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4. Staying in rotation. McCoy, M. Digger Farwest Edition 55(8):43-48. 2011.

Staying in rotation

Annually shifting the location of production areas rebuilds the soil, while decreasing opportunities for pests and pathogens to establish themselves

By Miles McCoy

Crop rotation is increasingly common in nurseries, as growers try to improve soil texture and nutrition, and control diseases.

It is a key strategy leading to a more sustainable production system.

"Today it is more common for growers to use crop rotation than not," said Rich Regan, an associate professor at North Willamette Research & Extension Center in Aurora, Ore. "We certainly have seen increased use of cover crops in rotation the past 20 years."

Why? Practical field knowledge, mostly from other crops, pointed to possible problems in field production, especially with certain genera. Continual cropping with the same variety is similar to a monoculture and optimizes the environment for disease and pest organisms.

Rotations can break that cycle, he said.

Van Essen Nursery, Lebanon, Ore. is typical of a grower using rotations.

"Typically we'll try to rotate a different species of plant into an area," said Lynn Gerig, growing systems supervisor at the nursery. "For example, we'll plant conifers into an area formerly used to grow deciduous."

The nursery will also rotate in a nitrogen-fixing legume plant, or a plant such as a hybrid Sudan grass, between nursery crops. "Our plan isn't as formal as we'd like, however, the goal for rotation is still there," Gerig said.

This concept is succinctly described in the book *Nursery Management*. "Different crops will attract different pest and disease problems," author John Mason states. "Where possible, rotate crops so that the host plants are always different. For in-ground nursery production, crop rotation plays a particularly vital role



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A&R Spada Farms in St. Paul, Ore., rotates land in and out of production, planting cover crops in unused areas.

in controlling root disease. Crops also have different nutritional needs, so rotation also prevents exhaustion of specific crop nutrients in the soil.”

The science behind soil health

Many benefits of rotating ornamental crops with cover crops are well documented (See *Digger*, March 2010). While there has been much less research done on rotating the actual nursery crops themselves, most industry experts agree any rotations are useful.

“There is a strong correlation between soil quality and the quality of the plants,” said John Luna, an associate professor of horticulture at Oregon State University in Corvallis, Ore.

His 30 years of both academic and practical experience with cover crops has convinced him they have a place in

nursery field production.

“The life cycle of many cover crops matches our growing season,” he said.

But, not all the more common varieties work equally well, so growers need to match varieties with soils and crops.

“We are always learning,” said Allan Elliott, production manager of Carlton Plants LLC in Dayton, Ore. He noted that after 30 years of use, the nursery has recognized that “cover crops hold a lot of value.”

Measuring that “value” is now easier with Oregon State University’s “Cover Crop Calculator,” which is a new, efficient tool to estimate the plant-available nitrogen (PAN) supplied by the cover crop, according to Nick Andrews, a small farms extension agent for Oregon State University and the North Willamette Research and Extension Center.

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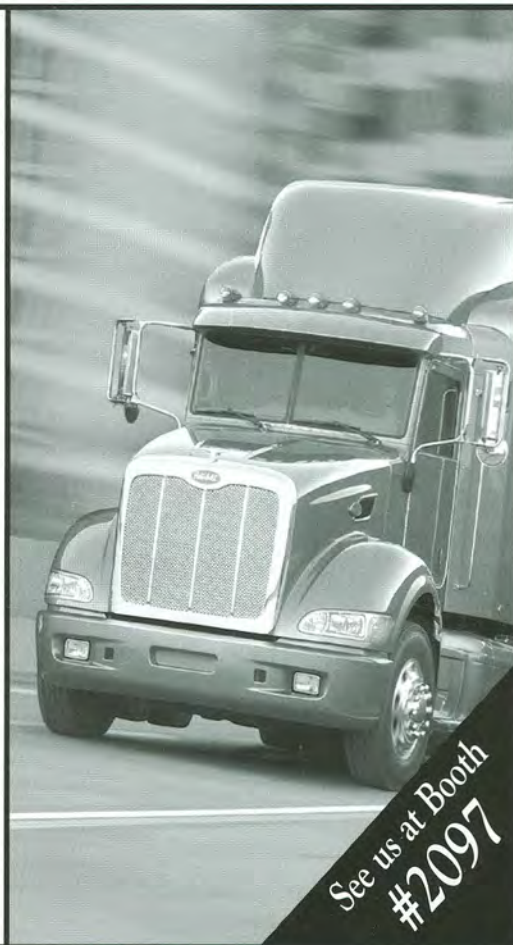
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Researchers at OSU spent several years comparing five methods for estimating nitrogen from annual cover crops. After the tests, OSU now has a procedure where a sample is sent to OSU for results.

After the results are entered into the "calculator," it predicts the crop's PAN. Growers then roughly know how much nitrogen they added to the soil, and what it cost. It compares various fertilizers and cover crops to find the most cost-effective sources of each nutrient.

The field sampling method is explained on OSU Extension's Small Farms website (<http://smallfarms.oregonstate.edu/sfn/spg09covercrop2>). The cover crop calculator is available online at <http://smallfarms.oregonstate.edu/organic-fertilizer-calculator>.

Rotations are also used to control disease, and have proven useful in apple tree production. Continual cropping with the same apples increases soil disease levels, leading to what researchers call "apple re-plant disease."

"Growers learned this lesson when, in New York apple industry, they lost 20-30 percent of their young trees to soilborne disease," said Mark Mazzola, a research plant pathologist with Washington State University's Tree Fruit Research Laboratory in Wenatchee, Wash. He said this phenomenon affects related crops including *Pyrus* and *Prunus* varieties.

Regan agreed with the list, but added that he had seen the same problem in the Christmas tree industry, where the same few cultivars are grown on the same ground, year after year.

"Christmas tree growers have seen a similar decline," he said. He did note that, at this point, the decline's causes are not completely understood.

Reducing herbicide damage

The rotations also reduce damage from residual herbicides in fields.

"Planting a field to cover crop

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▲ CROP ROTATION

instead of money-making nursery crops may seem like a huge sacrifice just to avoid the possibility of herbicide carry-over," stated Dr. James Altland, now at ARS/USDA unit in Wooster, Ohio, in his OSU Extension publication "Herbicide Residues in Field Soils."

He said the cover crops pay because the loss from herbicide damaged crops can be significant.

"However, cover cropping does more than just degrade herbicides," Altland stated.

It can also help control nematodes, according to the *University of California Pest Management Guide*, which is viewable online at www.ipm.ucdavis.edu/PMG. It recommends planting "barley, marigolds, perennial rye, certain legumes such as clover and vetch, and other plants with bioactive properties are grown as cover crops, trap crops, or crop rotations in some row crops."

These plants can produce chemicals that "kill or repel nematodes, suppress nematode growth, stimulate premature egg hatch, or disrupt the attraction between nematodes seeking to mate," the guide states.

However, the guide notes that some crops that suppress one species of nematode are actually hosts to other nematode species. And, some cover crops that help control nematodes, such as marigold, are actually phytotoxic to some crops, including lilies. Therefore, each nursery should do its own checking before choosing an appropriate cover crop.

For more on nematodes, log on to http://entnemdept.ufl.edu/creatures/nematode/r_reniformis.htm, or see the UC guide section on nematodes at www.ipm.ucdavis.edu/PMG/r280200111.html

Microorganisms and enzymes

Environmental conditions improved by rotations can affect populations of beneficial microorganisms as well as pathogens, according to references at the OSU online plant disease control site.

For instance, research from the University of Georgia, done by J. W. Huang, showed that the beneficial fungus *Trichoderma barzianum* Rifai suppresses the pathogenic fungus *Rhizoctonia solani* Kühn at a soil pH of 4.3. The populations are greater in acidic soil conditions, which can be created by planting the correct cover crop.

Crop rotations can also have a positive effect on soil enzymes, according to a paper published in *Acta Physiologiae Plantarum*, called "The effect of crop rotation of six forest tree species on peat-bark substrate enzymatic activity." Authors Jan Łukaszewicz and Grażyna Olszowska, in 2003 research done at the Forest Research Institute in Katowice, Poland, focused on using crop rotation with six main forest tree species grown on a peat-bark substrate (sound familiar?). They then recorded the "changes in the substrate enzymatic activity during successive rotation cycles."

The study was conducted in the forest nursery using seedlings of Scotch pine (*Pinus sylvestris*), Norway spruce (*Picea abies*), European larch (*Larix decidua*), pendiculate oak (*Quercus robur*), common beech (*Fagus sylvatica*), and silver birch (*Betula verrucosa*).

The activity of five different soil enzymes (betaglucosidase, invertase, urease, asparaginase, acid phosphatase and dehydrogenases) was assessed. Researchers observed the succession of three, three-year crop rotation cycles with species following each other according to the rotation plan.

The enzymatic activity of the peat-bark substrate changed after each three-year crop rotation cycle and decreased with time, confirming suppositions that the tree species and their rotation modify soil enzymatic activity. The paper stated, "After three crop rotation cycles the positive effect of appropriate species rotation on the enzymatic activity of the substrate was noted."

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For more information on the study, see *Acta Physiologiae Plantarum*, Volume 25, Number 4, 345-352, DOI: 10.1007/s11738-003-0015-2.

Making things worse

Despite all the positives, research has shown that not all cover crops control pathogens.

In fact some cover crops are also hosts for seedling pathogens.

Research by Dr. J. D. Soloman, US Department of Agriculture, Forest Service, Southern Region facility, showed that legume crops actually increase inoculum levels of *Cylindrocladium* spp., while grass cover crops do not.

For more on this research, see Soloman, J.D.; McCracken, F.I.; Anderson, R.L. [and others]. 1987. *Oak pests: a guide to major insects, diseases, air pollution, and chemical injury*. Atlanta, GA: US Department of Agriculture, Forest Service, Southern Region.

While cover can help improve disease control, the benefit varies with cover crop species, reported the researchers at the Forest Research Laboratory, OSU, Corvallis, Ore.

For instance, legume cover crops can encourage damping-off fungi more than grass crops, which would limit any planting of susceptible crops. This difference can be long-lasting, even surviving beyond fumigation

Thus, crop rotation looks like a beneficial production tool.

Is it worth the expense? Long term, probably. Short term — in today market — why not?

Some nurseries may not need all of their acreage in production. So, making an investment by enriching soils now could be a smart economic move. ☺

Miles McCoy is the owner of Sustainable Hort LLC, a sustainable and organic products marketing firm. He has 25-plus years of green industry experience in marketing, communications and research. He can be reached at miles@sustainablehort.com.