Effect of Nitrogen Level on Rate of Decomposition of Plantable Containers in the Landscape

Bethany A. Harris[1], Bodie V. Pennisi[2] and Mussie Y. Habteselassie[3]
Dept. of Horticulture[1,2] and Dept. of Crop & Sciences[3], University of Georgia, 1109 Experiment St, Griffin, GA

The University of Georgia
Horticulture Department

Abstract

Environmental concerns have increased interest in plantable containers. These containers serve as alternatives to petroleum-based plastic containers due to their ability to eliminate plastic waste and disposal, facilitate efficient planting, and produce marketable plants. However, adoption has been slow by the landscape industry, partly due to concerns over incomplete decomposition, particularly for shorter color rotations. A litterbag study was conducted at two locations at the UGA Griffin Campus (Spalding Co., GA) to evaluate effect of soil type and nitrogen fertilizer on decomposition of containers: coconut coir fiber, processed cow manure, and wood pulp fiber over a six-month growing season. Soil type and fertilizer application did not significantly impact plantable container decomposition. Manure containers on average had the highest decomposition at both locations followed by coir and wood pulp fiber containers. This suggests utilizing cow manure containers in the landscape could be an effective alternative to plastic containers, eliminating plant root disruption/transplant shock and aiding in efficient planting.

Introduction

- Green industry has identified biodegradable containers as a way to improve sustainability in production (1). Research has reported similar or greater performance of plants grown in these containers (2).
- Limited information exists regarding degradation of plantable containers in landscape.
- Nitrogen, pH, soil type, moisture, temperature, and microbial activity can influence biodegradation of plantable containers (3).
- The research goals were: 1) to determine the rate of biodegradation of three plantable containers in Georgia native soil; 2) to assess the effect of standard 10N-10P_2O_5-10K_2O fertilizer on decomposition of biocontainer materials.

Materials and Methods

- Mesh litter bags filled with cow manure [Cowpot Square #4, Freund's Farm, East Canaan, CT], wood pulp fiber [Fertilpot FP 513, Fertil International, Boulogne-Billancourt, France], and coconut coir [Greenhouse Megastore Inc., Los Angeles, CA] containers were weighed and placed:
  - Bledsoe Farm: sandy clay; pH 4.77; nutrients (mg/kg) Ca=230; K=136; Mg=44; Mn=12; P=12; OM=3.25%
  - Dempsey Farm: sandy clay; pH 5.01; nutrients (mg/kg) Ca=399; K=136; Mg=85; P=6; OM=3.33%
- Litter samples were buried at 10 cm soil depth in plots.
- Soil treatments:
  - Amended soil (1 lb. 10N-10P_2O_5-10K_2O per 9.29 m^3)
  - Unamended soil (no fertilizer applied)
- Randomized Complete Block Design (RCB) with five replications
- Litter bags were removed monthly in order to assess container decomposition by measuring containers after drying 48 hrs.
  - Container weight = $Weight_{Initial}$ – $Weight_{Dry}$
- Rainfall (8 mo): Dempsey Farm: 124 cm, Bledsoe Farm: 115 cm
- Data were analyzed with GLM Procedure of SAS® with means separated by Tukey's Least Significant Difference Test.

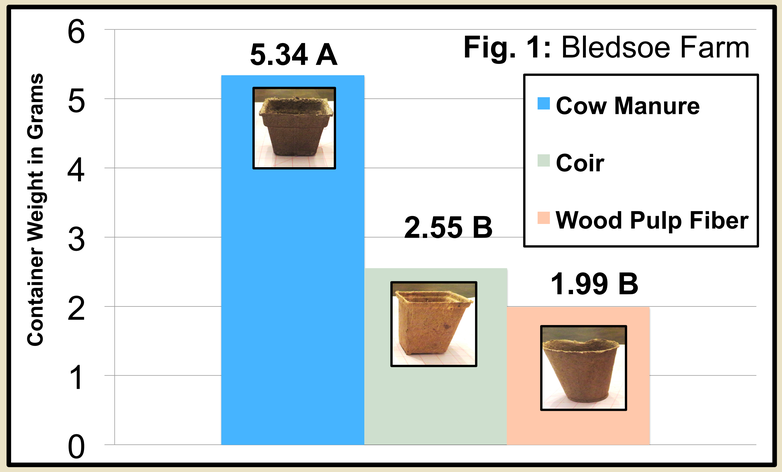
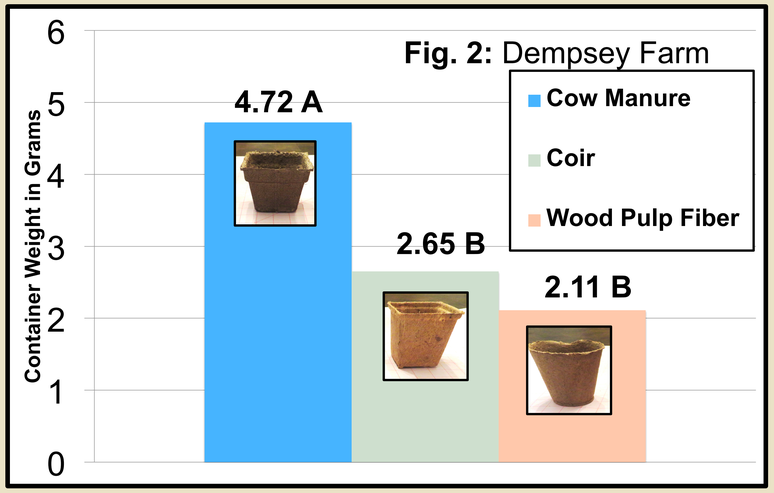


Table 1. Significance Values for Fertilizer Application, Biocontainer Type, and Soil Type

Location	10N-10P_2O_5-10K_2O Fertilizer Application	Container Type
Dempsey Farm	0.49	<0.0001***
Bledsoe Farm	0.14	<0.0001***
*Indicates P<0.05, ** P<0.01 , and *** P<0.001		
Soil Type		0.87



Results

- There were significant differences for container weight among biodegradable containers (P<0.05) at both research locations (Table 1).
- Processed cow manure containers had greater decomposition (higher difference $W_{initial}$ and W_{dry}) followed by coir and wood pulp fiber containers (Figs. 1 and 2).
- Container decomposition was not significantly influenced by nitrogen fertilizer (Table 1).
- Soil type did not significantly impact container decomposition (Table 1), although higher water content may contribute to faster decomposition (Dempsey farm received 9 cm of water more compared to Bledsoe farm).

Discussion

- Our results are consistent with previous studies in that containers high in cellulose only (i.e. manure) had higher decomposition than those composed of cellulose and lignin (i.e. coconut fiber and wood pulp).
- Higher irrigation may contribute to faster decomposition (4).
- Additional time may be needed to more fully assess the effect of fertilizer application on container decomposition.
- Our study indicates that higher levels of 10N-10P_2O_5-10K_2O fertilizer than the ones applied in this study may facilitate faster container biodegradation.

References

1. Fulcher, A., D.R. Cochran, and A.K. Koeser. 2015. An Introduction to the Impact of Utilizing Alternative Containers in Ornamental Crop Production Systems. Hort-Technology, 25(1), 6-7.
2. Koeser, A.K., S.T. Lovell, A.C. Petri, R.G. Brumfield, and J.R. Stewart. 2014. Bio-container use in a Petunia ·hybrid green-house production system: A cradle-to-grave carbon footprint assessment of secondary impacts. Hort-Science 49:265–271.
3. Nambuthiri, S., R.L. Geneve, Y. Sun, X. Wang, R.T. Fernandez, G. Niu, and A. Fulcher. 2015. Substrate temperature in plastic and alternative nursery containers. Hort-Technology, 25(1), 50-56.
4. Pennisi, B., B. Harris, and M. Habteselassie. 2014. Soil Water Content Affects Decomposition of Plantable Biocontainers for Landscape Use. HortScience 49(9) (Supplement): S301