germination of sporangia, the fruiting bodies of *Phytophthora* fungi. Prevention of sporangium germination reduces the number of zoospores, the primary infective units of the disease-causing fungi. The mix components likely to be responsible for such inhibition were composted hardwood bark, redwood bark, pine bark, and peat. In greenhouse experiments, rooted azalea cuttings also showed less root infection by *Phytophthora cinnamomi* in two potting mixes, one made up of redwood, perlite, and peat and the other of peat and perlite, than in the standard UC mix of peat and sand.

Higher acidity in the suppressive potting mixes might be a contributing factor in most, but not all, of these inhibition phenomena; some extracts of low acidity were also highly inhibitory. Most potting mixes and mix components tested, however, showed stimulation of *Phytophthora* sporangium formation in the test extracts.

### Soil ammendments

Nitrogenous organic substances have been known to suppress various fungus diseases when used as soil amendments. Of the eight nitrogenous organic amendments added to potting mixes in our study, extracts of urea-amended mix showed greater inhibition of *Phytophthora* sporangium formation than did chicken manure, sewage sludge, alfalfa meal, hydrolyzed feathermeal, cottonseed meal, lobster shell, or hoof and horn meal. Mixes amended with most of these organic substances showed only slightly greater inhibition of *Phytophthora* sporangium germination than did the nonamended control.

Certain inorganic calcium and magnesium fertilizers have been known to reduce Phytophthora disease incidence or severity on other crops and to adversely affect the physiology of these fungi when used at relatively high concentrations. In our study, pure solutions of different salts of calcium and mag-

Greenhouse tests of amended potting mixes revealed that many organic and inorganic amendments inhibited Phytophthora root rot on azalea but did not conclusively reduce infection by *P. cinnamomi*. Amendments may nevertheless play a part in development of biological control techniques.

nesium inhibited in varying degrees the in vitro sporangium formation, zoospore release, zoospore motility, and cystospore germination of *Phytophthora parasitica*. The overall results suggest that, at proper concentrations, calcium ion affects zoospores by reducing the swimming period and by causing bursting. Magnesium ion renders the sporangia nonfunctional or prevents zoospore release. When tested as an amendment, gypsum (calcium sulfate) showed inhibition activity against *Phytophthora* sporangium formation, but three other inorganic amendments did not; they were lime (calcium carbonate), hydrated lime (calcium hydroxide), and dolomite (calcium carbonate/magnesium carbonate). All extracts from these four amended potting mixes were inhibitory to *P. cinnamomi* sporangium germination, however.

While many of these organic and inorganic amendments exhibited *Phytophthora* inhibition in vitro, they did not conclusively reduce azalea root infection by *P. cinnamomi* in 11 greenhouse experiments. As the nonamended potting mix itself was considerably suppressive to *Phytophthora* infection, further greater reduction in disease severity was not observed in most experiments.

Greenhouse experiments were also conducted to evaluate 27 isolates of beneficial fungi (from a total of 155 isolates of soil fungi initially tested in vitro) known to be antagonistic to *Phytophthora cinnamomi* and *P. parasitica* in vitro, for their effectiveness as biological control agents for azalea root rot. Rooted cuttings of azaleas were inoculated simultaneously with *P. cinnamomi* and each of the antagonistic fungi by mixing them into the potting mix; the cuttings were heavily watered at weekly intervals. Several promising isolates, including *Aspergillus flavipes*, *A. flavus*, *A. ochraceus*, *Penicillium decumbens*, *P. janthinellum*, and *P. ochrochloron*, exhibited various degrees of suppression of azalea root infection by *Phytophthora cinnamomi* in repeated tests.

Proper choice of potting mix components, accompanied by judicious use of certain organic and inorganic amendment substances and antagonistic microorganisms as biological control agents, may lead to the development of a more suitable planting medium for the control of the omnipresent and devastating Phytophthora root diseases of many ornamentals.

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