Vessel Bio Products is situated within the Ohio Agricultural Research and Development Center’s BioHio Research Park. The horticultural division of Vessel specializes in adapting the sustainable soil health methodologies the company developed in agriculture into new growing mediums for greenhouse production. Vessel is in partnership with Cool Planet Energy Systems, the manufacturer of plant-based fuels and CoolTerra Enhanced BioChar.

The Ohio State Agricultural Technical Institute (ATI) is a two-year associate degree granting institution located in Wooster. More than 700 students earn Associate of Applied Science and Associate of Science degrees in horticulture, agricultural business, and in the agricultural animal and engineering sciences. The 13,000-square-foot greenhouse complex is used for teaching and research purposes for students and faculty. Commercial greenhouse crops are produced in the greenhouse complex under the supervision of Dr. Robert McMahon.

**Description and Overview**

One of the research projects involved the use of biochar in poinsettia production. Over a period of seven months, approximately 1,200 poinsettias were produced from rooted cuttings donated by Dümmen. The following crop sizes were produced: 4 1/2, 6 1/2, 8 1/2 and 12 inches.

The cuttings were potted in two types of root media:

- Ohio State ATI’s soilless mix, comprised of sphagnum peat moss, composted pine bark, and coarse perlite, amended with WaterWorks, dolomitic limestone, gypsum and Micromax fertilizer to bring a pH of 5.8 and an EC between 0.5 and 1.0.
- A 3:1 (V/V) mix of Ohio State ATI’s soilless mix and enhanced biochar.

The newly planted cuttings were then grown on to finish by Ohio State ATI second-year “grower” students in two separate greenhouses. The poinsettia crop’s nutritional regime consisted of a constant feed of 250 ppm of nitrogen and 250 ppm of potassium, along with 0.144 ppm of molybdenum and monthly drenches of Epsom salts at 8 oz/100 gallons to supply magnesium.

Student growers conducted weekly pour-through soil tests to monitor the soil pH and EC levels, adjusting fertilizer regimes when necessary to maintain the pH between 5.4 and 6.2 and an EC
at 2.0. The crops were grown under natural photoperiod, and proper spacing and water management techniques (primarily growing the crop on the dry side) were used for height control methods. Crops were treated twice for minor whitefly infestations using labeled pesticides. Once the crops reached the bract coloration stage, fertigation was reduced by 50 percent, with no fertigation being implemented once pollen was visible in the flowers.

**Background and Potential**

For more than a decade, a small segment of the horticultural industry has been attempting to understand how to successfully harness the potential that biochar can offer to plant health and vitality. There have been some notable contributions, however there’s a lack of consistent and reliable performance that has hindered the material from becoming a preferred alternative or enhancement to more traditional methods and mediums.

It is our opinion that these inconsistencies stem primarily from two areas: 1) a lack of consistently high-quality biochar and 2) a shortage of technical information and an understanding of how biochar changes traditional greenhouse management techniques.

For more than a decade, Vessel has successfully developed sustainable soil health practices for many agricultural crops, including grapes, walnuts, brassicas, flowers and herbs. Now with the availability of high-quality biochar, Vessel is creating a new healthy growing medium loosely based on those existing programs to fit into the horticultural industry.

What we have done is transplant our understanding of healthy soils in agriculture ecologies directly into the realm of greenhouse management, and at the heart of these programs is an extremely dynamic living medium.

The characteristics of a quality biochar are comprised of appropriate parent material, which has been properly fractionated and then undergone the process of pyrolysis at exactly the right temperature and pressure for the right amount of time.

The reason Vessel has partnered with Cool Planet and added Cool Terra to its product line is because not only have they been able to perfect the first three steps of the manufacturing process, but they then went further and enhanced the biochar with a proprietary blend of beneficial microorganisms and an adjusted pH. It sounds simple, but repeating it on a consistent basis is the challenge, and is critical to its effectiveness in a greenhouse system.

When we first began to develop our soil health programs in California we relied on biological soil assays to help establish a starting point and an understanding of what a healthy soil needed. With a few alterations we are essentially taking that same model into greenhouse production.

The keys of sustainability are about improving soil structure, stimulating healthy root growth and promoting overall plant wellness. Downstream we

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begin to see — as a result of these enhancements — increased water-holding capacity, which means the need for less water and reductions in nutrient inputs. Healthy roots can make a plant less prone to disease and pest pressure, which can reduce pesticide inputs.

The high porosity and surface area of this unique biochar creates the perfect habitat for encouraging beneficial microorganisms and promoting healthy root growth.

**Overview and Observations**

The poinsettia crops produced in Ohio State ATI's soilless medium and in the biochar blend were both commercially acceptable crops of high quality. Within two months of being planted...
in the biochar blend, poinsettia plants were growing vigorously with excellent foliage color and healthy root systems (Figure 1). During the summer, the poinsettia plants produced in the biochar blend compared favorably to the trees produced in Ohio State ATI’s soilless mix. During the fall semester, which started in late August 2014, student growers did notice that the biochar blend medium did not dry out as quickly as the soilless medium, and thus did not need to be watered/fertigated as often. Poinsettia root balls from both media featured well netted, healthy white roots (Figure 2) although the rooting overall seemed to be somewhat more extensive on the soilless mix. That being said, plants of such root systems produced large, beautiful bracts and were similar in size to plants grown in the soilless mix (Figure 3). Generally speaking, plant size and bracts were comparable, although a slight decrease in plant size (i.e. height and width) was noticed for some cultivars produced in the biochar blend medium. Poinsettias are notorious for developing root rot diseases from wet media, but little difference in the very low incidence (i.e. less than a 20 plants out of 1,200) of root rot disease frequency was observed regarding the medium in which the poinsettias were produced.

The results of this first trial of using a biochar blend medium to produce a commercially acceptable crop of poinsettias are encouraging. Poinsettia nutrition and managing root health can be quite tricky and the fact that student growers were able to produce high-quality poinsettia crops in the biochar blend shows promise for applications throughout the floriculture industry. Another major test for biochar regarding applications in the floriculture industry will be the quality of the finished bedding plant crops produced in this medium at Ohio State ATI during the 2015 spring semester, again managed by student growers. If the bedding plant crops produced in the biochar blend also compare favorably to the crops produced in the soilless mix, this will strengthen the case for biochar to be used as a root medium amendment to produce high-quality floriculture crops.

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