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Physical Properties of Biocontainers Used to Grow Long-term Greenhouse Crops in an Ebb-and-flood Irrigation System

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***Abstract*. The physical properties of new 15.2-cm plastic and comparably sized bioplastic, solid ricehull, slotted ricehull, paper, peat, dairy manure, wood fiber, rice straw, and coconut fiber containers were determined. Additionally, the physical properties of these containers were determined after being used to grow 'Rainier Purple' cyclamen (*Cyclamen persicum* L.) in ebb-and-flood benches for 15 weeks in a greenhouse environment. The punch strength of new coconut fiber containers was the highest of the containers. The used plastic containers had strengths of 228.0, 230.5, and 215.2 N for the bottom, middle, and top zones, respectively. The used peat, dairy manure, and wood fiber containers had strengths of less than 15 N for each zone. Tensile strength of all new containers was 10 kg. The plastic, bioplastic, solid ricehull, slotted ricehull, paper, and coconut fiber containers had used strengths that were similar to plastic containers. Total water used for wood fiber containers was higher than plastic containers. Irrigation intervals for plastic containers were similar to bioplastic, solid ricehull, slotted ricehull, paper, and coconut fiber containers. The irrigation interval for plastic containers was 1.32 days and the wood fiber container had the shortest irrigation interval at 0.61 day. Container absorption for coconut fiber containers was 255 mL and was higher than plastic containers. Wood fiber container absorption was 141 mL and lower than plastic containers. Plastic, bioplastic, solid ricehull, and slotted ricehull containers had no visible algal or fungal growth. The wood fiber containers had 79% of the container walls covered with algae or fungi and the bottom and middle zones had 100% algae or fungi coverage. The bottom zone of rice straw, dairy manure, and peat containers also had 100% algae or fungi coverage. The bioplastic, solid ricehull, and slotted ricehull containers in this study proved to be good substitutes for plastic containers. These containers retained high levels of punch and tensile strength, had no algal and fungal growth, and required a similar amount of solution as the plastic containers to grow a cyclamen crop. The peat, dairy manure, wood fiber, and rice straw containers proved not to be appropriate substitutes for plastic containers because of the low used strengths, high percentage of algal and fungal coverage, and shorter irrigation intervals as compared with plastic containers.**

The greenhouse floriculture crop production industry compromises such commodities as flowering potted crops, perennials, and annual bedding plants. This sector of the horticulture production industry was valued at $3.83 billion for the top 15 producing states in 2009 (USDA, 2010). Most greenhouse floriculture crops are grown in containers. The container size is dictated by the length of time the crop will be in production and the desired finished plant size. For example, florist potted crops such as poinsettia (*Euphorbia pulcherrima* L.) and chrysanthemum (*Chrysanthemum* ×*morifolium* Ramat) require longer production times to grow and are typically grown in larger containers than annual bedding plants.

Petroleum-based plastics (plastic) are the most common materials used to fabricate containers for greenhouse crop production. Plastic is relatively strong, resists mildew and algae growth, and can be molded into a variety of shapes and sizes. However, after use, these containers are typically discarded, and this results in large amounts of waste plastic containers going to landfills. One potential solution to the large amounts of waste plastic greenhouse containers is the use of biocontainers. Biocontainers are generally defined as containers that are not petroleum-based and break down quickly when planted into the soil or placed into a compost pile.

Biocontainers are generally categorized as being plantable or compostable (Evans and Hensley, 2004; Evans et al., 2010). Plantable biocontainers are containers that allow plant roots to grow through their walls and may be directly planted into the final container, the field, or the planting bed. Compostable biocontainers cannot be planted into the soil because the roots cannot physically break through the container walls, and the biocontainers do not break down quickly enough to allow the plant roots to grow through the container walls. Instead, these containers must be removed before planting but can be placed in a compost pile to decompose in a relatively short time (Mooney, 2009).

There are many types of plantable biocontainers and some of them are described here. Composted dairy manure containers (CowPot Co., Brodheadsville, PA) are made of composted, compressed cow manure held together with a binding agent. Peat containers (Jiffy Products, Kristiansand, Norway) are made from peat and paper fiber. Paper containers (Western Pulp Products, Corvallis, OR, and Kord Products, Lugoff, SC) are made from paper pulp with a binder. Rice straw containers (Ivy Acres, Inc., Baiting Hollow, NY) are composed of 80% rice straw, 20% coconut fiber, and a proprietary natural adhesive as a binder. Wood fiber containers are composed of 80% cedar fibers, 20% peat, and lime (Fertil International, Boulogne Billancourt, France). Coconut fiber containers are made from the medium and long fibers extracted from coconut husks and a binding agent (ITML Horticultural Products, Brantford, Ontario, Canada). One type of compostable biocontainer available for greenhouse production is the ricehull container, which is made of ground rice hulls with a binding agent (Summit Plastic Co., Tallmadge, OH). These containers are available in different sizes and may have solid or slotted walls. Another group of compostable biocontainers are bioplastic containers, which are made from a bioplastic derived from polylactic acid or wheat starch that is then thermoformed into containers (OP47; Summit Plastic Co.).

Most research on biocontainers for greenhouse crops production has focused on water use, algae growth on the container walls, strength of the containers, and plant growth in the containers. Evans and Karcher (2004) found that when comparing peat, feather fiber, and plastic containers, the peat containers had the highest rate of water loss through the container walls, and both feather fiber and peat containers required more water and more frequent irrigations when growing a crop than the traditional plastic containers. When various biocontainers and plastic containers were compared, the crops grown in peat and wood fiber containers had the highest water use (Evans et al., 2010), but the frequency of irrigation and amount of water used were not significantly different among bioplastic, ricehull, and traditional plastic containers.

The percent of the biocontainer surface covered by algae or fungi has been another area of interest to researchers because algal or fungal growth was considered unattractive and could affect marketability. Evans and Hensley (2004) reported that feather fiber containers

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Mention of trade names implies no endorsement of the products mentioned, nor criticism of similar products not mentioned.

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