Biodegradable Pot Options©

Matt Taylor
Longwood Gardens, PO Box 501, Kennett Square, Pennsylvania 19348, USA
Email: mtaylor@longwoodgardens.org

Michael R. Evans
Department of Horticulture, 318 Plant Sciences Building, University of Arkansas, Fayetteville, Arkansas 72701, USA

Jeff S. Kuehny
Louisiana Sate University, Department of Horticulture, 137 J.C. Miller Hall, Baton Rouge, Louisiana 70803-2120, USA

BACKGROUND

Biocontainers offer an exciting opportunity for the greenhouse industry to become more environmentally friendly. Currently the majority of greenhouse crops are produced in petroleum-based plastic containers. Plastic has a relatively low cost, is strong and can be formed into essentially any size and shape. However, the extensive use of plastic containers results in a significant waste disposal problem for the greenhouse industry.

Biocontainers are not petroleum based and will degrade rapidly when placed in a composting operation or when field planted. Biocontainers also fall into two categories: compostable biocontainers, which are designed to be removed from the rootball before the final planting and composted; and plantable biocontainers that are designed to be left intact on the rootball and planted directly into the field, landscape bed or final container. These biocontainers are designed to allow roots to grow through the container walls and to decompose after being planted.

Despite the introduction of many types of biocontainers, limited research has been conducted to evaluate these containers compared to traditional plastic containers. To determine the suitability of these biocontainers as a replacement for plastic containers, a comprehensive study was conducted my Matt Taylor at Longwood Gardens in Pennsylvania, Jeff Kuehny at Louisiana State University, and Michael Evans University of Arkansas. The containers tested are listed in Table 1.

Table 1. Name, composition and supplier of biocontainers tested. All containers were approximately 4-inch except OP47, which was 5-inch. Therefore, an additional 5-inch plastic control was tested.

Container name	Container composition	Supplier
Control: 4 and 5 in. plastic	Plastic	Dillen products
Plantable		
Peat	Peat and paper	Jiffy
DOTPot™/Fertil®	80% Cedar wood fiber, 20% peat and lime	Fertil International
CowPots™	Composted dairy manure and a binder	CowPots Co.
Coco 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 bio	Bioplastics	Summit Plastic Company
Paper/Kord® Fiber	Paper pulp and a binder	ITML Horticultural Products
Rice hull	Ground rice hulls and a binder	Summit Plastics Company

CONTAINER WALL STRENGTH

Container wall strength is very important when considering handleability of biocontainers. To determine wet strength, containers were filled with a peat based substrate, placed in a greenhouse and watered once per day. After 4 weeks, root substrate was removed and the container strength was determined by measuring the force required to punch a 0.2-inch probe through the side of the container. This test was done to simulate the force it would take a finger to puncture the container wall.

Plastic containers had the highest wall strength followed by paper containers (Fig. 1). Of all containers tested, peat and Fertil containers had the lowest wet wall strengths, which were just below CowPot™ containers. Wall strength is an important test to determine whether a container possesses enough durability when being packaged, shipped and handled by consumers. Currently, there are no specific standards or recommendations developed for biocontainers. The researchers found that if a container's wet wall strength was less than 2 kg, the containers tended to tear or break and handling became difficult. Fertil, peat and CowPot containers were below this threshold and thus handling of these containers was difficult and could make them problematic for greenhouse crop producers and retailers.

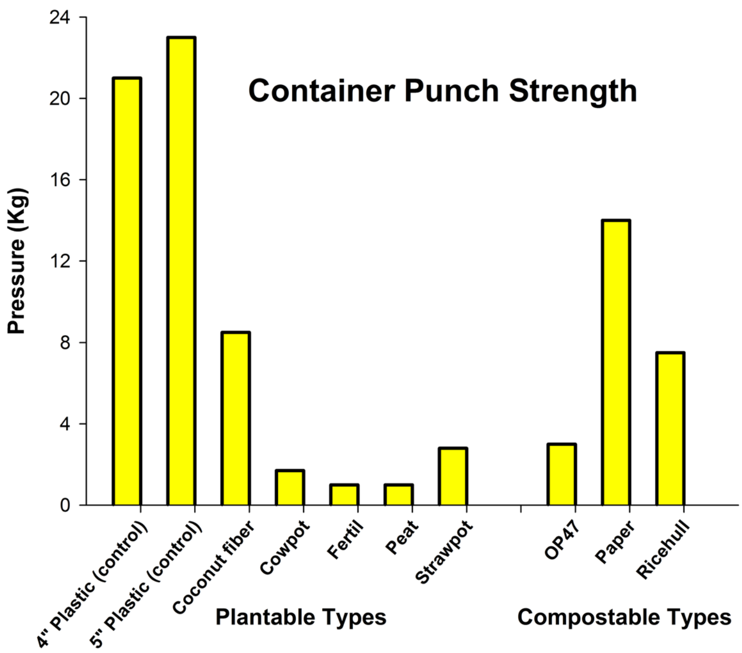

Fig. 1. Wall punch strength of containers.

DECOMPOSITION OF PLANTABLE BIOCONTAINERS

To evaluate decomposition of biocontainers in the landscape 'Cooler Blush' vinca plants were greenhouse produced in plantable biocontainers (CowPot, peat, Strawpots, Fertil and coco fiber) and then transplanted into outdoor beds. The biocontainers were left intact on the root ball. After 8 weeks in the outdoor beds, the containers were dug, removed from the root ball, cleaned, dried and weighted to determine the level of decomposition.

CowPot containers had the highest level of decomposition (Fig. 2). Peat, Strawpot, and Fertil containers had a lower level of decomposition compared to CowPot containers, however all three had significantly higher level of decomposition than coco fiber containers. Differences in decomposition rates are likely due to the difference in materials used to make the containers. Those composed of high cellulose materials, such as CowPots, had higher rates of decomposition than those containing high amounts of lignin or other difficult to decompose components such as coco fiber containers. Additionally, nitrogen in the dairy manure used to produce the CowPot containers may have stimulated the activity of microorganisms and subsequent decomposition rates.

All plantable biocontainers did not decomposed rapidly. The rate of decomposition of coco fiber containers may be low enough that the containers will still be present when a location is replanted. In this case, previously planted containers may need to be manually broken apart and incorporated into the soil or removed before replanting.

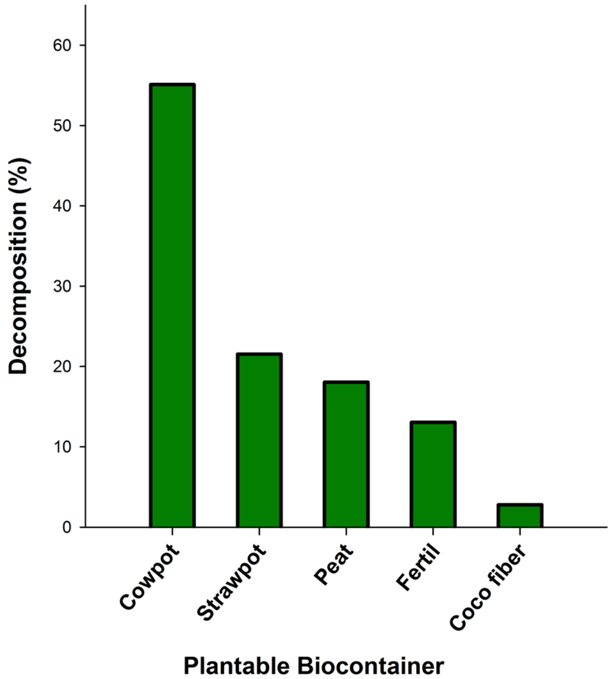

Fig. 2. Decomposition of plantable biocontainer after 8 weeks.

WATER USE

For water use experiments, plants were placed on drainage trays, irrigated with 150 ml of water and the resulting leachate was collected and measured. *Pelargonium* 'Orbit Cardinal' plants were greenhouse grown for 8 weeks and total water use and average irrigation interval are shown in Table 2.

Water use and irrigation interval followed similar trends in that plants that required greater amounts of water also had a lower irrigation interval. The only type of 4-inch biocontainers that did not require a greater amount of water than plastic to produce a marketable geranium was rice hull, which also had the highest interval of time between irrigations. Fertil and peat containers required the most water and this amount was about double the amount of water compared to plastic. The amount of water required and the irrigation interval was not significantly different between the OP47 and the control 5-inch plastic container.

Containers with water permeable walls had the highest water requirement and the lowest irrigation interval. Rice hull and OP47 containers are nearly impermeable to water, and had a similar water requirements and irrigation intervals as the plastic controls.

Table 2. Water required per container and average interval of time between irrigations during production of marketable geraniums.

Containers	Water per container (gal)	Irrigation interval (days)
4-in. containers		
Plastic (control)	0.55	3.7
Rice hull	0.55	3.8
Straw Pots®	0.68	3.2
Paper/Kord®	0.73	2.8
Coco fiber	0.87	2.7
CowPots™	0.97	2.5
Peat	1.09	2.2
DOTPot™/Fertil®	1.10	2.4
5-in. containers		
Plastic (control)	0.83	4.5
OP47 bio	0.85	4.4

Because water requirement may increase significantly with certain biocontainers, the benefits of reducing plastic would need to be weighed against the increased water usage. In areas where water use or availability is a major concern, biocontainers such as rice hull or OP47 may be favored to other biocontainers that have a greater water requirement.

GREENHOUSE AND FIELD PERFORMANCE

Growth of *Catharanthus roseus* (syn. *Vinca*) 'Grape Cooler', *P.* 'Orbit Cardinal' and *Impatiens walleriana* 'Dazzler Lilac Splash' were evaluated in greenhouses at all three test locations (data not shown). Root and shoot dry weights were determined after approximately 6 weeks. There were minor differences for both shoot and root weights of all plants tested. There were no trends in the data and visually these differences were not recognizable. All plants in the experiment were considered marketable; indicating that all biocontainers tested would serve as suitable replacements for plastic when considering plant growth.

Container strength, biodegradation, water use and greenhouse performance varied among the different types of biocontainers tested. Fertil, peat and CowPot containers had wall strengths low enough to make handling difficult and also had higher water requirements. On-the-other-hand, these biocontainers were some of the fastest to decompose in the landscape. Depending upon the geographic location, crop, cultural conditions and post production handling, different biocontainer properties will be more or less important. Greenhouse managers wanting to improve sustainability by switching to biocontainers will need to evaluate which of the properties are the most significant and choose a biocontainer that fits best into their production techniques, resources and end users. For more information on biocontainer physical properties please see Evans, Taylor and Kuehny. 2010. Physical Properties of Biocontainers for Greenhouse Crop Production. HortTechnology 20:549-555.

ACKNOWLDEGEMENT

This project was funded by the Arkansas Division of Agriculture, Longwood Gardens and The LSU Ag Center.