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Defending your ground

According to research, cover crops can provide many benefits for nurseries

Carlton Plants is evaluating the use of marigolds as a cover crop. The company learned that many European growers swear by the use of them to cleanse the soil and prevent "re-plant disease." They believe that the marigolds suppress the nematodes that may be causing the disease.

By Miles McCoy

Cover crops have many benefits for those engaged in sustainable agriculture. This is particularly true for nurseries producing shrubs and trees in the field.

ATTRA, a public-private partnership between USDA and the National Center for Appropriate Technology (NCAT), recognized the value of cover crops in its 2000 report, *Farmscaping to Enhance Biological Control*.

"Integrating living mulches, cover crops and the application of high-quality composts in field nursery operations are the fastest ways to improve nursery soil," the report stated.

Other research has confirmed these benefits. North Willamette Research and Extension Center (NWREC) in Aurora, Ore., has done extensive work evaluating the use of cover crops to reduce residual herbicides in fields.

"Planting a field to cover crop instead of money-making nursery crops may seem like a huge sacrifice just to avoid the possibility of herbicide carryover," stated Dr. James Altand in his Oregon State University Extension publication, *Herbicide Residues in Field Soils*. "However, cover cropping does

more than just degrade herbicides."

According to Altland's report, the benefits of cover crops include rebuilding soil structure, adding organic matter to the soil, and increasing soil aggregates. As a result, soil compaction is reduced and water movement is improved. "Constant nursery production can reduce field productivity over time," he stated. "Using cover crops can reverse some of the negative effects of constant farming."

All of this can help nurseries grow better plants.

John Luna is an associate professor of horticulture at Oregon State University. His 30 years of both academic and practical experience with cover crops has convinced him they have a place in nursery field production. "There is a strong correlation between soil quality and the quality of the plants," Luna said. "The life cycle of many cover crops matches our growing season."

That said, it's important to realize that not all of the more common cover crop varieties work equally well. Growers need to match varieties with soils and crops.

Carlton Plants LLC of Dayton, Ore., has been using cover crops for 30 years. According to production manager Allan Elliott, the nursery continues to tweak its approach. "We are always

learning," he said.

Research documents benefits

While cover cropping has a long history in agriculture, research from the last 50 years has documented several of its benefits. To name a few, cover crop biomass increases soil organic matter levels. This in turn enhances the soil's structure, and its capacity to hold water, and hold and buffer nutrients.

Meanwhile, research over the past decade has demonstrated that these crops could also increase soil carbon sequestration, reducing the rise in atmospheric carbon dioxide levels. Growers such as Lynn Gerig of Van Essen Nursery Co. in Lebanon, Ore., have recognized these benefits.

"We use cover crops because we want to maintain or improve soil tilth, reduce some of our nitrogen needs, break up compacted soil, and out compete weeds to reduce chemical inputs," she said. "They also improve soil stabilization during the winter periods."

Specific, confirmed benefits include the following:

- **Nutrition** – Historically, cover crops have been a main source of nitrogen in agriculture, through biological or nitrogen fixation. This is still an advantage, and can now be measured by a new "Cover Crop Calculator," recently introduced by



Cultivar Choices

There are many plant varieties that can be used as cover crops, though grasses and legumes are the dominant choices.

As mentioned in the main story, the legumes use “fix nitrogen” through a beneficial relationship with *Rhizobium spp.*, a soil bacteria living on the roots. This bacterium converts N₂ gas into a soil nitrate that plants can use.

Many are in the bean family, (*Fabaceae*) including field peas (*Pisum sativum*), vetch (*Vicia spp.*), cowpea (*Vigna unguiculata*), and soybean (*Glycine max*). Other benefits include added biomass, beneficial insect attraction, weed suppression and even allelopathy.

Meanwhile, non-legume green manures add organic matter, improve soil tilth and provide weed control. Common grass varieties are cereal rye (*Secale cereale* L.), sorghum (*Sorghum bicolor ssp. bicolor*), sorghum-sudangrass hybrids (*Sorghum bicolor* X *S. bicolor var. sudanense*), and wheat (*Triticum aestivum*). Other grass choices include several fescues and perennial ryes,

Allelopathic cover crops include rye (*Secale cereale*), hairy vetch (*Vicia villosa*), red clover (*Trifolium pratense*), sorghum (*Sorghum bicolor*), and species in the Brassicaceae family, particularly mustards.

Others outside these two groups include buckwheat (*Fagopyrum esculentum*), sunflower (*Helianthus spp.*) and many, crucifer family (*Brassicaceae*), such as mustards (*Brassica spp.*) and forage radishes (*Raphanus sativus*).

Oregon State University (see below).

Cover crops can also be “catch crops” that retain and recycle soil nitrogen. They take up surplus nitrogen from the previous crop, so it is not lost through leaching and denitrification.

• **Erosion control** – Cover crops are often grown for the sole purpose of preventing soil erosion by physically reducing the rainfall’s velocity prior to impacting the soil’s surface. This lessens soil splashing and surface runoff that are primary causes of erosion. Cover crop root networks also anchor the soil in place and increase soil porosity, which, in turn, creates a better environment for soil organisms. Often called “living mulches,” these aisle planted crops also provide traction and suppress weeds.

They are also physical barriers between the soil surface and raindrop impact, which lessens compaction.

• **Water use** – Cover crops’ positive impacts on erosion are related to reductions in the rate and amount of water running off of fields. This reduces the risks to waterways and downstream ecosystems, according to research efforts over the past decade.

First, the cover crops increase the infiltration of water. This enhances soil macro-fauna habitat by moving more water through the soil profile. At the same time, this infiltration improves soil water storage and the recharging of aquifers. Finally, they act as a mulch that shades and cools the soil surface, reducing evaporation of soil moisture.

• **Pest control** – Cover crops are also recognized for helping control pests in several ways. First, they can attract natural predators of pests by providing hospitable habitat, a type of biological control called “habitat augmentation.”

While findings on the cover crop presence and predator/pest population dynamics are mixed, there are some successes. For example, in California researchers found that planting leguminous cover crops (see below) could attract a predator mite (*Euseius tularensis*) that helps control citrus thrips, a serious pest in orchards. The cover crop provides enough pollen,

which the predator mite feeds on.

Cover crops can also be “trap crops,” where pests are attracted to the cover crops instead of the commercial crop. They are planted within and around the valued crops. The trap crops can be treated with pesticides or, organically, using large vacuum equipment to pull the pests off the plants. This system has been used to control the *Lygus* bugs in organic strawberry production.

• **Disease control** – Some soil borne pathogens and root diseases may be suppressed by turning in certain cover crops. Various organic amendments’ suppressive effectiveness may be due to the formation of toxic volatile compounds or increases in antagonistic soil microflora. For example, brassicas contain glucosinates that degrade to toxic isothiocyanates, while Sudan grasses’ dhurrin becomes hydrogen cyanide. Both have been reported to control phytonematodes and pathogenic fungi.

“We plant oriental mustard which, when plowed in, acts as a bio-fumigant,” Elliott said. “It can help control nematodes and soil borne-diseases.”

• **Weed control** – Cover crops suppress weeds by both competing with them and shading the soil, reducing the light needed by seeds to germinate. Deep-rooted varieties also loosen soils, so weeds that prefer compacted soils do not thrive.

“We’ve found that the hard fescue is a low growing variety that provides a dense barrier with great weed suppression,” Gerig said. It takes about one season to get well established and needs well-drained soil, she added.

Research has also shown that certain cover crops suppress weeds through a process called “allelopathy,” where biochemical cover crop compounds degrade, becoming toxic to other plant species and/or inhibiting seed germination.

• **Removing residual herbicides** – These crops can even help clean the soil, removing residual herbicides. Altland’s work at NWREC suggested rotating fields after fall harvest into summer cover crops before planting the next fall or spring.

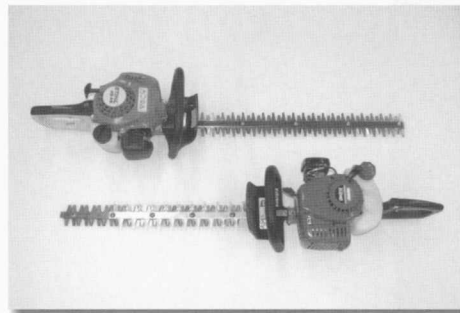
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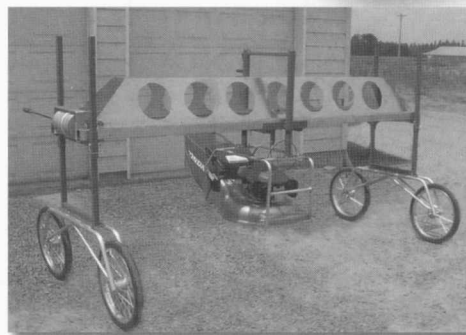
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He stated that herbicide degradation is increased with more soil organic matter and biological activity. Soil biological activity also responds to more nitrogen and soil moisture, further accelerating herbicide breakdown.

OSU's cover crop calculator

While these crops definitely add nitrogen, growers have lacked an efficient tool to estimate the amount of plant-available nitrogen (PAN) supplied by the cover crop, especially mixes that contain both legumes and non-legumes, according to Nick Andrews, metro area small farms extension agent for OSU and NWREC.

In response, researchers at OSU spent the last few years comparing five methods for estimating nitrogen from annual cover crops. As a result of their research, OSU recommends sampling the above ground cover crop from a known area of the field, weighing the full sample and a sub sample (approximately 1 lb.). This sub sample is sent to a lab for total nitrogen analysis. The lab results are entered into the new cover crop calculator that uses a model to predict the crop's PAN.

Previously, researchers often felt it necessary to separate grasses from legumes to estimate cover crop PAN.

"However, estimates from bulked samples compare very well to separated species estimates and is relatively easy to use," Andrews, said at the recent annual meeting of the North Willamette Horticultural Society.

Growers then have an estimate of how much PAN their cover crops can be expected to add to the soil, and what the nitrogen cost is likely to be. The calculator 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 farm Web site (<http://smallfarms.oregonstate.edu/sfn/spg09covercrop2>). The cover crop calculator will be available online.

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Limitations of cover crops

While the benefits tend to outweigh the negatives, there are a few drawbacks to consider. One is rodents, since several types can live in certain cover crops. Their feeding might damage specific shrub and tree species.

In some cases, where rain is less than 30 inches annually, there can be competition for water and nutrients. Planting the cover crop too close or around trees can cause a slight decrease in caliper and height. "We did see some decrease in size with grasses planted too close," said Elliott.

Cover crop insect communities, as mentioned, can be useful as predators on pests. But, occasionally others can harbor pest insects. For instance, winter legumes can attract insects that cause problems in orchards, while nematodes populations can increase in sandy soils with certain legumes.

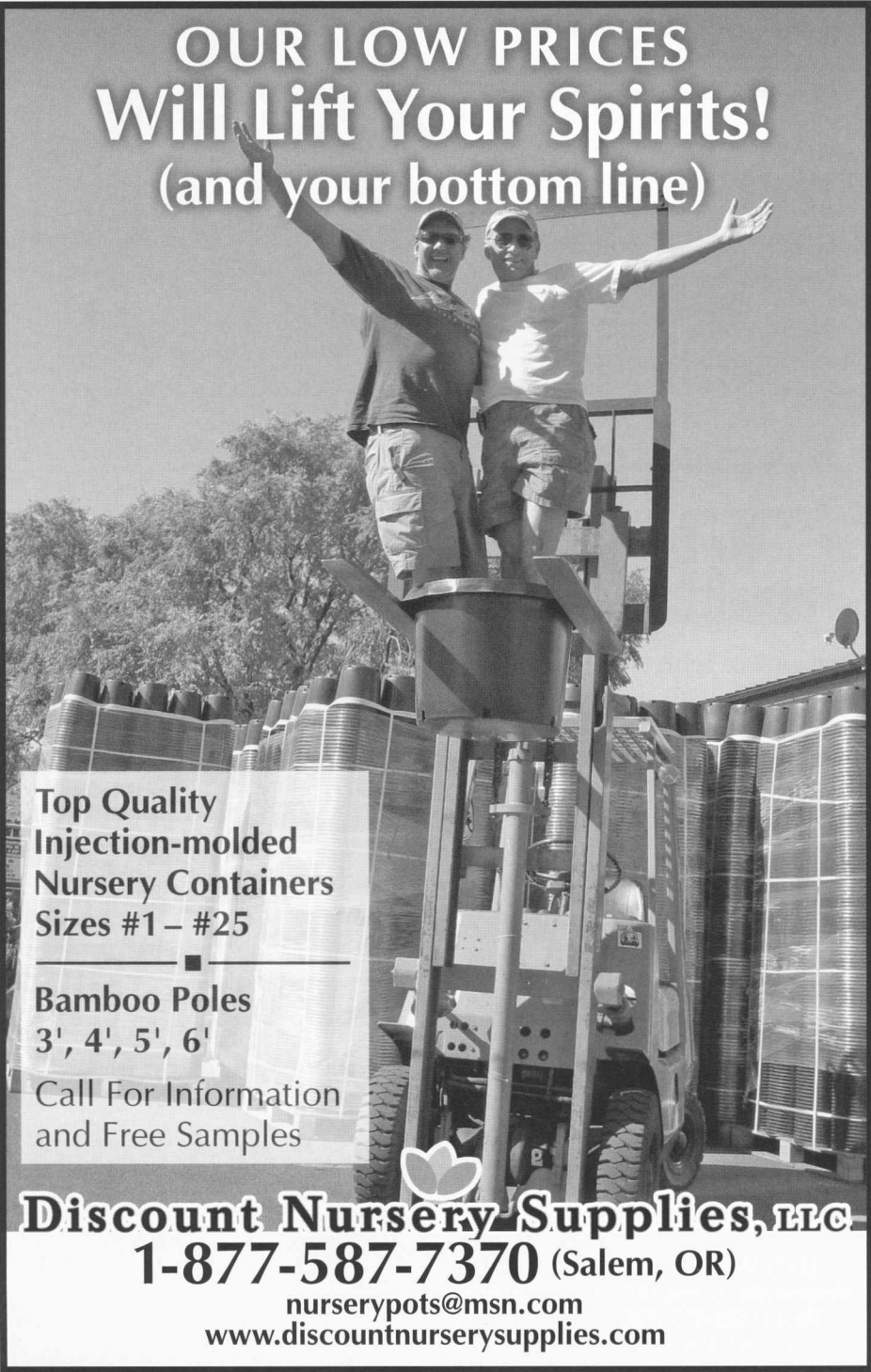
Summary

With the diverse range of both ornamental crops and site conditions, it is advisable to work with local extension experts to determine the best mix for cover crop selection. OSU's small farm Web site (<http://smallfarms.oregonstate.edu/improving-soil-quality-crops>) provides useful information on using cover crops, including detailed management pages for 15 varieties.

Other useful information is on the Cooperative Extension Service's Web site cover crop pages listed at <http://www.extension.org/article/18545> and the National Sustainable Agriculture Information Service's site at <http://attra.ncat.org/attra-pub/covercrop.html>. ☺

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