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Evaluation of Soilless Growing Media in Container-Grown Vegetables for Home Gardeners

Abstract

One of the most important factors for successful container gardening is the use of a growing mix that will support fruit and vegetable production. In this study, three container mixes were evaluated for their use as growing media for tomato, cucumber, and sweet potato. Evaluated mixes included Old Castle topsoil, Pro Mix (BX) and a Louisiana State University (LSU)-developed potting media called Garden Greaux™. All plants received irrigation daily to maintain substrate field capacity. Cucumber and tomato count and total harvested weight were doubled in the LSU substrate mix as compared to both Pro Mix (BX) and Old Castle topsoil yields. Sweet potato count and weights were also greater when grown in the LSU potting media. Sweet potato yielded 3 times the count and 8 times the weight compared to Pro Mix media and greater than 4 times the count with 8 times the weight when grown in Old Castle. While tomatoes and cucumbers are commonly produced in containers, sweet potatoes are not, as sweet potato roots are especially difficult to produce in containers. This project was inspired by the LSU sweet potato breeding program at LSU to evaluate the roots harvested from containers. Overall, the LSU packaged substrate outperformed the other two mixes and produced acceptable produce quality.

Keywords: Vegetables; tomatoes; cucumbers; sweet potatoes; container-grown; soilless growing media; edible food production

Introduction

Today's gardeners are interested in growing their own food in an efficient and convenient way. According to Garden Media group's 2022 Garden Trends Report, home gardeners have a renewed interest in food production and edible gardening with the highest interest in seed starting and container-grown vegetables (Garden Media Group, 2021; Whitinger and Cohen, 2021). The increase in the popularity of container gardening is thought to be in part due to the increase in both high-density housing and patio or deck gardening (Nagase, 2021). This interest in container-grown vegetables, coupled with shrinking lot sizes and the continued trend of building larger homes, shrinks urban garden size. Gardeners are now faced with making use of less space and they are turning to container growing to address space constraints. Research shows that this interest in home growing is due to a surge in home cooking, the fear of food security (Lal, 2020) and the joy of growing their own food (Garden Media Group, 2021; Cerda et al., 2022).

According to the U.S. Census Bureau's Survey of Construction (SOC), the median lot size of a new single-family home sold in 2017 was 8,650 square feet, or less than one-fifth of an acre, making it the record low since the beginning of the survey in 1992 (U.S. Census Bureau, 2022). In contrast to shrinking lot sizes, houses are growing larger and demanding more room in the landscape, while directly diminishing space for landscape features, plants, and spaces large enough to produce vegetables. In addition, consumers are more attuned to the need for sustainable, environmentally friendly products, plants, and maximizing the use of smaller spaces. How can consumers adapt to these changes so that they continue to grow the vegetables they enjoy while working within these constraints? Home gardeners living on smaller lots do not have an easy means of vegetable production.

One solution for achieving improved vegetable yields is by using a modified growing media in containers to grow vegetables. Plants that are grown for fruit and vegetable production often need more fertilizer inputs to help increase yields and to support vigorous, healthy plant development. Previous research conducted at the LSU AgCenter identified a lack of options when it came to commercially available growing media specifically for vegetable growth and a need to develop a growing media that could support vegetable growth (Everhart, 2017). Garden Greaux™ was developed to improve the quality and yield of container-grown vegetables. The objective of this study was to determine if the Garden Greaux™ media is suitable for container production of cucumber, tomato and sweet potatoes compared to topsoil and a standard commercial mix. Some of the most commonly grown container vegetables are cucumbers and tomatoes (Mays et al., 2022). The best time to plant both cucumbers and tomatoes is in spring when disease and temperature stresses are low (Crane et al., 2018). Sweet potatoes in Louisiana are typically started in early summer and grown until harvest 95 to 120 days later in the early fall. The objective of this study was to evaluate the LSU potting mix Garden Greaux™ (LSU) compared to a topsoil control and a typical industry mix for yields in terms of number of edible fruit or roots and weight of edible fruit and roots in 28L plastic containers.

Materials and Methods

This experiment was conducted at the Louisiana State University Agricultural Center (LSU AgCenter) Hill Farm Teaching Facility in Baton Rouge, Louisiana. The experimental site consisted of a nursery yard covered with black landscape fabric to simulate a homeowner's patio. Containers were arranged in a randomized block design with drip irrigation (2 gal/h) and exposed to rainwater. Summer crops studied consisted of cucumbers, tomatoes, and sweet potatoes that were grown in three media treatments. Each media treatment and crop combination was replicated eight times in 28 L containers, and each planting was replicated over two planting dates (2020 and 2021), 1 year apart.

Media treatments

Three media treatments were used in this study:

- Garden Greaux™ (Phillip's Bark, Brookhaven, MS), consisting of 80 bark: 20 peat moss with incorporated slow-release fertilizer and micronutrients, was the LSU-developed media (LSU). Because this media is quite acidic, lime was added to increase the media pH to a range of 5.5 to 6.4.
- A commercially available bagged Pro Mix (BX) (Premier Tech Horticulture, Quakertown, PA), composed of 85 sphagnum peat moss to 15 perlite with no added nutrients and a pH of 4.5-6.5, was the industry standard media (IS).
- Old Castle topsoil (Timberline, USA), composed of organic humus, sand, and bark fines with no added nutrients at a pH of 5.5-7.0, was the control (C).

The three commercially available medias were evaluated to compare fruit and vegetable production of 'Dasher II' cucumber (*Cucumis sativus*), 'Sweetheart of the Patio' tomato (*Solanum lycopersicum*) and 'Jewel' sweet potato (*Solanum tuberosum*). Crops were grown on a nursery yard in 7.5 gallon (28 L) black plastic nursery containers. Irrigation spray stakes were installed for each treatment. Once the tomatoes and cucumbers began flowering, a weekly application of Miracle-Gro LiquaFeed All Purpose Plant Food Advanced (12-4-8) (Scotts Miracle Gro, Marysville, OH) was applied weekly for the duration of the study. Nursery yard sites were used to test media performances in the presence of rainwater to simulate container-grown vegetables growing in a home garden situation. The water used for irrigation was Baton Rouge, LA, municipal water with a measured pH of 8.6 and EC 0.38 $mS \cdot cm^{-1}$ during this study.

Pots were placed on 18-inch centers on the nursery yard and watered to saturate media before transplanting the vegetables. Additional media was not added to individual containers after settling. Baton Rouge municipal water was used to irrigate the crops during the study. Transplants of cucumber and tomato crops were planted on May 1st and harvesting began 4-weeks later. The study was terminated on August 3rd for both cucumbers and tomatoes when plants stopped producing fruit. The study was conducted in both 2020 and 2021 during the summer. Sweet potatoes were planted later in the season when slips were available on June 3rd and were harvested on September 6th both years in 2020 and 2021.

Containers were watered twice daily at 10-min increments using one spray stake per pot. Pesticides were used as needed and included 1.5 fl oz/acre malathion (Spectracide Malathion Insect Spray Concentrate; Chemsico, St. Louis, MO), 30 kg/acre metaldehyde (Deadline M-Ps Mini Pellets; AMVAC Chemical Corporation, Los Angeles, CA), and 65 fl oz/acre *Bacillus thuringiensis* (Thuricide; Bonide Produces Inc., Oriskany, NY), 65 fl oz/acre to control, aphids (*Aphis* sp.), slugs (*Deroceras sp*.), and caterpillars (*Lepidoptera sp.*). Cucumber and tomatoes were harvested once weekly. The number of fruit for each replication of media and crop combination was recorded along with harvest weights. Sweet potatoes were harvested upon completion of the study. The number of tuberous roots were recorded, and each was graded as either one, two, jumbo, or culls. The tuberous roots were graded according to the USDA Agricultural Marketing Service's Sweetpotato Grades and Standards document *United States Standards for Grades of Sweetpotatoes* (USDA, 2005). The individual weights were also recorded.

Data analysis

Data were analyzed with SAS software (version 9.3; SAS Institute, Cary, NC) at a 0.05% error rate. Proc GLM was used to compare continuous variables based on arithmetic means and standard deviations. A Duncan's multiple range test was performed on all variables of interest for each crop.

Results and Discussion

Garden Greaux™ (LSU) outperformed the industry standard (IS) and control (C) media treatments for all crops. The combination of peat moss and pine bark in the LSU mix provides good media aeration, water holding capacity, and cation exchange capacity. Average cucumber counts (combining both 2021 and 2022 harvests) were 3, 8 and 15 fruit for C, IS, and LSU media treatments respectively (Figure 1). Average harvest weight (lb) of cucumber fruit was also greater in the LSU media as compared to the IS and C media 7.07 lb, 2.09 lb, and 0.32 lb respectively (Figure 1). For yield of cucumbers, grams were converted to pounds to make graphs easy to read along with the counts of cucumber fruit.

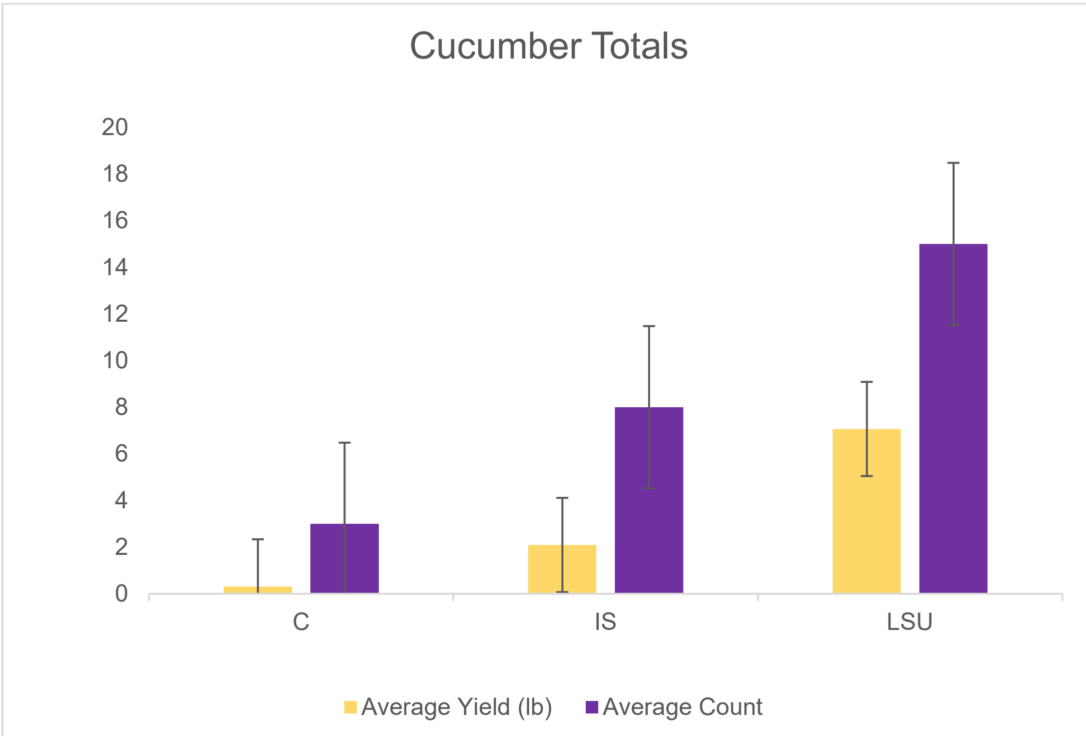

Figure 1. Average yield (pounds) and numbers of 'Dasher II' cucumbers harvested from container-grown plants with selected container mixes (Control, Industry Standard, and LSU) for two growing seasons.

Like cucumber yields, tomato yields were greatest when grown in LSU media ($p \leq 0.05$). Over the two-year period, the average number of tomatoes collected per container for the entire individual season was 384 fruit in the LSU media, 144 fruit per container from the IS media, and 100 fruit per container from the C media (Figure 2). Average tomato weight (g) for the two seasons was also greatest ($p \leq 0.05$) in the LSU media 2,504 g as compared to the IS 931 g and C media 464 g (Figure 2).

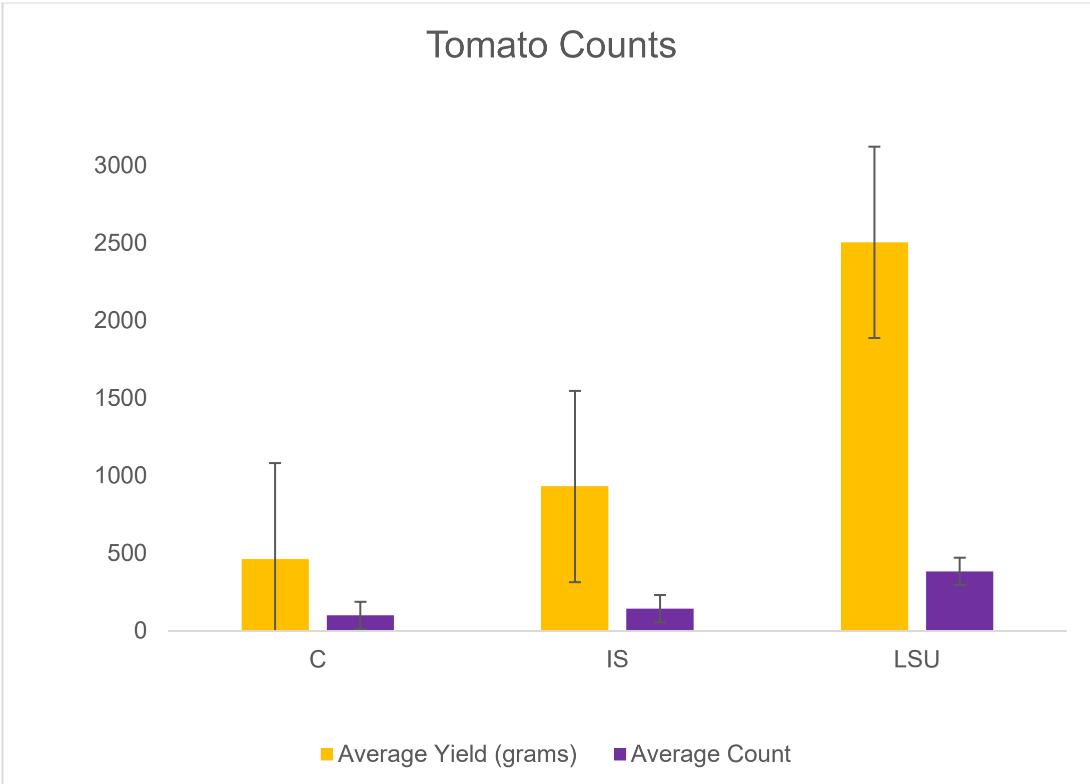

Figure 2. Average yield (grams) and numbers of tomatoes harvested from container-grown plants with selected container mixes (Control, Industry Standard, and LSU) for 12 weeks and repeated over two growing seasons.

Commercial production of sweet potatoes exclusively occurs in the field. However, more homeowners are interested in producing this crop in containers and raised beds. Good yields of tuberous roots were produced in the LSU media as compared to the IS and C medias. The average weight (g) of each container was 3,400 g in the LSU media, 403 g in the IS media and 237 g in the C media (Figure 3). Tuberous root count was also greatest in the LSU media with an average of 20 roots per container in LSU media, 3.9 roots in each IS container and 5.9 roots in the C media (Figure 3). Sweet potatoes were harvested once in each harvest season 2020-21.

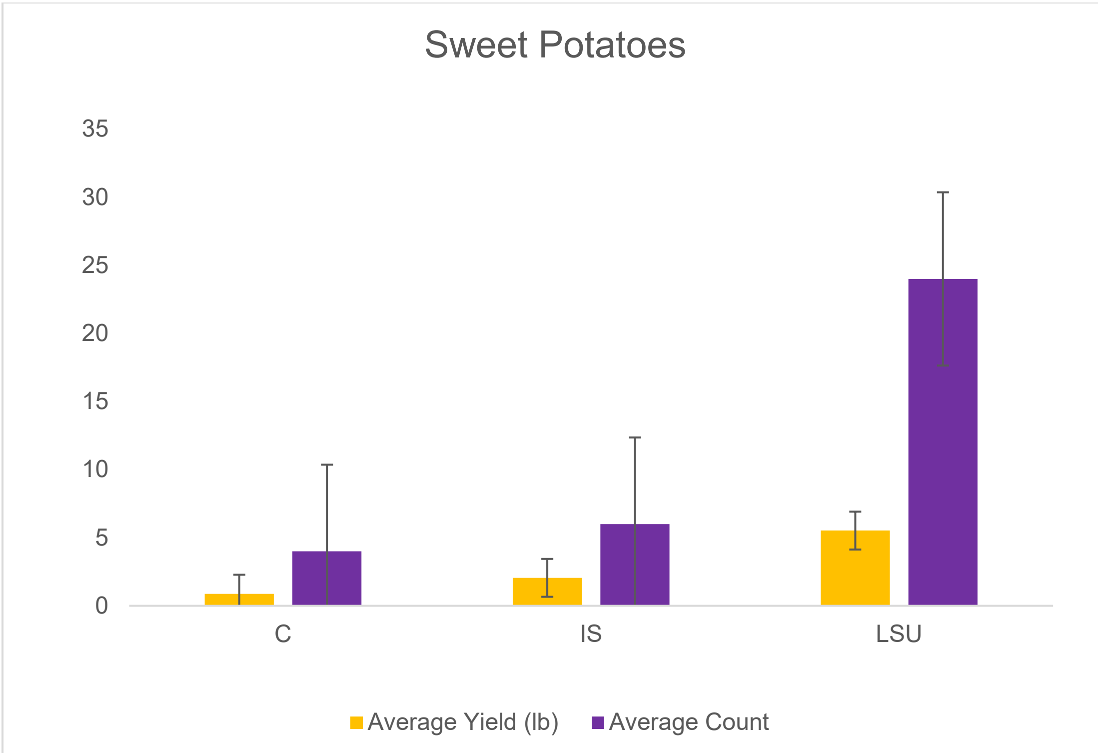

Figure 3. Average yield (pounds) and numbers of ‘Jewel’ sweet potato harvested from container-grown pots (28L) with selected soilless substrates (Control, Industry Standard, and LSU).

All three trialed crops performed best when growing in the LSU media. The LSU media was superior in that it not only contained preplant fertilizer and micronutrients as compared to the IS with fertilizers but no micronutrients and C with no additives to start. Supplemental fertilization at the same rates were applied throughout the study to all containers. However, even with supplemental fertilization the IS and C media treatments did not produce comparable yields to the LSU media, and this was also seen visually in plants as those grown in LSU media had larger biomass than the IS and C medias (biomass data not presented). Tomato plants growing in the IS and C were not visually different (size and color) as compared to the LSU media but did have significantly less fruit production as data showed. Sweet potato foliage was similar in color in all three media selections.

Conclusions

Many home gardeners assume a bag of potting media has everything in it they need for a successful crop. Few gardeners read the label to check if there is fertilizer in the bag and many home gardeners don't know when to apply fertilizer for successful crops unless they have gone through some sort of training (such as the Master Gardener Program) or have done extensive research prior to growing the crop. Media mixing companies should consider adding fertilizer and micronutrients to their potting mixes to increase customer satisfaction and retain their customer base. Adding micronutrients and basic fertilizer will increase the manufacturing costs, however, this study shows that doing so will make the home gardener more successful.

Follow up studies should be conducted to look at customer satisfaction and retention with the use of those soilless growing medias with preplant fertilizer included versus medias without. The LSU-branded medium is an excellent choice for vegetable production in containers for home gardeners. The combination of pine bark mulch to peat moss ratio, combined with micronutrients and lime to buffer the pH, offer a superior option for container substrates for vegetable production. We recommend utilizing this mix for home vegetable production. Next steps will be to compare the LSU potting media with other commercially available mixes containing slow-release fertilizers.

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