From Forest Nursery Notes, Summer 2011

1. Comparing strength and biodegradability of biocontainers. Taylor, M., Evans, M, and Kuehny, J. Greenhouse Management and Production 30(9):16-17, 20. 2010.

Comparing strength and biodegradability of

biocontainers

A major concern for using biocontainers is their ability to physically withstand greenhouse production and shipping conditions prior to reaching their final destination.

By Matt Taylor, Michael Evans and Jeff Kuehny

Most greenhouse crops are grown in petroleum-based plastic containers. The extensive use of plastic containers has resulted in a significant waste disposal problem.

As the greenhouse industry moves toward improving sustainability, the amount of waste plastic it generates has become a significant issue. Although container recycling is an option, reducing the use of plastic containers by switching to alternative biocontainers is one strategy that could help reduce the amount of waste plastic. This switch could also reduce dependence on petroleum-based products.

Biocontainers are containers that are not petroleum-based and degrade rapidly when planted into the field or when placed in a composting operation. Biocontainers fall into two categories. Plantable containers are designed to be left intact with the plant root ball and transplanted into the field, landscape bed or final container. These containers are designed to allow the roots to grow through their walls and to decompose after being planted.

A second category consists of compostable biocontainers. These are designed so the plants are removed before final planting and the container is composted.

Plants growing in a variety of biocontainers.

A major concern of growers using either of these two types of biocontainers is their ability to physically withstand

Table 1. Biocontainers tested for physical strength and degradation in the field (plantable containers only).

Container name	Container composition	Supplier
4- and 5-inch plastic (Control)	Plastic	Dillen Products
Plantable		
Peat	Peat and paper	Jiffy
DOT/Fertil	80% cedar wood fiber, 20% peat and lime	Fertil International
CowPots	Composted dairy manure and a binder	CowPots Mfg. & Sales
Coconut fiber	Coconut husk fibers and a binder	ITML Horticultural Products
Straw Pots	80% rice straw, 20% coconut fiber and a binder	Ivy Acres
Compostable		
OP47	Bioplastics	Summit Plastic Co.
Paper/Kord	Paper pulp and a binder	Western Pulp Products
Ricehull/VIPOT	Ground rice hulls and a binder	Summit Plastic Co.

All containers were approximately 4 inches except OP47, which was 5 inches. A 5-inch plastic container was used as a control.

greenhouse production and shipping conditions prior to reaching their final destination.

Measuring container strength

Despite the commercial availability of several types of biocontainers, limited research has been conducted to evaluate these containers compared to plastic containers. One particular area of interest is the actual physical strength of each container in a wet and dry state.

Research was conducted at the University of Arkansas to determine the vertical, horizontal and punch strength of several biocontainers (Table 1).

New containers were used to test for dry strength. To measure wet strength, containers were filled with a peat-based substrate, placed in a greenhouse and watered once per day. After four weeks, the growing substrate was removed and the container strength was tested.

Vertical strength was tested by determining the amount of pressure required to crush upright sitting containers 1.2 inches from top to bottom. Lateral strength was tested by laying the containers on their side and measuring the force required to crush the bottom edge of the containers 2 inches.

The final strength test measured the force required to punch a 0.2 inch probe through the side of a wet or dry container. The punch test was done to simulate the force it would take a finger to puncture the container wall.

Real-world results

The plastic controls, paper and rice hull containers exhibited the greatest vertical strength in both wet and dry states, while the other containers tested were much weaker in a wet state. In the dry state, coconut fiber, CowPots, Fertil and peat containers had intermediate vertical strengths, but were stronger than Straw Pot and OP47 containers.

Rice hull containers displayed the greatest lateral strength when wet compared to the other containers. This was followed by paper and both 4- and 5-inch plastic with the remaining containers having less lateral wet strength. Fertil and peat containers had the lowest lateral strength.

For dry lateral strength, paper and rice hull containers were the strongest, followed by the plastic controls, CowPots and Straw Pot, respectively. The remaining four types of containers were similar and the weakest among those tested for lateral dry strength.

In both wet and dry states, the 4- and 5-inch plastic containers had the highest punch strength followed by paper containers. Coconut fiber and rice hull containers had higher wet and dry punch strengths than OP47, Fertil, CowPots, peat and Straw Pot containers, which had the lowest dry punch strengths. Of the containers tested, the peat and Fertil ones had the lowest wet punch strength, which were just below the CowPots containers.

Dry vertical and lateral strengths were primarily a function of container wall rigidity and thickness. Containers like OP47 that had thinner and more flexible walls had lower dry vertical and lateral strengths than containers with thicker and more rigid walls such as rice hull containers.

Wet strength

Wet strength was lower than dry strength for all containers that were able to absorb water into the container wall. Absorption of water resulted in a softening of the walls and a subsequent reduction in all measures of strength.

Since filling the containers with substrate improves wet lateral strength, wet vertical and punch strengths are the most important strength measures when considering container handling. Although wet vertical and punch strength varied among containers, they are the most important tests to determine whether a container possesses enough strength when wet to be packaged, shipped and handled by retailers and consumers.

Strength standards

No specific standards or recommendations have been developed for biocontainers. During this research, if a container's wet vertical and punch strengths were less than 2 kilograms, the containers tended to tear or break and handling became problematic.

In this study, all containers had adequate wet vertical and punch strengths with the exception of Fertil, peat and CowPots containers, and thus handling of these containers when wet was difficult and could make them problematic for greenhouse growers.

Container decomposition

In addition to container strength, research was conducted at Longwood Gardens in Kennett Square, Pa., and at Louisiana State University in Baton Rouge on the degradation of the plantable containers once placed into the landscape. 'Cooler Blush' vinca plants were greenhouse produced in plantable CowPots, peat, Straw Pots, Fertil and coconut fiber containers. After about six weeks of greenhouse production, plants were transplanted into outdoor landscape beds. All plantable biocontainers were left intact.

After eight weeks, the containers were dug, cleaned and dried. The level of decomposition of the containers was determined and expressed as a percentage of the original dry weight of an unused container.

At both locations, CowPots containers had the highest level of decomposition. Although not as decomposed as the CowPots containers, the peat, Straw Pot and Fertil containers had a significantly higher level of decomposition than coconut fiber containers in Pennsylvania. This trend was similar in Louisiana, except Fertil container decomposition was similar to coconut fiber containers.

Differences in decomposition rates are likely due to the composition of the containers. Containers composed of materials high in cellulose such as CowPots, had higher rates of decomposition than those composed of materials high in lignin or other difficult-to-decompose components such as coconut fiber. Also, the significant levels of nitrogen present in the dairy manure used to formulate the CowPots containers may have increased microbial activity and hastened decomposition.

Although the biocontainers evaluated were marketed as plantable, not all decomposed rapidly. The rate of decomposition of coconut fiber containers may be slow enough that the containers do not significantly decompose. When landscape beds are replanted, previously planted containers may need to be manually broken apart and incorporated into the soil or the plants removed before replanting.

Property differences

Container strength and degradation varied significantly among the different types of biocontainers tested. Fertil, peat and CowPots containers had wet strengths low enough to make handling difficult. However, CowPots and peat containers decomposed most rapidly in the landscape.

Depending upon the specific location, crop grown, cultural conditions and post production handling, different container properties will be more or less important. Growers wanting to use biocontainers will need to decide which of the physical properties are most important and choose a container that best fits their production techniques and the needs of end user.

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This project was supported by the Arkansas Division of Agriculture, Longwood Gardens and the LSU AgCenter. The authors gratefully acknowledge the assistance of Drew Lehrian and thank SunGro Horticulture for providing substrate.

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Lewis and Randy Sharp, owners of Premier Growers in Buford, Ga., grow only for landscapers. The company measures its success by being able to deliver what its customers need.
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Photo by David Kuack

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