Editors' Note: This is the fifth in a seven-part series on Extension, teaching and research programs being performed at Purdue University in West Lafayette, Ind.

Managing Pests and Diseases in the Greenhouse

RECENT RESEARCH AT PURDUE HIGHLIGHTS STRATEGIES FOR PEST AND DISEASE MANAGEMENT WITHIN THE GREENHOUSE AND NURSERY ENVIRONMENT.

By Janna L. Beckerman, Roberto G. Lopez and Clifford S. Sadof

No matter their size, pests can quickly spread as plant material is moved from facility to facility and become unmanageable, leading to shrink, reduced profits and even loss of native species. In this fifth article, the ornamental pest management team in the departments of Botany and Plant Pathology and Entomology at Purdue University will highlight some of their recent research that focuses on pest management within the greenhouse and nursery environment.

Disease Management

Phytophthora species are a major threat to the production of ornamental plants in the floriculture industry and cause significant losses due to root rots, crown rots, and leaf blights (Figure 1). Phytophthora species have an incredibly broad host range — from aster to vinca, with many of the most commonly produced greenhouse plants in between. Phytophthora species are also an ecological concern: *P. ramorum*, the casual organism of sudden oak death, has had a devastating impact in Oregon and California; *P. cinnamomi* has created devastation in Australia, threatening several plant species with extinction. If that wasn't bad enough, Phytophthora species are known to hybridize — and these hybrids sometimes have different, and devastating, host ranges as evidenced by the alder decline in Europe. The threat of Phytophthora species, and the development of hybrid species, have prompted many studies to survey for native and exotic species of Phytophthora, in particular *P. ramorum*.

Most greenhouses produce a diversity of ornamentals, with the potential for infection by different Phytophthoras. There are some "usual suspects" species of Phytophthora that regularly show up (e.g., *P. nicotianae*, *P. dreschleri*), but in greenhouses and nurseries, contact between different Phytophthora species is likely to occur as host material is moved both around the globe and across the nation, potentially exposing plants to a lot of different Phytophthora species at the same time (Figure 2). This creates a situation where two species that "never met before" can make contact, like the recently discovered *P. cactorum x nicotianae* and *P. cactorum x hedraiandra*. Complicating things is the fact that these hybrid Phytophthoras look like *P. cactorum* but they have an expanded host range. Translated in English, this means that *P. cactorum* (mommy) can infect plants A, B and C; *P. nicotianae* (daddy) infects Plants X, Y and Z. Baby *P. cactorum x hedraiandra* can infect plants A, B, Y, Z, and L, M, P!

***Figure 1.** Phytophthora root rot and aerial blight on vinca during propagation.*

In Indiana, we conducted a survey that found 11 species of Phytophthora and two hybrid species. Most interesting and disconcerting of all was the discovery of hybrid isolates of *P. cactorum x hedraiandra* that were found on rhododendron and dicentra. Rhododendron has been reported

Figure 2 (left). *Many Phytophthora outbreaks can begin with a single sporangiophore.*

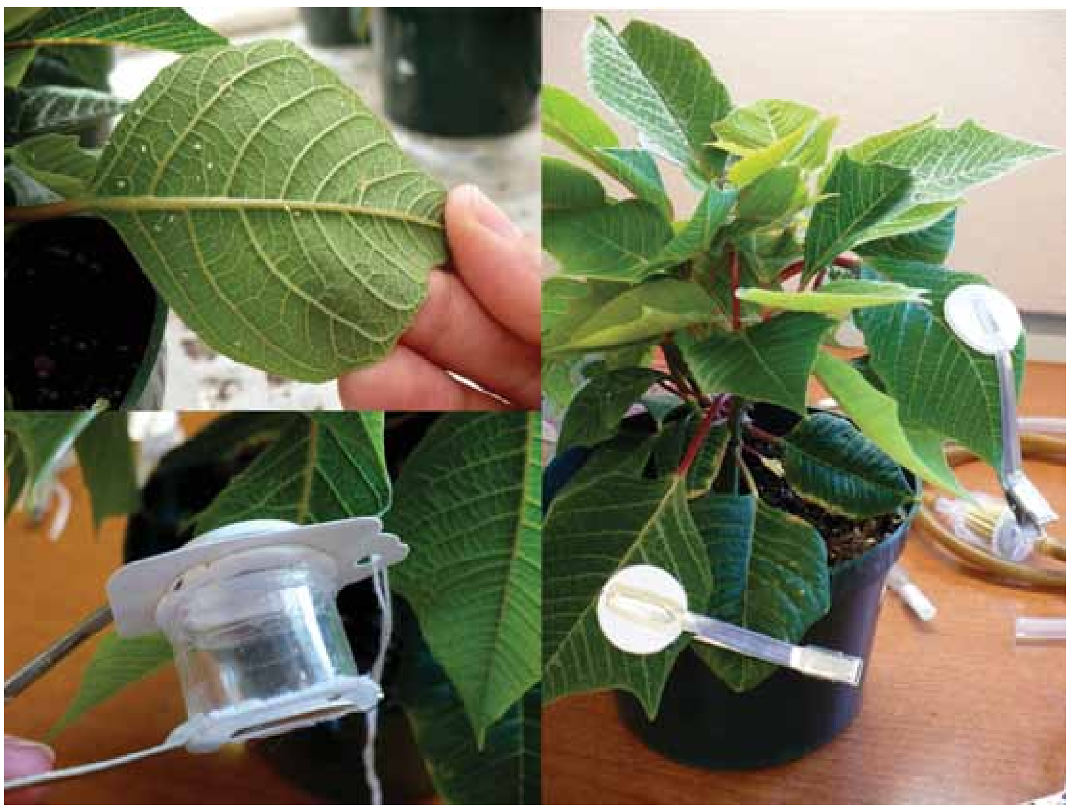

Figure 3 (below left). *Whiteflies were caged on poinsettia leaves to determine how the fertilizers affected the rate of whitefly growth from egg to adult and the number of offspring produced.*

previously to be a host of this hybrid and its parents but dicentra was never reported to be a host of *P. cactorum*, *P. hedraiandra* or *P. cactorum x hedraiandra*. We performed a series of experiments that confirms that *P. cactorum x hedraiandra* is pathogenic on dicentra and is an expansion of the host range due to species hybridization, since neither isolate of the parental species was able to infect dicentra. The significance of this finding is easily overlooked until one considers that Indiana hosts three different species of native dicentra: Squirrel-corn (*Dicentra canadensis*), Dutchmans' breeches (*D. cucullaria*) and wild bleeding heart (*D. eximia*). Wildflowers throughout Indiana and the Midwest face increasing threats from invasive weeds, like garlic-mustard, illegal collecting, and now possibly newly developed hybrid Phytophthora spp. with expanded host ranges. It is very likely that a dicentra plant infected in a nursery situation could be planted in a woodland setting and can serve as a disease focus that expands into the native dicentra population and infect other heretofore unknown hosts as well.

Hybrid species of phytophthora represent a real and emerging threat that needs to be taken seriously. Ornamental plant producers can lower the risk of phytophthora infection by using mixes with good drainage, proper water management, good sanitation and the incorporation of fungicides when needed. But growers should go a step further and prevent the potential for developing phytophthora hybrids arising by separating plants according to source of origin and by the susceptibility of host plants to *Phytophthora spp*. This will lower the risk that geographically distant Phytophthora species can meet and hybridize, and be disseminated by the greenhouse and nursery industries.

Unfortunately, the diversity of plants the greenhouse and nursery industries provide creates a multitude of known and potentially new hosts with potentially closely related phytophthora species in a breeding ground for new hybrid phytophthora species development.

Insect Management

As we are all aware, whiteflies can be a serious pest of many greenhouse crops, especially on poinsettia causing them to be covered with a sticky coating of sugary insect excrement that can turn plants an unsightly black when infested with sooty mold. Although many species of whiteflies can be controlled with insecticides, these insects have a long history of becoming resistant when growers fail to rotate insecticides by mode of action. The Q biotype of *Bemesia tabaci*, resistant to neonicotinoid has already been reported in 26 states according to Lance Osborne's whitefly Web page (http://mrec.ifas.ufl.edu/lso/bemisia/bemisia.htm) and the B biotype has strong potential to become resistant as well. Clearly, multiple tactics are needed to keep populations under control while reducing the potential for insecticide resistance.

The commercial availability of effective natural enemies for whitefly make them excellent candidate for use in a biological control program. Unfortunately, growers with whiteflies must also manage for other pests such as thrips, aphids, and fungus gnats and spider mites. It can be a challenge to find products that are effective for each of these pests, yet are selective enough to kill their target pest without attacking natural enemies.

The search for compatible pesticides is ongoing. Growers should be aware that desktop and mobile Web resources are available to guide in the selection of pesticides that are compatible with natural enemies. For example, the website provided by Kopert stands out as one of the more useful ways to stay on top of what is known — http://side-effects.koppert.nl.

Although pesticides and biological controls provide important reactive measures to specific pests, cultural practices must also be a part of the mix. Nitrogen fertilizer has long been

Figure 4. *Poinsettia in 6.5-inch containers were irrigated with clear water (no fertilizer), conventional water soluble fertilizer (CWSF, Peters Excel Cal-Mag), weekly alternation between CWSF and sustainable water soluble fertilizer (SWFS; Daniels Plant Food) or clear water [substrate top dressed with controlled release fertilizer (CRF; Osmocote Plus, 15N–3.9P–1.0K)]. Photo taken 10 weeks after transplant.*

known to influence growth and reproduction of whiteflies. As the push toward sustainable practices creates new types of fertilization options for growers it is important to know how these materials can affect susceptibility to pests.

Research was conducted at Purdue to compare how poinsettia plants and silverleaf whitefly respond to a controlled-release fertilizer [CRF (Osmocote Plus, 15N–3.9P–1.0K; 5 to 6 month)], a conventional water soluble fertilizer [CWSF (Peters Excel Cal-Mag; 15N-2.2P-12.5K) and a sustainable water soluble fertilizer [SWFS (Daniels Plant Food; 10N–1.7P–2.5K). Three of the five fertilizer treatments were comprised of each of the three previously mentioned fertilizers. A fourth treatment was a weekly alternation of the CWSF and the SWSF. The last treatment was an unfertilized water control. Time to marketability, plant height and shoot dry mass were measured to examine effects of the fertilization on the plants. Whiteflies were caged on plants to determine how the fertilizers affected the rate of whitefly growth from egg to adult and the number of offspring produced (Figure 3).

At the end of the four-month study, all the fertilizer treatments produced plants that were much larger than the unfertilized control plants (Figure 4). Among the fertilized plants, there were no obvious differences in plant appearance that affect marketability. Lack of visual differences among fertilizer treatment was further confirmed by the detailed measurements.

From the pest perspective, it was apparent that whiteflies were also affected by the fertilizer treatments. Plants that received clear water or the SWSF produced females that laid 24 to 25 eggs over a 12-day period. In contrast, plants treated with CRF or CWSF, or a combination of CWSF and SWSF, produced from 39 to 45 eggs per female over this time. While only 41 percent of the eggs laid on unfertilized poinsettia survived to adult, 75 to 86 percent of whitefly eggs laid on any of the fertilized plants eventually produced adult insects. Clearly, despite the capacity of the SWSF to diminish survival, it did reduce the number of eggs produced by each female. This demonstrates that the source of fertilizer needs to be scrutinized for its capacity to contribute to the overall decline in whitefly abundance as part of an integrated strategy to manage whiteflies.

References

England, K. M., C. S. Sadof, L. A. Cañas, C. H. Kuniyoshi, and R. G. Lopez 2011. Effects of selected fertilizers on the life history of Bemesia tabaci, biotype B. Journ. Econ. Entomol. 104:548-554.

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