

**Evaluating Ornamental Performance and Public Perceptions of Cool-  
Season Annual Bedding Plants within Alabama Public Gardens: A  
Partnership of Green Industry Groups.**

by

Monte J. Baugh

A thesis submitted to the Graduate Faculty of  
Auburn University  
In partial fulfillment of the  
requirements for the Degree of  
Master of Science

Auburn, Alabama  
May 9, 2015

Keywords: Annual trials, plant evaluation, plant combinations,  
public garden survey

Copyright 2015 by Monte J. Baugh

Approved by

Joe Eakes, Chair, Professor, Horticulture  
Dave Williams, Professor and Head, Horticulture  
Carolyn Robinson, Associate Professor, Horticulture

## Abstract

This study focused on field evaluations of cool season annual ornamental selections at two Alabama public garden sites and public perceptions of annual color combinations in planters at three separate public gardens throughout the state of Alabama. Partnerships were formed between individuals within Alabama public gardens, the Alabama Cooperative Extension System, Master Gardener Associations, Green Industry professionals, and Auburn University's Department of Horticulture to bring about this work. There were two parts to this research; field evaluations at two public garden sites consisting of growth indices and visual performance ratings of the plant selections, and a survey at three public gardens to gather information about public perceptions of plant color combinations and preferences.

The first part consisted of evaluating the performance of select cool season annuals at the Auburn University Plant Science Research Center (AUPSRC) in Auburn, Alabama and Dothan Area Botanical Garden (DABG) located in Dothan, Alabama. Four experiments were conducted from fall 2013 through spring 2014 to evaluate the growth and performance of these cool season annual ornamental cultivars: four ornamental kale (*Brassica oleracea* L.), four dwarf snapdragons (*Antirrhinum majus* L.), four trailing pansies (*Viola X wittrockiana* Gams.), four violas (*Viola cornuta* L.), and five pansies (*Viola X wittrockiana* Gams.). Selections were planted in full sun locations to simulate optimal growing conditions for the

species used within the deep south. The plants' growth indices and visual performance ratings were taken every three weeks from planting until termination.

A record freeze event occurred in Alabama on January 7, 2014, which had major impacts on the growth and performance of many plant selections. Temperatures of 9°F (-13°C) and 15°F (-9.4°C) were recorded in Auburn, Alabama and Dothan, Alabama, respectively. In spite of these record temperatures, the ornamental kale selection, 'Redbor' was the largest and highest rated of the ornamental kale selections. The 'Sunset' dwarf snapdragon selection was consistently the best performer among its species. 'Golden Yellow' trailing pansy was a top performer, while 'Yellow with Blotch' under performed when compared to all other selections. Among viola species, 'Deep Marina Improved' and 'Violet Beacon' were consistently the highest rated selections at both locations with some of the highest average visual subjective ratings. Nature® series pansies, 'Lemon Yellow' and 'Mulberry Shades' were the best performers among pansies.

The second portion of the research focused on public perceptions of color combinations of cool season annual ornamentals among different groups of garden guests that visited three public gardens in Alabama. A survey was developed to gather this information from Master Gardeners, university staff and faculty, students, horticulture professionals, and public garden guests. The survey yielded 74 responses from the three locations: the Dothan Area Botanical Garden in Dothan, Alabama, the Auburn University Plant Science Research Center in Auburn, Alabama, and Huntsville Botanical Gardens in Huntsville, Alabama. Sixteen different combination planters were displayed at each of the three public gardens. Based on a 9 point Likert scale, the highest mean rating among all combinations and locations was Planter #5 (7.66 rating) containing Nature® 'Lemon

Yellow' pansy, Penny® 'Deep Marina Improved' viola, and 'Songbird White' ornamental kale. When asked whether the combination surveying experience helped expand personal knowledge of container gardening, 38.9% of participants indicated "Moderately" and 37.5% indicated "Very Much." When participants were asked how likely they were to purchase plants seen in this survey over those advertised in magazines or catalogs, 33.3% of participants were "somewhat likely" and 37.5% were "likely" to do so. Some plant selections found in the top-rated combinations and being identified by participants as "favorites" were some of the same selections receiving the highest ratings in the plant performance evaluations that were conducted in the same growing season.

## Acknowledgements

I am sincerely thankful to so many people for a multitude of reasons throughout this study. To Dr. Joe Eakes, thank you for the opportunity you gave me to come back to school and work toward a goal more suited to my skills and interests. Your time, attention, and confident encouragement throughout this work has set an example for me that I will continue to value. To Dr. Dave Williams and Dr. Carolyn Robinson, thank you for your valuable insights, support, advice and encouragement during all stages of this work.

I would also like to thank the Wiregrass Master Gardeners Association and North Alabama Master Gardeners Association for your contributions to planting and data collections. I would like to thank all the ALNLA members that contributed plant material and support. A thank you to the Dothan Area Botanical Garden and Huntsville Botanical Gardens administrators and board of directors for your approval and enthusiasm about this project. A special thanks to Harvey Cotton and Connor Vernon for sharing your experiences and advice in public garden management. Thanks to Jane Farr, Mark Foshee, and the Auburn University Plant Science Research staff for your willingness to assist me and provide space for this project. A huge “Thank You” to fellow horticulture graduate students Heath Hoffman, Jack Lecroy, Seth Allen, Leah Rogers, Dr. Ann Fleener, Hillary Heath, Hanna Pettus, and Kira Chaloupka for the hours of hands on assistance, data

collection, and advice. To my sisters, Dia and Erin, along with my Mom and Dad thank you for being supportive, encouraging, and loving throughout this study and in all that I do.

And to my wonderfully, sweet bride, Martha Lee Anne, I'm so happy to have you as my wife. Thank you for your listening ear, your kind, encouraging words, and your loving heart. And lastly, I would like to thank the Lord Jesus for blessing my life with everyone mentioned above and abundantly more.

## Table of Contents

Abstract.....	ii
Acknowledgments.....	v
List of Tables.....	viii
List of Figures.....	ix
CHAPTER 1 LITERATURE REVIEW.....	1
CHAPTER 2 FIELD EVALUATION OF <i>BRASSICA</i> , <i>ANTIRRHINUM</i> , AND <i>VIOLA</i> CULTIVAR PERFORMANCE IN EAST CENTRAL AND SOUTHEASTERN ALABAMA.....	19
CHAPTER 3 PUBLIC PERCEPTIONS OF COOL SEASON ANNUAL ORNAMENTAL COMBINATION PLANTERS IN ALABAMA PUBLIC GARDENS.....	53
CHAPTER 4 FINAL DISCUSSION.....	78

## List of Tables

<b>Table 2.1.</b> Ornamental kale ( <i>Brassica oleracea</i> L.) cultivar performance results from two evaluations at Auburn University's Plant Science Research Center in 2013-2014....	43
<b>Table 2.2.</b> Dwarf snapdragon ( <i>Antirrhinum majus</i> L.) cultivar performance results from two evaluations at Auburn University's Plant Science Research Center in 2013-2014.....	44
<b>Table 2.3.</b> Pansy ( <i>Viola x wittrockiana</i> Gams.) cultivar performance results from two evaluations at Auburn University's Plant Science Research Center in 2013-14.....	45
<b>Table 2.4.</b> Trailing pansy ( <i>Viola x wittrockiana</i> Gams.) cultivar performance results from two evaluations at Auburn University's Plant Science Research Center in 2013-2014.....	46
<b>Table 2.5.</b> Viola ( <i>Viola cornuta</i> L.) cultivar performance results from two evaluations at Auburn University's Plant Science Research Center in 2013-2014.....	47
<b>Table 2.6.</b> Ornamental kale ( <i>Brassica oleracea</i> L.) cultivar performance results from two evaluations at Dothan Area Botanical Gardens in 2013-2014.....	48
<b>Table 2.7.</b> Pansy ( <i>Viola X wittrockiana</i> Gams.) cultivar performance results from two evaluations at Dothan Area Botanical Gardens in 2013-2014.....	49
<b>Table 2.8.</b> Dwarf snapdragons ( <i>Majus antirrhinum</i> L.) cultivar performance results from two evaluations at Dothan Area Botanical Gardens in 2013-2014.....	50
<b>Table 2.9.</b> Trailing pansy ( <i>Viola X wittrockiana</i> Gams.) cultivar performance results from two evaluations at Dothan Area Botanical Gardens in 2013-2014.....	51
<b>Table 2.10.</b> Viola ( <i>Viola cornuta</i> L.) cultivar performance results from two evaluations at Dothan Area Botanical Gardens in 2013-2014.....	52
<b>Table 3.1.</b> Color combination rating survey results of 16 planters displayed at three Alabama public gardens from April to May 2014 at Dothan Area Botanical Gardens in Dothan, AL, Auburn University's Plant Science Research Center in Auburn, AL, and Huntsville Botanical Garden in Huntsville, AL.....	72



## List of Figures

- Figure 3.1.** Color combination ratings for the highest rated planter combination, Planter #5<sup>z</sup> among gardening experience level groups (Not Applicable, Beginner, Intermediate, and Advanced)(Meanrating = 7.66).....74
- Figure 3.2.** Color combination ratings for the lowest rated planter combination, Planter #2<sup>z</sup>, among gardening experience level groups (Not Applicable<sup>y</sup>, Beginner, Intermediate, and Advanced)(Mean rating = 5.96).....75
- Figure 3.3.** Color combination mean ratings for the highest rated planter combination, Planter #5<sup>y</sup>, for participants at Dothan Area Botanical Gardens in Dothan, AL (DABG)(8.47), Auburn University’s Plant Science Research Center in Auburn, AL (AUPSRC)(7.67), and Huntsville Botanical Garden in Huntsville, AL (HSVBG) (7.08)<sup>z</sup>.....76
- Figure 3.4.** Color combination mean ratings for the lowest rated planter combination, Planter #2<sup>y</sup>, for participants at Dothan Area Botanical Gardens in Dothan, AL (DABG)(6.78), Auburn University’s Plant Science Research Center in Auburn, AL (AUPSRC)(6.20), and Huntsville Botanical Garden in Huntsville, AL (HSVBG) (5.08)<sup>z</sup>.....77



# CHAPTER I

## LITERATURE REVIEW

### Overview

**Trial Gardens throughout the United States.** Ornamental plant trials are becoming commonly practiced components of the horticulture industry's supply chain throughout the United States and the world (Anderson, 2006; Arnold et al., 2001). Trial Gardens are implemented by various organizations ranging from non-profit public gardens and city parks to private plant growers and retailers to public state universities and extension systems. Conferences that are initiated by these groups, such as the International Trials Conference, are promoted with the purpose of sharing information about marketing strategy, breeding, plant promotions, and plant introductions obtained from data collected from a variety of trial gardens worldwide (ISHS, 2013).

**All-America Selections.** The All-America Selections (AAS) is a prime example of a non-profit organization whose stated mission is "to promote new garden seed varieties with superior garden performance judged in impartial trials in North America" (All-America Selections, 2014). This organization partners with other horticulture industry groups (i.e. botanical gardens, university gardens, and retail garden centers) throughout the U.S. to implement trial gardens at respective sites. This partnership provides trial sites with like ornamental plants and a standardized data collection system designed to create

congruency between plant trialing programs throughout the country. The goal of their efforts is to assist the ornamental and edible horticulture industries in providing growers, retailers, and consumers with information on the performance of plant selections for all regions of the continental U.S. and Canada.

AAS also sponsors display gardens at public locations throughout North America for the purpose of showcasing past years' AAS® Winners (All-America Selections, 2014). Locations wishing to serve as AAS display gardens must meet all qualifications outlined by the AAS® criteria. If qualifications are met, seeds are supplied, then grown to transplant size by the participating organizations. Many locations hold "field days" and "open houses" to assist in increasing display garden visitors.

Data collected by plant evaluations, like AAS, are published through various outlets to provide informational material to growers, retailers and consumers in determining which plants will perform best within given regions. By choosing AAS Winners or other highly rated plant selections, consumers may experience greater confidence in the seasonal success and sustainability of their plant purchases. In the same manner, plant breeders, growers, and retailers can supply these plant varieties to their customers with greater confidence in the proven success of their product (Harris, 2008; Swindle, 2013).

**Public Garden Trials.** In the U.S., trial gardens are integrated into many different types of landscapes and gardens. Some of the most common types include those found within public or botanical gardens. Trial gardens placed within public gardens serve as a link between the plant production industry and urban consumers (Pemberton and Roberson, 2001). These plant trials are typically maintained and operated by gardens' horticulture staff, area Master Gardens, and university extension systems' personnel.

Gardens are designed to display groups of plant cultivars by species or like colors. This display emphasis is commonly practiced to support a public garden's goal of providing aesthetic value to an existing landscape space while still conducting valid research (Anderson, 2006). This method of trialing ornamental bedding plants is used by several gardens throughout the U.S. including Longwood Gardens in Kennett Square, Pennsylvania, Chicago Botanic Garden in Glencoe, Illinois, Callaway Gardens in Pine Mountain, Georgia, the Dallas Arboretum and Botanical Garden in Dallas, Texas, Missouri Botanical Garden in St. Louis, Missouri and the Cincinnati Zoo and Botanical Garden in Cincinnati, Ohio.

**University Trial Gardens.** Public universities within the U.S. are other institutions that implement trial gardens for the purpose of benefitting the horticulture industry (Arnold et al., 2001). Many university trial gardens play an integral role in state plant promotion and introduction programs. Plant evaluations in university gardens can provide performance data for various plant selections to the horticulture industry and public through state extension system publications (Anella et al., 2001; Pemberton et al., 2011). These gardens vary in size and scope and are often operated in conjunction with state extension offices. Colorado State University in Fort Collins, Colorado, University of Georgia in Athens, Georgia, Michigan State University in East Lansing, Michigan, the Ohio State University in Columbus, Ohio, North Carolina State University in Raleigh, North Carolina, and Kansas State University in Manhattan, Kansas are a few public universities that operate and maintain seasonal trial gardens.

**Green Industry Trial Gardens.** It is becoming more common for members of the Green Industry like private seed companies, growers, and retail garden centers to conduct independent plant trials. Like public and university trial gardens, the mission of these

ventures is to provide consumers with performance data for a variety of selections and combinations (Young's Plant Farm, 2015). These trials, however, are often limited to only those plant selections the business offers. The data produced in these trials is often a single subjective rating given to each selection at certain intervals by a trained evaluator. Like "The Gardens at Ball" located at Ball Seed Company's headquarters in Chicago, Illinois, some trial gardens are open to the public (Ball Seed Co., 2014). Young's Plant Farm in Auburn, Alabama, however, coordinates special promotional "field days" in order to display their products to current and potential customers. In this way, independently operated trial gardens can prove to be financially beneficial to seed companies, growers, or retail garden centers. However, these do not always offer the quantity of public exposure a university or public garden trial might.

## **Evaluation Methods**

**Public Gardens.** Plant evaluation methods can vary between gardens. Most are based on a subjective rating system that involves one or a few trained horticulturists making evaluations of selected plants based on their own expertise (Anderson, 2006). Other public gardens add the element of the garden guests' personal evaluations of the trial garden selections through field day surveys (Armitage, 2013; Swindle, 2013). By making the results of these evaluations available through their own garden literature, symposiums, and web-based publications, public gardens provide beneficial plant performance information to regional production nurseries, retailers, and consumers.

**Universities.** Plant evaluations also vary between university institutions, although most have more scientific parameters than do public garden trials. Subjective rating

systems are common for these evaluations (Anderson, 2006). Most performance ratings systems are designed on a “0 to 5” Likert-type scale with “0” being given to dead plants and “5” being assigned to the most exceptional specimens during periods of observation. A specified individual that bases his/her rating scores upon pre-determined criteria usually completes these observations. A number of other measurements that can be equally as subjective might include ratings of heat or drought tolerance, disease resistance, foliage color, and bloom color uniformity. More objective ratings might include plant growth indices, bloom length, bloom counts, shoot fresh and/or dry weights, and leaf surface area.

### **Annual Bedding Plant Trials**

In 2012, sales of annual bedding plants accounted for more than a quarter of floriculture sales for the USDA’s top 15-States program. This program annually reports sales for floriculture crops from wholesale growers grossing more than \$100,000 in total gross sales across the top selling 15 states. Total wholesale annual bedding plant sales accounted for \$1.36 billion from this top 15-State program (USDA, 2013).

Annual bedding plants are the most commonly evaluated group of plants for seasonal performance in U.S. trial gardens. Since this group of plants completes a full life cycle within one year, conducting complete evaluations takes a shorter period of time when compared to perennial or woody ornamental trials. Although some time is required to evaluate annual selections, quickness in a selection’s performance evaluations may allow for a more rapid introduction and promotion into grower and consumer markets (Anella et al., 2001). The ability to move a product from development to introduction in a short

period of time is crucial for increased profitability of a product in any market (Swafford et al., 2006).

Public garden and university trial gardens commonly conduct a majority of the annual bedding plant evaluations in the U.S. (Armitage and Green, 2001). These gardens often consist of landscape beds, raised beds, combination containers, and hanging basket trials integrated within a shared space (Anderson, 2006). This versatility makes annual trial gardens a colorful and attractive addition to public gardens while serving the dual purposes of research and education (Arnold et al., 2001; Melville, 2009).

### **Herbaceous Perennial Trials**

Although not as commonly trialed as annual bedding plants, herbaceous perennials are evaluated in select trial gardens (Armitage, 2008). Every year, All America Selections evaluates the performance of herbaceous perennials over one growing season (All-American Selections, 2014). These evaluations can only provide information on these plants utilized as annual bedding plants although they are characterized in literature as perennial.

In 1996 and 1997, a two-year trial of 57 different full-sun herbaceous perennial selections was conducted by Auburn University's Department of Horticulture at the E.V. Smith Research Center located in Shorter, Alabama (Kessler et al., 2000). Nine plants from each selection were trialed across three bedding locations in a randomized complete block design. The evaluations concluded that the selections trialed in this study generally performed better in the first planting year than in the second trial year. Although plants were not specifically recommended from this study, plants were evaluated and



performance ratings were reported to assist horticulturists in selecting their own full-sun perennials for the central Alabama region.

### **Woody Ornamental Trials**

In recent years, a few trials on shrubs and trees have been conducted nationally. According to Pooler (2001) of the U.S. National Arboretum in Washington, D.C., tree and shrub evaluations require the most time and resources out of all the processes of plant breeding. Because most plant trials cater to the evaluation of annual and herbaceous perennial plant performance over one or two growing seasons, shrubs and trees are not as commonly trialed due to their longer life-cycle and need for larger growing spaces.

In 1984, the NC-7 Regional Ornamental Plant Trials began evaluating woody landscape plants with an emphasis on detailed, long-term plant evaluations over a wide range of sites (Widrlechner, 1990). These trials spanned 17 states and 36 sites across the northern U.S. Evaluations were conducted after years one, five, and 10 via subjective ratings and observations. Although the program was not responsible for plant introductions, it did provide propagation material and early introduction information to horticulturists and growers in the northern U.S.

Other documented woody plant trials include the Lyle E. Littlefield Ornamentals Hardiness Trial at the University of Maine Demonstration and Test Garden, the Auburn University Shade Tree Evaluation, and Chicago Botanic Garden Plant Evaluation Program (Cappiello and Littlefield, 1994; Chicago Botanic Garden, 2014; Williams et. al., 1993). With the exception of Chicago Botanic Garden, these programs are no longer active and no scientific publications have been generated from these evaluations in recent years.

## **Annual Bedding Plant Evaluations in Alabama**

One active site in Alabama, affiliated with annual bedding evaluations, is located at the Birmingham Botanical Gardens where AAS sponsors a regional display garden located near the garden's Conservatory entrance. Although not an active plant trial site, this garden displays seasonal bedding plants denoted as AAS® Winners in trial gardens from previous years (All-America Selections, 2014). Several short-term evaluations have been conducted by the AU Department of Horticulture at various locations throughout the state in the past (Kessler et al., 1998; Kessler et al., 2005; Quinn et al., 1996). In more recent years, efforts to continue similar evaluations have been the forerunners in expanding this work to a broader range within Alabama (Harris, 2008; Swindle, 2013).

### **Evaluations and Promotional Programs.**

Plant evaluations have been shown to provide regional performance data of ornamental plant selections to plant introduction, promotion, and marketing programs for several states (Wehry et al., 2007). Promotional programs may select plants based on input by a committee of industry experts, plant performance evaluation results, or a combination of both (Anella et al., 2001; Dunwell et al., 2001; Harris, 2008). Through these programs, selections are granted special consideration for promotion to the nursery industry, retailers, landscapers, garden organizations, and consumers (Harris, 2008). Increased profits from sales of plant selections sponsored by plant promotion programs have been observed from year to year in a number of states (Anella et al., 2001; Pemberton et al., 2011; Mackay et al., 2001). Because of these increases in plant sales and the success of neighboring states' programs, members of Alabama's horticulture industry are

interested in the development of a statewide plant promotion program affiliated with a plant evaluation program conducted through designated trial gardens (Harris, 2008; Swindle, 2013).

**Challenges.** Development and initiation of such a program would require financial backing from various stakeholders. The greatest limiting factor for functioning evaluation gardens, particularly with herbaceous plant evaluations, is the high cost of maintenance (Armitage & Green, 2001). Maintaining ornamental bedding plants consists of regular weeding, mulching, supplemental watering, scheduled fertilization, and pest monitoring and control. These tasks can require many labor hours from individuals responsible for upkeep, and lack of adequate funding to pay personnel to conduct these tasks can be a major difficulty for programs over extended periods of time (Armitage & Green, 2001).

In Alabama, public annual bedding plant evaluations have been limited in recent years. Auburn University's Department of Horticulture conducted various seasonal trials at three research stations throughout the state in the 1990's and early 2000's (Kessler et al., 1998; Kessler et al., 2004; Kessler et al., 2005; Quinn et al., 1996; Williams et al., 1994). However, due to lack of funding these efforts were unsustainable and subsequently discontinued. Lack of sustainable funding for management has been the greatest limiting factor for the formation of a statewide plant evaluation and/or promotion program in Alabama for a number of years (Harris, 2008).

Plant trialing, or evaluation, programs in other states have struggled to remain sustainable during initial years of existence (Anella et al., 2001; Harris, 2008; Lindstrom et al., 2001). Failure of programs has occurred for a number of reasons including: loss of funding, retirement of key directors or personnel, inefficiency of program operations, and

lack of clear, guiding goals or mission. Since lack of funding has been the single greatest limiting factor for the initiation and continuation of plant evaluation gardens, dispersing the financial burden associated with operating such a garden throughout several stakeholders could increase the likelihood of sustaining a statewide plant evaluation program. One of the greatest expenditures for such a program is the compensation of evaluation garden staffs.

In Alabama, interest in collaborative partnerships to provide effort and resources for plant evaluations exists among a number of stakeholder groups including Master Gardeners, public gardens, Auburn University's Department of Horticulture, and Alabama Cooperative Extension System, and the horticulture industry. This opportunity to establish plant evaluation partnerships is viable. Establishment of partnerships consisting of multiple groups and stakeholders could be mutually beneficial. Through the process of collaborating to develop, operate, maintain, and promote evaluation gardens, stronger interactions have been observed in other states between various members of similar groups (Armitage, 2013).

A study by Arnold et al. (2001), reported students' increased skills in plant maintenance, plot layout planning, statistical design, data collection and analysis and professional communication of trial results from involvement in a university trial garden. The initiation of the Master of Science program with a certification in Public Horticulture in the Department of Horticulture at Auburn University presents the opportunity for graduate students to conduct plant evaluation research and organize the continued operations of an Alabama Statewide Plant Evaluation program. By providing students with educational opportunities to engage the public through educational training programs and collaborating

with Green Industry professionals on choosing plant selections for evaluations, students would fulfill requirements for the completion of a Public Horticulture Certificate and a Master's of Science (M.S.) thesis (Scoggins, 2010).

In volunteering to assist Public Horticulture M.S. graduate students in the operation and maintenance of plant evaluations, Alabama Master Gardeners (MG) and MG interns would satisfy continued learning volunteer hours required to maintain MG status. Through this partnership Alabama's Green Industry would acquire desired plant performance evaluation data to be used in the promotion of plant selections while lessening the burden for continued funding for the day-to-day operations of an evaluation garden.

Similar partnerships and evaluations taking place on a larger, regional basis have produced favorable results to the Green Industry. In a study by Dunwell et al. (2001), partnerships took place between the U.S. National Arboretum, southern state cooperative extension offices and nurserymen. Participants from thirteen states committed to growing plants from liners to mature size and evaluating growth rate and bloom time over several years. This model has proven to be successful in providing valuable evaluation data for the promotion of several new tree and shrub selections. By implementing a similar model by establishing evaluation gardens within Alabama public gardens, similar benefits could be expressed for Alabama's Green Industry and other partnering groups. Public gardens and MG could benefit by connecting community outreach educational opportunities to local Green Industry members all while obtaining attractive showpieces in their garden sites.

## Objectives

The first objective of this research was to begin the formation of partnerships between members of the following: Alabama Master Gardeners, Auburn University Department of Horticulture, the Alabama Cooperative Extension System, public gardens and Alabama's Green Industry. Another objective was to evaluate the seasonal performance of cool-season annual selections based on growth indices and subjective visual ratings at multiple public gardens within Alabama. This was done to gather information about the performance of these selections for different regions of the state. The final objective was to identify trends that might exist among garden guests, consumers, Master Gardeners, and horticulture professionals in regard to perception of cool-season annual combination planters at multiple public garden locations in Alabama.

Species used in these studies were chosen based on their cold tolerance for use during fall and winter months in Alabama (Kessler, 2013). Pansy (*Viola X wittrockiana* Gams.) and viola (*Viola cornuta* L.) cultivars have been planted extensively as the fall, winter, and spring annual bedding plants of choice for many years in the Southeastern U.S. (Healy, 1998; Nau, 1998b). Development in diversity of pansy and viola cultivars has been on the rise for the last two decades, leading to the development of new selections like trailing pansies (*Viola X wittrockiana* Gams.) in recent years (Ball Seed Co. 2014; Kessler, 1998). Snapdragon (*Antirrhinum majus* L.) cultivar breeding has expanded in diversity with dwarf and trailing varieties being offered in recent years (Creel & Kessler, 2007). Ornamental kale (*Brassicas oleracea* L.) has also seen tremendous growth in popularity and diversity of cultivars within recent years (Gibson & Whipker, 2001; Nau, 1999). According

to Nau (1998a), demand for new selections of ornamental kale have out-grown seed supplies making acquiring desired cultivars difficult for many growers.

**Plant Selections.** Twenty-one selections were chosen for the studies. Four selections each of ornamental kale, dwarf snapdragon, trailing pansy, and viola, and five selections of pansy were chosen for the two performance evaluation and color combination studies. Ornamental kale cultivar selections were 'Redbor,' used in the first evaluation only, and 'Coral Prince,' 'Songbird White,' and 'Kamome Pink' in both the first and second evaluation. Due to limited seed availability with a difference only in foliage color, 'Winterbor' was substituted for 'Redbor' in the second evaluations. Dwarf snapdragon cultivar selections chosen from the Snapshot® Series were 'Sunset' and 'Plumblossom' (Ball Seed Co., 2014). Dwarf snapdragon selections chosen from the Montego® Series were 'Burgundy Bi-color' and 'Rose Bi-color.' Pansy cultivar selections were 'True Blue Improved,' 'Pure Orange,' and 'Red with Blotch' chosen from the Delta® series. 'Lemon Yellow' and 'Mulberry Shades' were selections chosen from the Nature® Series. Viola cultivars were 'Violet Beacon XP' and 'Pink Halo XP' of the Sorbet® Series and 'Deep Marina Improved' and 'Primrose Blotch' of the Penny® Series. New trailing pansy selections included the Wonderfall® Series' 'Blue with Blotch,' 'Yellow with Blotch,' and 'Yellow with Red Wing'. 'Golden Yellow' came from the Cool Wave® Series (Ball Seed Co., 2014).

**Methods.** Partnerships and evaluations were established in the summer of 2013. Plant performance evaluations were conducted on the 21 selections of cool-season annual bedding plants beginning in October 2013. Plants were grown in prepared randomized beds in working landscape settings at two public garden locations - Dothan Area Botanical Gardens (DABG) in Dothan, Alabama and the Auburn University Plant Science Research

Center (AUPSRC) in Auburn, Alabama. Selections were evaluated based on growth indices (GI) and visual performance through subjective ratings over two 15 week periods from 1 October 2013 through 8 May 2014. Comparisons of the selections were made between like species to determine best performers within each evaluation.

Sixteen combinations of the same 21 cool season annual selections were also grown in large containers at three different public gardens - DABG, AUPSRC, and the Huntsville Botanical Garden (HSVBG) in Huntsville, Alabama. Three different selections for each of the 16 containers were combined with the purpose of gathering public perceptions of combination plantings. Similar studies have indicated consumer preferences for purchasing annual planters. According to Phillips and others (2007), the most important factor for consumers when deciding to purchase planters was price followed by color harmony and container style, respectively. Based on that study, surveys were completed by garden guests, students, Master Gardeners, university personnel and horticulture industry professionals to determine color and combination perceptions trends among these groups.

Additionally, a variety of new and common woody ornamental shrubs were provided by Alabama growers to be evaluated over three years. Selections were planted in groupings of three at AUPSRC and DABG for continued future plant performance evaluations. Initial GI and ratings were recorded for comparisons over time. Future AU public horticulture M.S. students and Master Gardeners will be responsible for collecting data biannually for the duration of the shrub evaluations.



## Literature Cited

- All-America Selections. 2014. AAS Trial Grounds. Display Gardens. All-America Selections, Downers Grove, IL. <[http://all-americaelections.org/trial\\_grounds/index.cfm](http://all-americaelections.org/trial_grounds/index.cfm)>
- Anderson, N.O. 2006. Ch. 3 Cultivar Testing: America's trial gardens. p. 65-80. In: J. Nau. Flower Breeding and Genetics: Issues, Challenges and Opportunities for the 21st Century. Springer. New York, NY
- Anella, L.B., M.A. Schnelle, and D.M. Maronek. 2001. Oklahoma Proven: A plant evaluation and marketing program. HortTechnology 11:381-384.
- Armitage, A.M. 2008. Herbaceous Perennial Plants: A Treatise on Their Identification, Culture, and Garden Attributes. Cool Springs Press.
- Armitage, A.M. and M. Green. 2001. The University Trial Garden as a tool for evaluating and introducing new plant materials. HortTechnology 11:368-372.
- Armitage, A.M. 2013. The Trial Gardens at the University of Georgia: an evolution. Proc. Intl. Trials Conf. Intl. Soc. Hort. Sci. 1:125-127
- Arnold, M.A., R.D. Lineberger, T.D. Davis, S.W. George, W.A. Mackay, G.D. Grant, J.M. Parsons, and L.A. Stein. 2001. Integrating plant trials into teaching and student research programs. HortTechnology 11:385-388.
- Ball Seed Co. 2014. Ball Seed Catalog 2015-2016. Ball Horticultural Company. West Chicago, Ill. <[http://www.ballseed.com/virtual/2015\\_bsc/index.aspx#](http://www.ballseed.com/virtual/2015_bsc/index.aspx#)>
- Cappiello, P. and L. Littlefield. 1994. Woody landscape plant cold-hardiness ratings. Maine Agr. For. Expt. Sta. Tech. Bul. 156.
- Chicago Botanic Garden. 2014. Conservation. Ornamental Plant Research. Plant Evaluation Program. Chicago Botanic Garden, Chicago. 10 June 2014 <[http://www.chicagobotanic.org/research/plant\\_evaluation/](http://www.chicagobotanic.org/research/plant_evaluation/)>
- Creel, R. and R.J. Kessler. 2007. Greenhouse Production of Bedding Plant Snapdragons. Alabama Cooperative Extension Publication. <<http://www.aces.edu/pubs/docs/A/ANR-1312/ANR-1312.pdf>>.
- Dunwell, W.C., D. Fare, M.A. Arnold, K. Tilt, G. Knox, W. Witte, P. Knight, M. Pooler, W. Klingeman, A. Niemiera, J. Ruter, T. Yeager, T. Ranney, R. Beeson, J. Lindstrom, E. Bush, A. Owings, and M. Schnelle. 2001. Plant evaluation program for nursery crops and landscape systems by the Southern Extension and Research Activities/Information Exchange Group-27. HortTechnology 11:373-375.

- Gibson, J.L. and B.E. Whipker. 2001. Ornamental cabbage and kale cultivar comparison study: Growth characteristics and response to daminozide and uniconazole foliar sprays. *HortTechnology* 11:376-380.
- Harris, E. 2008. A National Overview of Plant Selection/Introduction Programs and a State Survey of Growers and Retailers to Determine the Potential for an Alabama Plant Selection/Introduction Program. Auburn Univ., Auburn, MS Thesis
- Healy, W. 1998. *Viola x wittrockiana* (Pansy). p. 777-782. In: V. Ball (ed.). Ball Red Book. 16<sup>th</sup> ed. Ball Publ., West Chicago, Ill.
- International Society of Horticultural Science. International Trials Conference. 2013. Proc. I. Surrey, UK, 4-7 July 2011. (Proc. Intl. Trials Conf. Intl. Soc. Hort. Sci. 1)
- Kessler, J.R., J.L. Sibley, B.K. Behe, D.M. Quinn, and J.S. Bannon. 2000. Herbaceous perennial trials in central Alabama, 1996-97. *HortTechnology* 10: 222-228.
- Kessler, J.R., J. Coleman, and A. Caylor. 1998. 1997 summer trial garden results. Ala. Agr. Expt. Sta. Res. Circ. 320.
- Kessler, J.R., Coleman J., and A. Caylor. 2004. 2003-2004 winter trial garden results. Ala. Agr. Expt. Sta. Res. Circ. 327.
- Kessler, J.R., Coleman J., and A. Caylor. 2005. 2004-2005 winter trial garden results. Ala. Agr. Expt. Sta. Res. Circ. 330.
- Kessler, J.R. 2013. Annual Bedding Plants. Alabama Cooperative Extension Publication. <<http://www.aces.edu/pubs/docs/A/ANR-0184/ANR-0184.pdf>>.
- Lindstrom, J.T., J.A. Robbins, G.L. Klingaman, S. Starr, and J. Carson. 2001. The University of Arkansas Plant Evaluation Program. *HortTechnology* 11:362-364.
- Mackay, W.A., S.W. George, T.D. Davis, M.A. Arnold, R.D. Lineberger, J.M. Parsons, L.A. Stein, and G.G. Grant. 2001. Texas Superstar and the Coordinated Educational and Marketing Assistance Program (CEMAP): How we operate. *HortTechnology* 11: 389-391.
- Melville, E. 2009. University Trial Gardens Put Plant Performance to the Test. *American Gardener* 88:48-48.
- Nau, J. 1998a. *Brassica* (ornamental cabbage and kale), p.401-403. In: V. Ball (ed.). Ball Red Book. 16<sup>th</sup> ed. Ball Publ., West Chicago, Ill.
- Nau, J. 1998b. *Viola* (Johnny Jump-Up, Violet). p. 775-776 In: V. Ball (ed.). Ball Red Book. 16<sup>th</sup> ed. Ball Publ., West Chicago, Ill.

- Nau, J. 1999. *Ball Culture Guide: The encyclopedia of seed germination*. 3<sup>rd</sup> ed. Ball Publ. West Chicago, Ill.
- Pemberton, B., M. Arnold, T. Davis, D. Lineberger, C. McKenney, D. Rodriguez, L. Stein, C. Hall, M. Palma, and R.D.L. Santos. 2011. The Texas Superstar® Program: Success through partnership. *HortTechnology* 21:698–699.
- Pemberton, H.B. and W.E. Roberson. 2001. The East Texas Bedding Plant Pack and Garden Performance Trials. *HortTechnology* 11:392–396.
- Phillips, J., E.J. Holcomb, and K. Kelley. 2007. Determining interest in value-added planters: Consumer preference and current grower and retailer perceptions. *HortTechnology* 17:238–246.
- Pooler, M.R. 2001. Plant breeding at the U.S. National Arboretum: Selection, evaluation, and release of new cultivars. *HortTechnology* 11:365–367.
- Quinn, D., AGRI, and Alabama Agricultural Experiment Station. 1996. 1994-1995 Annual winter trial garden results. *Ala. Agr. Expt. Sta. Res. Circ.* 317
- Scoggins, H.L. 2010. University Garden stakeholders: Student, industry, and community connections. *HortTechnology* 20:528–529.
- Swafford, P.M., S. Ghosh, and N. Murthy. 2006. The antecedents of supply chain agility of a firm: Scale development and model testing. *J. Operations Mgt.* 24:170–188.
- Swindle, C.W. 2013. *The Development of a Statewide Trial, Evaluation, and Promotion Program: Trialing Summer Annuals*. Auburn Univ., Auburn, MS Thesis
- U.S. Department of Agriculture. 2013. *Floriculture Crops – 2012 Summary*. U.S. Dept. Agr. Washington, D.C.
- Wehry, R.H., K.M. Kelley, R.D. Berghage, and J.C. Sellmer. 2007. Capturing consumer preferences and interests in developing a state plant promotional program. *HortScience* 42:574–580.
- Widrechner, M. 1990. NC-7 Regional Ornamental Trials: Evaluation of New Woody Plants. *Proc. Conf. Metro. Tree Imp. Alliance* 7. <[http://lib.dr.iastate.edu/ncrpis\\_conf/10](http://lib.dr.iastate.edu/ncrpis_conf/10)>
- Williams, J.D., B.K. Behe, C.C. Montgomery, J.B. Witt, and L.M. 1994. 1994 Winter Trial Garden Results. *Ala. Agr. Expt. Sta. Res. Circ.* 313.
- Williams, J.D., D.C. Fare, C.H. Gilliam, G.J. Keever, H.G. Ponder, and J.T. Owen. 1993. *Shade Trees for the Southeastern States: An Auburn Evaluation*. Brown Printing, Montgomery, AL.

Young's Plant Farm. 2015. Trial Gardens: Young's Plant Farm Mid-South Trial Garden. 15  
March 2015. <<http://youngspanthfarm.com/trialgarden-main/>>

**CHAPTER II**  
**FIELD EVALUATION OF *BRASSICA*, *ANTIRRHINUM*, AND *VIOLA* CULTIVAR**  
**PERFORMANCE IN EAST CENTRAL AND SOUTHEASTERN ALABAMA**

**Abstract**

Four experiments conducted in 2013 and 2014 evaluated the growth and performance of various cool season annual ornamental cultivars: four ornamental kale (*Brassica oleracea* L.), four dwarf snapdragons (*Antirrhinum majus* L.), four trailing pansies (*Viola X wittrockiana* Gams.), four violas (*Viola cornuta* L.), and five pansies (*Viola X wittrockiana* Gams.). These evaluations took place at the Auburn University Plant Science Research Center (AUPSRC) on the campus of Auburn University in Auburn, Alabama, and the Dothan Area Botanical Garden (DABG) located in Dothan, Alabama. Selections were planted in full sun to simulate optimal growing conditions for all the species used within the deep south. Supplemental irrigation was provided at both locations from October through November and again from March through April. Irrigation totals were sporadic at DABG due to problems with the irrigation system, but irrigation was applied at a rate of one inch per week at the AUPSRC. Rainfall totals in Auburn, Alabama for December 2013, January 2014, and February 2014 were 5.76 in, 1.60 in, and 4.79 in, respectively. Rainfall totals in Dothan, Alabama for December 2013, January 2014, and February 2014 were 8.64 in, 2.93 in and 4.80 in, respectively (Weather Underground, 2014). Plots were evaluated

every 21 days throughout the duration of each experiment. Initial experiments, termed first evaluation, were conducted from October 2013 to January 2014. Repeat experiments, termed second evaluation, were conducted from February 2014 to May 2014. Similar experiments took place at both locations to evaluate the growth and performance of selections at the AUPSRC and DABG.

An extreme freeze event occurred in Alabama on January 7<sup>th</sup>, 2014, which had major impact on many selections in the first evaluation. Low temperatures of 9°F (-13°C) in Auburn, AL and 15°F (-9.4°C) in Dothan, AL were recorded (wunderground.com, 2014). All dwarf snapdragons and several ornamental kale selections at the AUPSRC were killed. However, some of the same selections at DABG survived.

Of the ornamental kale selections, 'Redbor' ornamental kale was the largest and highest rated. The 'Sunset' dwarf snapdragon selection was consistently the best performer among its species. 'Golden Yellow' trailing pansy was a top performer, while 'Yellow with Blotch' under performed all other selections. Among viola species, 'Deep Marina Improved' and 'Violet Beacon' were consistently the highest rated selections at both locations with some of the highest average visual subjective ratings. Nature® series pansies, 'Lemon Yellow' and 'Mulberry Shades' were the best performers among pansies.

## **Introduction**

Species for these evaluations were chosen based on their cold tolerance for use during fall and winter months in Alabama (Kessler, 2013). Pansy and viola cultivars have been planted extensively as the fall, winter, and spring annual bedding plants of choice for many years in the Southeastern U.S. (Healy, 1998; Nau, 1998b). Development in diversity

of pansy and viola cultivars has been on the rise for the last two decades (Kessler, 1998). Snapdragon cultivar breeding has expanded in diversity with dwarf and trailing varieties being offered in recent years (Creel & Kessler, 2007). Known sometimes by the misnomers “flowering” or “ornamental cabbage,” ornamental kale has also seen tremendous growth in popularity and diversity of cultivars within recent years (Gibson & Whipker, 2001; Nau, 1999). According to Nau (1998a), demand for new selections of ornamental kale have outgrown seed supplies making acquiring desired cultivars difficult for many growers.

An All-America Selections trial garden evaluated the performance of cool season annual cultivars in Alabama from 1993 to 1994 at the E.V. Smith Research Center in Shorter, Alabama (Williams et al., 1994). Cool season annual trials were again conducted from 2003 to 2005 at the Auburn University Campus in Auburn, Alabama and the North Alabama Horticulture Research Center in Cullman, Alabama (Kessler et al., 2004; Kessler et al., 2005). Due to lack of funding and sustainable resources both efforts were discontinued. However, because of the continued growing demands for newer cool season annual selections, the objective of this work was to evaluate growth and ornamental performance of specific cultivars within species under full sun conditions in east central and southeast Alabama. This study was intended to act as a base model for future work that could provide empirical information about these plants and others to local markets and promotions.

## **Materials and Methods**

This work consisted of four plant evaluations. Two evaluations were conducted in east central Alabama at the Auburn University Plant Science Research Center (AUPSRC),

Auburn, Alabama, and two more experiments were implemented in Southeast Alabama at the Dothan Area Botanical Gardens (DABG) in Dothan, AL 36303. The first evaluations were initiated on 10 October 2013 in Auburn, Alabama and 17 October 2013 in Dothan, Alabama. Since cool season annual market demand is highest during this season in Alabama, these evaluations represented a typical fall planting of cool season annuals (Kessler, 1998). The second evaluations were implemented on 6 February 2014 in Auburn, Alabama and on 14 February 2014 in Dothan, Alabama. These evaluations represented what is customarily known as spring planting time for cool-season annuals in Alabama. Although fall plantings are more commonly practiced for these plant selections, the practice of spring cool-season annual planting has the potential of increasing in many markets (Kessler, 1998).

**Plant Selections.** Four selections each of ornamental kale, dwarf snapdragon, trailing pansy, and viola, and five selections of pansy were chosen for performance evaluations at the two locations. Ornamental kale cultivar selections were 'Redbor,' used in the first evaluation only, and 'Coral Prince,' 'Songbird White,' and 'Kamome Pink' in both the first and second evaluation. Due to limited seed availability with a difference only in foliage color, 'Winterbor' was substituted for 'Redbor' in the second evaluations. Dwarf snapdragon cultivar selections chosen from the Snapshot® Series were 'Sunset' and 'Plumblossom' (Ball Seed Co., 2014). Dwarf snapdragon selections chosen from the Montego® Series were 'Burgundy Bi-color' and 'Rose Bi-color.' Pansy cultivar selections were 'True Blue Improved,' 'Pure Orange,' and 'Red with Blotch' chosen from the Delta® series. 'Lemon Yellow' and 'Mulberry Shades' were selections chosen from the Nature® Series. Viola cultivars were 'Violet Beacon XP' and 'Pink Halo XP' of the Sorbet® Series and



'Deep Marina Improved' and 'Primrose Blotch' of the Penny® Series. New trailing pansy selections included the Wonderfall® Series' 'Blue with Blotch,' 'Yellow with Blotch,' and 'Yellow with Red Wing'. 'Golden Yellow' came from the Cool Wave® Series (Ball Seed Co., 2014). All 21 selections were evaluated during both the first and second evaluations at both locations.

Plants used in these evaluations were obtained from Young's Plant Farm located in Auburn, Alabama on 22 August 2013 in 288-cell plug trays measuring 3/4 in x 3/4 in x 1 1/2 in per plug. Plugs were potted into 4 1/2 in square plastic containers (4 1/2 in o.d. x 3 1/2 in depth) filled with Fafard 3B Potting Mix (Conrad Fafard Inc., Agawam, MA, USA). Plants were placed in a climate-controlled polycarbonate greenhouse at the Paterson Greenhouse Complex in Auburn, Alabama for 6 weeks. Transplants were watered as needed by hand, and Total Gro Pansy Special (15:2:20; SDT Industries, Inc., Winnsboro, LA, USA) liquid fertilizer 150 ppm N was applied weekly through irrigation starting two weeks after potting (Whipker, 2002).

**Auburn University Plant Science Research Center (AUPSRC).** Two evaluations took place at the Auburn University Plant Science Research Center in Auburn, Alabama. Designed to mimic a landscape bed planting that might be found within a typical commercial or residential landscape setting in Alabama, the garden included areas for woody ornamental shrubs, grasses, perennials, and annuals to be evaluated for years to come. The garden site is located within the AUPSRC facility's landscape adjacent to the front parking area. Three existing Crape myrtles (*Lagerstroemia spp.* L) and one existing Chinese Fringetree (*Chionanthus retusus* var. *serrulatus* Lindl. et Paxt.) were included in the

garden design. Four plots of annual bedding plants were incorporated into the garden design for the purpose of evaluating annual ornamentals in this study and future work.

Installation of the garden took place on 17 and 18 September 2013. Undergraduate and graduate students, as well as Auburn University Department of Horticulture staff members, were recruited to complete the installation. Installation consisted of cutting and removal of dead bermudagrass (*Cynodon dactylon* L.) turf, sprayed three weeks prior with a medium-rate Glyphosate (2.25 oz./gal), and tillage of all planting areas to a depth of 4 to 6 in. Fine grading was completed after tillage to encourage proper surface water drainage throughout the garden. Exposed debris such as roots and rocks were removed to allow for unobstructed planting. Ornamental shrubs were planted according to the specification of the design. Shrub selections were planted in groups of three and five specimens depending on species. Following plant installation, the garden was mulched with shredded pine bark to a depth of 3 in.

**AUPRSC Plot Installation and Maintenance.** Annual plot installation was completed on 1 and 2 October 2013, two weeks following the garden installation. The four plots were half-circle to oval in shape and covered an area of approximately 150 ft<sup>2</sup> each. The Auburn University Soil Testing Laboratory analyzed soils from the four plots. Plots “A” and “C” were comprised of clay soils high in organic matter with pH measurements of 6.9 and 6.5, respectively. Plots “B” and “D” were comprised of loam to light clay soils with pH measurements of 5.7 to 6.7, respectively. No agricultural limestone was added. However, to encourage proper soil drainage, 1 yd<sup>3</sup> of composted amendment grade pine bark was tilled into the existing soil of each plot at a depth of 8 in. All rocks, roots, and debris were removed from planting beds during tillage. Plots were shaped with yard rakes in a

mounded form to increase drainage and visibility of flowers from surrounding areas. Plots were top-dressed with 3 lbs of 3-4 Month Osmocote (19:6:12; Everris International B.V., Geldermalsen, Netherlands) controlled-release granular fertilizer blend as recommended to meet nutritional requirements of cool season annuals.

Plots were planted with the 21 selections of cool-season annual ornamentals. All selections were planted in groups of three, designed to make up one experimental unit in a generalized randomized block design. Shorter species, such as violas and pansies, were planted in the front two-thirds of each bed. Taller species, such as snapdragons and kale, were placed the back one-third of beds allowing for greater visibility of all selections from prominent viewing angles. Annuals were spaced 18 in o.c. with the exception of ornamental kale species being spaced 24 in o.c. Planting depth was 4 in with root zones just below soil surface. Upon completion of planting, all beds were lightly raked then mulched with shredded pine bark mulch to a depth of 1 in.

Each plot received 2 minutes of overhead, hand watering three times per week during the month of October. Water was delivered by the principal investigator through a 3/4 in hose pipe and water breaker connected to an exterior hose bib on the AUPSRC facility. An irrigation system was later installed to the four annual beds on 30 October 2013. The system was set to run three times per week for 10 minutes to deliver 1 in of water per week. From December 2013 through March 2014, monthly rainfall totaled 5.76 in, 1.60 in, 4.79 in, and 5.75 in, respectively in Auburn, Alabama (wunderground.com, 2014). Out of concern for freeze damage to irrigation systems and problems associated with over-watering of cool season selections, overhead irrigation was discontinued during those months. Irrigation was reactivated to the previous schedule in March 2014.

Hand weeding was conducted throughout plots as needed. Deadheading was limited intentionally to determine how well selections performed under lower maintenance conditions. However, deadheading was implemented on Delta® series pansies in December 2013 after a severe freeze nine weeks after planting. Delta® series pansies have the largest flowers, therefore, decaying flowers were removed to help prevent the spread of fungal disease on pansy and viola selections.

**DABG Plot Installation and Maintenance.** The experiment at the Dothan Area Botanical Garden (DABG) was to be conducted in collaboration with the Wiregrass Area Master Gardener Association. Upon proposal of the plant evaluation project, the Wiregrass Master Gardener Board of Directors voted unanimously in favor of the project. Through collaboration with DABG and the Wiregrass Area Master Gardener Association, three existing raised beds at DABG were donated to the project for annual cultivar evaluations. Raised plots were located in full sun and bed edging was constructed of 7 in x 9 in x 8 ft treated railroad ties. Inside dimensions for each raised bed measured 30 ft x 5 ft totaling 150ft<sup>2</sup> of usable planting area. Master Gardener (MG) volunteers sprayed existing vegetation with commercial grade glyphosate at the label rate of 2 oz per gal three weeks prior to installation. Weeds that remained or germinated after herbicide application were removed by hand 2 days prior to bed preparation.

Prior to plant installation, a soil sample was sent to the Auburn University Soil Testing Laboratory identifying the soil as light loamy clay with soil pH measurements ranging from 5.9 to 6.2. Twelve ft<sup>3</sup> of mushroom compost was added to each plot to increase soil organic matter. After the amendment was added, the raised beds were tilled to a depth of 8 in to encourage adequate soil drainage. Remaining roots and debris were

removed during tillage, and plots were raked into a mounded form to help promote flower visibility. Beds were top dressed with 3 lbs of 3-4 Month Osmocote (19:6:12; Everris International B.V., Geldermalsen, Netherlands) controlled-release granular fertilizer blend as recommended by the Soil Testing Laboratory at Auburn University to meet nutritional requirements. In addition, upon requests from MG volunteers, Pendulum 2G pre-emergent granular herbicide was applied to each raised bed at the lowest label rate of 0.35 lbs per 150 ft<sup>2</sup> plot. Each plot was installed with all 21 selections of cool-season annual ornamentals. Groups of plants were installed randomly throughout each bed. All selections were planted at 18 in o.c. spacing with ornamental kale species being planted 24 in o.c. Selections were then planted to a depth of 4 in. Upon completion of planting, all beds were lightly raked and mulched with mini-nugget pine bark mulch to a depth of 1 in.

Raised bed evaluation plots at DABG shared an overhead irrigation zone with an adjacent vegetable demonstration garden. Watering took place every other morning for 30 minutes. Uneven coverage and system problems made acquiring accurate watering totals for the plots difficult. The system was shut off in late November after the final crops in the vegetable garden were harvested. Due to the frequency of irrigation run times and high rainfall totals from December through February, soil moisture in the evaluated beds remained very high from October 2013 through January 2014.

**Data Collection.** Data were collected for evaluation at the AUPSRC by the principle investigator and graduate students from Auburn University's Public Horticulture Program. At DABG, a MG volunteer group of four were trained on proper growth indices (GI) measurements and subjective visual rating scale criteria for data collection. All data were collected entirely by MG volunteers of the Wiregrass Master Gardener Association.

GI measurements were first taken 2 weeks after planting (WAP) and every 21 days throughout the 15-week growing period for the first evaluation. The same measurements were taken for the 13-week second evaluation starting 2 WAP and every 14 days thereafter until termination. Five sets of measurements for each unit were recorded during the first and second evaluation periods. GI consisted of measuring each plant's height and two perpendicular widths starting with the plant's widest diameter. The sum of these measurements was divided by 3 to calculate a standardized measurement for GI. GI for the three plants of each selection within each plot were averaged together to achieve a unit measurement. One unit GI of each selection for each plot was recorded and included in data analyses.

In addition, plants were given subjective visual ratings by the principle investigator at AUPRSC and a single, trained evaluator at DABG. Ratings were based on a 0 to 5 scale using a whole number for each experimental unit. A "0" was recorded for dead plants, a "1" was recorded for a living plant of the poorest quality, and a "5" was given to a plant with exceptional ornamental characteristics. The overall rating criteria for ornamental kale included overall foliage appearance, plant shape and structure, insect/disease resistance, and cold tolerance. Foliage appearance for ornamental kale was evaluated based on foliage coloration, fullness, and density. Criteria considered in the overall rating of snapdragons, pansies, violas, and trailing pansies included flower appearance, plant shape and structure, insect/disease resistance, and cold tolerance. Flower appearance for snapdragons, pansies, and violas was evaluated based on overall flower coverage, coloration, consistency and abundance. Insect and disease resistance was assessed by evaluating each plant for the presence of physical damage caused by insects or diseases. Inspecting for cold damage on

flowers, foliage, and stems assessed cold tolerance. All of these factors were considered in giving each experimental unit one rating score. Visual performance ratings were designated and recorded at the time GI measurements were taken. At termination, final GI measurements and subjective visual ratings were recorded. Plants were then harvested and discarded.

The experimental design was a generalized randomized block design with the primary factor being time. Means comparisons of GI and visual subjective ratings were conducted using IBM SPSS 19. One-way analysis of variance was conducted within like species groups to identify significant differences between cultivars on measurement dates. All significances were at  $\alpha=0.05$ .

## **Results**

A low temperature of 9°F (-13°C) and high temperatures that remained below freezing in Auburn, Alabama on 7 January 2014, caused major damage to snapdragons and kale selections prior to the final two observation dates occurring 13 and 15 WAP. The same extreme freeze event produced a low temperature of 15°F (-9.4°C) in Dothan, Alabama. GI of many selections decreased following this date at both locations. Subjective visual ratings also declined for many selections between observations 9 WAP and 15 WAP. Ratings for kale and dwarf snapdragon selections suffered major decreases due to the deaths of many plants. Deaths were reflected in the rating means with several units yielding “0’s.”

### **AUPSRC First Evaluation**

**Ornamental Kale.** Four ornamental kale species were included, each from a

different cultivar series. 'Redbor' is considered by literature in seed catalogs to be the largest growing cultivar, followed by 'Coral Prince', 'Kamome Pink', and 'Songbird White', respectively (Ball Seed Co., 2014). Throughout the first evaluation, Ball Seed Co. observations were confirmed with differences in GI being established for all observation dates (Table 2.1). 'Redbor' was largest selection followed by 'Coral Prince.' 'Kamome Pink' and 'Songbird White' were the smallest.

Good to exceptional ratings that were similar were recorded for all selections until the extreme freeze event, which occurred between observation dates 9 and 13 WAP. 'Redbor' had the highest ratings two weeks after the hard freeze, followed by 'Coral Prince'. 'Songbird White' and 'Kamome Pink' were severely damaged by the extreme freeze and several species exhibited signs of complete plant death within two weeks of the event.

**Dwarf Snapdragons.** No differences in GI were observed between 'Burgundy Bicolor,' 'Rose Bicolor,' 'Sunset,' or 'Plumblossom' during the study (Table 2.2).

Visual ratings for all snapdragon selections were good to exceptional for observations 2, 5, and 9 WAP. In response to the extreme freeze event, 'Sunset' showed less initial damage than 'Rose Bi-color' or 'Burgundy Bi-color' 13 WAP. However, by 15 WAP widespread plant death among all selections was observed. No selection exhibited any extreme freeze tolerance compared to others.

**Pansies.** Pansy cultivars that were selected included "True Blue Improved," 'Red with Blotch,' and 'Pure Orange' from the Delta® series, and 'Lemon Yellow' and 'Mulberry Shades' from the Nature® series. Like snapdragons, no GI differences were expressed comparing selections throughout the study (Table 2.3). Differences among visual ratings were observed between various selections throughout the evaluation. 'Lemon Yellow' had



the highest ratings for all observation dates with the exception of the observation 5 WAP. 9 WAP 'Lemon Yellow' and 'Mulberry Shades' of the Nature® series had higher ratings than all other cultivars. After the extreme freeze event, 'Lemon Yellow' was least affected and was the only cultivar that maintained good ratings 15 WAP.

**Trailing Pansies.** Trailing pansy selections were chosen from the new Cool Wave™ series and the Wonderfall® series. The Cool Wave™ series 'Golden Yellow' was chosen along with 'Yellow with Red Wing,' 'Blue with Blotch,' and 'Yellow with Blotch' from the Wonderfall® series. Differences in GI were observed early, however, all selections grew to the same size by the end of the 15-week evaluation (Table 2.4).

Although 'Golden Yellow' performed better than 'Yellow with Blotch' on the first observation date of the study 2 WAP, all selections yielded consistently similar visual ratings for the remainder of the evaluation. All selections maintained acceptable quality even after the extreme freeze event on January 7, 2014.

**Viola.** Viola cultivars selected were 'Deep Marina Improved' and 'Primrose Blotch' from the Penny® series and 'Pink Halo XP' and 'Violet Beacon XP' from the Sorbet® series. No differences in GI occurred between the cultivars during the first evaluation (Table 2.5).

Viola selections earned excellent ratings for much of the first evaluation. Exceptional flower quality, flower abundance, and plant vigor was observed for all selections throughout the evaluation. Even after the extreme freeze, selections maintained acceptable ornamental performance.

### **AUPSRC Second Evaluation**

**Ornamental kale.** During the spring evaluation of ornamental kale, 'Redbor' was substituted with 'Winderbor' due to an insufficient supply of seeds at germination time.

Although all selections exhibited slow GI increases early, more rapid increases were observed from 9 WAP until termination 13 WAP as spring temperatures increased (Table 2.1). 'Winterbor' was larger than both 'Songbird White' and 'Kamome Pink' throughout the study. Although 'Coral Prince' was larger than 'Kamome Pink' and 'Songbird White' 6 WAP, similar GI were expressed at the final observation 13 WAP between 'Coral Prince' and all other cultivars.

Although 'Coral Prince' yielded better visual ratings than 'Kamome Pink' in observations 9 WAP, all had similar ratings during observations 11 and 13 WAP. Exceptional performance characteristics were observed for all selections during the final month of the evaluation.

**Dwarf snapdragons.** Snapdragon GI varied greatly between cultivars throughout the duration of the second evaluation (Table 2.2). 'Sunset' was larger than 'Rose Bi-color' and 'Burgundy Bi-color' for the first observation 2 WAP in February. 'Plumblossom' was larger than 'Burgundy Bi-color' and 'Rose Bi-color' 6 WAP in March. In April 9 WAP both Snapshot® series selections, 'Sunset' and 'Plumblossom,' were larger than both of the Montego® series selections, 'Burgundy Bi-color' and 'Rose Bi-color.' 'Plumblossom' was larger than both Montego® series selections 11 WAP, and 'Sunset' was larger than Montego® series selections 13 WAP at termination.

All visual ratings for the selections increased throughout the duration of the second evaluation. All selections were similar in performance and showed exceptional quality 13 WAP before termination in May.

**Pansies.** On the first observation date 2 WAP 'Red with Blotch' had larger GI than 'True Blue Improved' and 'Lemon Yellow' but was similar to all other selections. On the

second observation date 6 WAP ‘Mulberry Shades’ was larger than ‘Lemon Yellow.’ They were all similar for the final 3 observations.

Although no differences among visual ratings were observed during the second evaluation, selections’ quality increased continually throughout the growing season. Many selections earned good to exceptional ratings within all the test beds at AUPSRC (Table 2.3).

**Trailing pansies.** Like common pansies, trailing pansy selections showed differences during early observations, but had similar GI for the final 3 observations (Table 2.4). 2 WAP ‘Yellow with Blotch’ had the smallest GI with all other selections being similar. ‘Golden Yellow’ had larger GI than ‘Yellow with Blotch’ by the second observation date 6 WAP.

Selections exhibited good to exceptional visual characteristics throughout the month of April, however, decreases in visual ratings occurred in early May. No differences in visual ratings were observed between any selections throughout the evaluation.

**Violas.** Viola selections had similar GI throughout the second evaluation. Cultivars grew slowly during February and March, but increased as temperatures warmed in April, reaching their largest GI at termination (Table 2.5).

As was the case in the first evaluation, viola selections performed exceptionally with abundant flower quantity and quality, as well as, excellent overall plant vigor. No differences were observed between any selections on any dates during the evaluation.

### **DABG First Evaluation**

Due to plant selections’ poor performances and miscommunications between the principal investigator and MG volunteers, subjective visual ratings were not determined for

this evaluation period at DABG. GI data was collected on four dates throughout the first evaluation.

**Ornamental kale.** Ornamental kale selections exhibited differences throughout the first evaluation (Table 2.6). 'Redbor' had the largest GI throughout the evaluation with 'Coral Prince' being similar during December and January observation dates 10 and 12 WAP. 'Kamome Pink' consistently had the smallest GI but was similar to 'Songbird White' and 'Coral Prince' other than the first observation date. Slight decreases in GI were recorded for all selections on the final observation date due to sub-freezing temperatures of 15°F on 7 January 2014.

**Pansy.** Pansy selections grew poorly throughout the fall test, and no differences in GI measurements were noted during any of the four observation dates (Table 2.7). GI measurements remained relatively unchanged throughout the remainder of the observation dates.

**Dwarf snapdragons.** Dwarf snapdragon selections also expressed no differences in GI during the second evaluation (Table 2.8). Growth continued steadily throughout the observation dates for all selections.

**Trailing pansy.** Trailing pansy selections, like pansies, grew poorly at DABG. For the first two months of the evaluation there were no GI differences among selections (Table 2.9). By December observations, 'Blue with Blotch' had the greatest GI. As the study ended in January, 'Yellow with Blotch' had a similar GI to that of 'Blue with Blotch.' 'Blue with Blotch' along with 'Golden Yellow' decreased in size during the last three observation dates likely due to stunting and the extreme freeze event that affected Alabama on 7 January 2014.

**Violas.** Like other *Viola* species, violas grew poorly during the first evaluation in DABG (Table 2.10). Differences in GI occurred in December as plants declined in size and form.

### **DABG Second Evaluation**

After termination of the first evaluation and upon investigation of common problems associated with cool season annuals, beds were treated on 17 January 2014, prior to the second evaluation, for soil-borne fungal black root rot with Cleary's 3336 Flowable Fungicide (Cleary Chemical, LLC.) soil drench application at a rate of 16 oz. per 100 gallons (Mullen & Hagan, 2001).

**Ornamental kale.** Ornamental kale GI were similar early in the growing season with both 'Coral Prince' and 'Winterbor' being larger than 'Kamome Pink.' However, throughout the remainder of the second evaluation no differences in GI regardless of selection were observed (Table 2.6). Visual ratings were good overall with no differences being observed.

**Pansies.** Pansy selections had few differences in GI during the second evaluation (Table 2.7). The only difference during the evaluation occurred 12 WAP when 'Red with Blotch' was larger than only 'Lemon Yellow' at termination of the evaluation.

Visual performance ratings were good to exceptional for all selections, and no differences were observed.

**Dwarf snapdragons.** Dwarf snapdragon selections exhibited differences in GI between cultivars early in the second evaluation. 'Sunset' was larger than 'Rose Bi-color' during the February and March observation dates 2 and 5 WAP and larger than 'Burgundy Bi-color' in February (Table 2.8). As the season progressed, differences were overcome

between selections by April continuing to the end of the study.

Visual ratings of dwarf snapdragons increased evenly throughout the evaluation with the highest ratings yielded at termination, regardless of the selection, much like the second evaluation at AUPSRC (Table 2.8).

**Trailing pansies.** ‘Golden Yellow’ was consistently the largest trailing pansy selection throughout the second evaluation (Table 2.9). ‘Golden Yellow’ was larger than ‘Yellow with Blotch’ throughout the duration of the study, other than the April observations 7 and 10 WAP. At termination 12 WAP, ‘Blue with Blotch’ was also larger than ‘Yellow with Blotch.’ Lower GI for the ‘Yellow with Blotch’ selection was due to lack of the spreading habit this group of plants typically exhibits. Some specimens of ‘Yellow with Blotch’ failed to spread and some spread as is typical with this selection during the second evaluation at DABG.

‘Golden Yellow’ and ‘Yellow with Red Wing’ yielded the highest visual ratings during the March observation 5 WAP. Floral abundance and growth habit of these selections were better than ‘Yellow with Blotch’ and ‘Blue with Blotch’ early in the evaluation. Rating means of the second evaluation for ‘Golden Yellow,’ ‘Yellow with Red Wing,’ and ‘Blue with Blotch’ were higher than ‘Yellow with Blotch.’

**Violas.** For viola selections, ‘Violet Beacon’ was larger than ‘Primrose with Blotch’ during the April observation dates 7 and 10 WAP (Table 2.10). All selections were similar during the February, March, and May observation dates.

Visual subjective ratings for viola selections once again earned exceptional marks for overall quality regardless of selection.

## **Discussion**

### **AUPSRC Evaluation**

Colder than average temperatures on 7 January 2014 impacted the performance and growth of plant selections in the first evaluation at AUPSRC. One of the most obvious observations from this evaluation was that ornamental kale selections ‘Kamome Pink,’ ‘Songbird White,’ and ‘Coral Prince’ were severely damaged by the cold event along with all dwarf snapdragon selections and Delta® series pansies. ‘Redbor’ ornamental kale, ‘Lemon Yellow’ pansy, all trailing pansy selections and all viola selections maintained better overall health than selections mentioned previously.

Like all other groups, viola selections declined throughout the final weeks of the study, but obtained the highest visual ratings of any selections on all observation dates. Observations of viola cultivars yielded longer floral display, more consistent form, better cold tolerance, and better overall health than any other cool-season annual groups in the first evaluation.

During the second evaluation from February to May 2014, pansy, trailing pansy, and viola selections peaked in performance 9 WAP in early April while selections of ornamental kale and snapdragon selections exhibited best performance late in the growing season 11 to 13 WAP. Snapdragon selections performed well overall throughout the second evaluation. However, because ‘Sunset’ and ‘Plumblossom’ had higher GI and exceptional floral displays at bloom time, Snapshot® series could be slightly better spring performers than Montego® series dwarf snapdragon cultivars for the central Alabama region.

### **DABG Evaluation**

The first evaluation of cool season annuals at DABG produced very poor ratings and

little to no growth for many selections. Over-watering and weed encroachment were problems that persisted throughout the duration of the evaluation. Discoloration and stunting of all selections was observed in two of three plots within weeks of planting. These problems indicate some possible hazards in employing volunteers for future plant evaluation research collaborations. High soil moisture and lower than average temperatures were also observed throughout the length of this evaluation. Despite these complications, 'Redbor' ornamental kale and 'Yellow with Blotch' trailing pansy exhibited better GI than other selections within their respective groups for multiple observation dates.

The second evaluation at DABG produced better results than the first evaluation. Violas and trailing pansies performed exceptionally. Viola selections in this study earned some of the highest ratings of all other cool season annual cultivars from either location. All selections performed consistently when compared with other selections of violas. Of the trailing pansies, 'Golden Yellow' and 'Blue with Blotch' seemed to grow the largest, display most flowers, and maintained adequate plant health of the selections. Several specimens of 'Yellow with Blotch,' however, remained small and compact much like the common pansy selections. These stunted plants affected the mean GI, however, overall rating was only lower because of plant size not bloom coverage or plant health.

Pansy, ornamental kale, and snapdragons earned very good ratings and grew continually throughout the evaluation period. The three Delta series pansies performed equally well throughout the evaluation, but 'Lemon Yellow' from the Nature® series lacked size and performance throughout. This was different than 'Mulberry Shades' of the same series, which was comparable in size and flower abundance with the Delta series plants. Of



the ornamental kale selections, 'Winterbor' and 'Coral Prince' were similar as the top performers. For snapdragons, GI trends suggest the Snapshot® series cultivars, 'Sunset' and 'Plumblossom,' grow larger than Montego® series cultivars, 'Burgundy Bi-color' and 'Rose Bi-color,' during spring months. However, seed catalogs and others report Snapshot® series plants reaching the smaller heights and widths (Bachman, 2014; Ball Seed Co., 2014). Optimal rainfall, combined with gradual increases in daytime temperatures throughout the spring, created an exceptional growing environment for cool-season annuals in southeast Alabama.

Plants in plots A and C exhibited excellent display characteristics overall. Plot B plants grew well in the first half of the study, but seemed to struggle in the second half during the month of April. Although all selections grew and performed much better overall than the same selections from the first evaluation, symptoms persisted in a few individual specimens. Leaf stunting, discoloration, and decreased floral displays were observed in plants from all groups. Although not as widespread as symptoms on plants from the first evaluation, symptoms were similar and located randomly throughout plot B. A snapdragon sample, noticeably affected by leaf stunting and lack of flowers, was analyzed at the Auburn University Plant Diagnostics Lab. Results were negative for nematodes, bacterial, fungal, viral, or insect problems. Although not verified by tests, a suggested cause of symptoms in plot B was herbicide damage from past soil-active chemicals.

Based on this model for evaluating cool season annuals in Alabama, several selections performed exceptionally within their given groups. 'Sunset' and 'Plumblossom' snapdragons of the Snapshot® series, 'Coral Prince' ornamental kale, 'Mulberry Shades' pansy of the Nature® series, 'Golden Yellow' trailing pansy of the Cool Wave® series, 'Deep

Marina Improved' and 'Violet Beacon' violas were the top performers within their groups based on having the highest average subjective ratings from both evaluation periods at both public garden locations. However, 'Deep Marina Improved' viola, 'Violet Beacon' viola, 'Golden Yellow' trailing pansy, 'Redbor' ornamental kale, and 'Coral Prince' ornamental kale consistently exhibited exceptional subjective ratings combined with vigorous growth and larger plant size. We would consider these to be the top 5 performing cool season annual cultivars from our list of selections.

Although a limited number of selections were used in these evaluations, this model could be used as a reference to assist in determining selections for promotion in a statewide program for Alabama's Green Industry. Future evaluations should be conducted on a larger number of selections including those used in this study to compare how those cultivars might perform in a different growing season and among larger sets of selections. The addition of a North Alabama evaluation site would also provide more thorough information to any organization seeking to promote selections based upon their overall statewide performance.

## Literature Cited

- Ball Seed Co. 2014. Ball Seed Catalog 2015-2016. Ball Horticultural Company. West Chicago, Ill. <[http://www.ballseed.com/virtual/2015\\_bsc/index.aspx#](http://www.ballseed.com/virtual/2015_bsc/index.aspx#)>
- Bachman, G.R. 2014. Snapdragons Meet Winter Challenges. Mississippi State University Extension Publication. <<http://msucares.com/news/print/sgnews/sg14/sg20141117.html>>
- Creel, R. and R.J. Kessler. 2007. Greenhouse Production of Bedding Plant Snapdragons. Alabama Cooperative Extension Publication. <<http://www.aces.edu/pubs/docs/A/ANR-1312/ANR-1312.pdf>>.
- Gibson, J.L. and B.E. Whipker. 2001. Ornamental cabbage and kale cultivar comparison study: Growth characteristics and response to daminozide and uniconazole foliar sprays. HortTechnology 11:376-380.
- Healy, W. 1998. *Viola x wittrockiana* (Pansy). p. 777-782. In: V. Ball (ed.). Ball Red Book. 16<sup>th</sup> ed. Ball Publ., West Chicago, Ill.
- Kessler, J.R. 1998. Pansy Production and Marketing. Alabama Cooperative Extension Publication. <<http://www.aces.edu/pubs/docs/A/ANR-0596/ANR-0596.pdf>>.
- Kessler, J.R., Coleman J., and A. Caylor. 2004. 2003-2004 winter trial garden results. Ala. Agr. Expt. Sta. Res. Circ. 327.
- Kessler, J.R., Coleman J., and A. Caylor. 2005. 2004-2005 winter trial garden results. Ala. Agr. Expt. Sta. Res. Circ. 330.
- Kessler, J.R. 2013. Annual Bedding Plants. Alabama Cooperative Extension Publication. <<http://www.aces.edu/pubs/docs/A/ANR-0184/ANR-0184.pdf>>.
- Mullen, J. and A. Hagan. 2001. Diseases of Pansies and Their Control. Alabama Cooperative Extension Publication. <<http://www.aces.edu/pubs/docs/A/ANR-1214/ANR-1214.pdf>>.
- Nau, J. 1998a. *Brassica* (ornamental cabbage and kale), p.401-403. In: V. Ball (ed.). Ball Red Book. 16<sup>th</sup> ed. Ball Publ., West Chicago, Ill.
- Nau, J. 1998b. *Viola* (Johnny Jump-Up, Violet). p. 775-776 In: V. Ball (ed.). Ball Red Book. 16<sup>th</sup> ed. Ball Publ., West Chicago, Ill.
- Nau, J. 1999. Ball Culture Guide: The encyclopedia of seed germination. 3<sup>rd</sup> ed. Ball Publ. West Chicago, Ill.

- Weather Underground. 2014. Weather History for Auburn, AL.  
<<http://www.wunderground.com/history/airport/KAUO/2013/12/7/MonthlyHistory.html>>
- Whipker, B., T.J. Cavins, and J.L. Gibson. 2002. Managing Fall Pansy Fertilization. NC State University Cooperative Extension Publication  
<[http://www.ces.ncsu.edu/depts/hort/floriculture/Florex/pansy\\_fert\\_mgt.pdf](http://www.ces.ncsu.edu/depts/hort/floriculture/Florex/pansy_fert_mgt.pdf)>
- Williams, J.D., B.K. Behe, C.C. Montgomery, J.B. Witt, and L.M. 1994. 1994 Winter Trial Garden Results. Ala. Agr. Expt. Sta. Res. Circ. 31

**Table 2.1.** Ornamental kale (*Brassica oleracea* L.) cultivar performance results from two evaluations at Auburn University's Plant Science Research Center in 2013-2014.

Evaluation 1 <sup>z</sup> Cultivar	<i>Brassica oleracea</i>										Rating means <sup>v</sup>
	2 WAP <sup>y</sup>		5 WAP		9 WAP		13 WAP		15 WAP		
	G.I. (cm) <sup>x</sup>	Rating <sup>w</sup>	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	
Redbor	35.0 a <sup>n</sup>	4.0 a	54.3 a	5.0 a	59.1 a	5.0 a	50.2 a	3.5 ab	50.0 a	3.0 a	4.1 a
Coral Prince	27.7 b	4.0 a	38.7 b	5.0 a	44.4 b	4.8 a	41.8 b	3.8 a	40.6 b	2.3 b	3.9 ab
Songbird White	19.6 c	4.0 a	26.6 c	4.8 a	28.8 c	4.8 a	28.4 c	2.8 ab	27.8 c	1.0 c	3.4 bc
Kamome Pink	20.6 c	3.8 a	27.4 c	4.5 a	27.8 c	4.5 a	28.4 c	2.3 b	26.6 c	0.8 c	3.3 c
Evaluation 2 <sup>i</sup> Cultivar	2 WAP		6 WAP		9 WAP		11 WAP		13 WAP		Rating means
	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	
Winterbor	26.6 a	2.0 a	25.6 a	3.0 a	34.5 a	3.8 ab	43.7 a	4.8 a	50.5 a	4.8 a	3.7 a
Coral Prince	26.0 a	2.8 a	24.8 a	3.5 a	29.8 ab	4.8 a	35.5 ab	5.0 a	38.0 ab	5.0 a	4.2 a
Songbird White	18.8 b	2.3 a	19.0 b	3.8 a	23.7 b	4.5 ab	25.7 bc	4.8 a	28.8 b	4.8 a	4.0 a
Kamome Pink	20.6 b	2.3 a	19.9 b	3.0 a	20.6 b	3.3 b	22.9 c	4.5 a	30.7 b	4.3 a	3.5 a

<sup>z</sup>Planted on 10 Oct. 2013.

<sup>y</sup>Data collection weeks after planting (WAP).

<sup>x</sup>Growth index = [(height+width<sub>1</sub>+width<sub>2</sub>)/3](n=4).

<sup>w</sup>Mean subjective rating with 0=dead plant, 1=poorest quality, and 5=exceptional quality (n=4).

<sup>v</sup>Mean subjective rating for all five observation dates (n=5).

<sup>u</sup>Means compared within columns with Tukey's HSD Test (P ≤ 0.05).

<sup>i</sup>Planted on 06 Feb. 2014.

**Table 2.2.** Dwarf snapdragon (*Antirrhinum majus* L.) cultivar performance results from two evaluations at Auburn University's Plant Science Research Center in 2013-2014.

Evaluation 1 <sup>z</sup> Cultivar	<i>Antirrhinum majus</i>										Rating means <sup>v</sup>
	2 WAP <sup>y</sup>		5 WAP		9 WAP		13 WAP		15 WAP		
	G.I. (cm) <sup>x</sup>	Rating <sup>w</sup>	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	
Sunset	16.0 a <sup>u</sup>	2.8 a	21.5 a	4.3 a	23.3 a	3.8 a	24.4 a	2.8 a	23.2 a	0.3 a	2.8 a
Plumblossom	15.2 a	3.3 a	21.7 a	4.3 a	23.1 a	3.8 a	23.7 a	2.0 ab	21.6 a	0.0 a	2.7 a
Burgundy Bicolor	13.9 a	3.0 a	18.8 a	4.0 a	22.1 a	3.3 a	20.8 a	1.5 b	18.9 a	0.3 a	2.4 a
Rose Bicolor	14.8 a	3.3 a	21.8 a	4.8 a	23.5 a	3.5 a	22.5 a	1.3 b	21.1 a	0.3 a	2.6 a
Evaluation 2 <sup>i</sup> Cultivar	2 WAP		6 WAP		9 WAP		11 WAP		13 WAP		Rating means
	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	
	Sunset	10.3 a	3.0 a	11.7 ab	3.0 a	21.0 a	3.8 a	26.7 ab	5.0 a	32.5 a	
Plumblossom	9.6 ab	3.0 a	13.1 a	3.3 a	20.8 a	3.8 a	27.7 a	5.0 a	31.1 ab	4.8 a	3.9 a
Burgundy Bicolor	7.8 bc	2.8 a	10.5 b	3.0 a	16.1 b	3.3 a	21.9 bc	4.8 a	26.4 bc	4.3 a	3.7 a
Rose Bicolor	7.8 c	2.8 a	10.4 b	2.8 a	16.5 b	3.3 a	21.8 c	4.8 a	24.8 c	4.3 a	3.6 a

<sup>z</sup>Planted on 10 Oct. 2013.

<sup>y</sup>Data collection weeks after planting (WAP).

<sup>x</sup>Growth index = [(height+width<sub>1</sub>+width<sub>2</sub>)/3](n=4).

<sup>w</sup>Mean subjective rating with 0=dead plant, 1=poorest quality, and 5=exceptional quality (n=4).

<sup>v</sup>Mean subjective rating for all five observation dates (n=5).

<sup>u</sup>Means compared within columns with Tukey's HSD Test (P ≤ 0.05).

<sup>i</sup>Planted on 06 Feb. 2014.

**Table 2.3.** Pansy (*Viola x wittrockiana* Gams.) cultivar performance results from two evaluations at Auburn University's Plant Science Research Center in 2013-14.

		<i>Viola x wittrockiana</i>												
Evaluation 1 <sup>z</sup>	Cultivar	2 WAP <sup>y</sup>		5 WAP		9 WAP		13 WAP		15 WAP		Rating means <sup>v</sup>		
		G.I. (cm) <sup>x</sup>	Rating <sup>w</sup>	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating			
Evaluation 1 <sup>z</sup>	True Blue Improved	16.3 a <sup>u</sup>	3.0 ab	20.3 a	4.8 a	20.9 a	3.0 b	20.1 a	2.5 ab	18.6 a	1.3 b	3.0 b		
	Pure Orange	15.7 a	2.8 b	18.6 a	3.5 b	19.1 a	3.3 b	19.8 a	2.8 ab	19.6 a	1.8 b	2.8 b		
	Red with Blotch	14.5 a	2.8 b	19.1 a	4.5 ab	20.5 a	3.5 b	19.6 a	2.3 b	19.5 a	1.5 b	2.9 b		
	Lemon Yellow	16.2 a	4.0 a	21.0 a	4.5 ab	23.6 a	5.0 a	23.8 a	3.5 a	23.3 a	3.0 a	4.0 a		
	Mulberry Shades	16.0 a	3.8 ab	21.0 a	4.8 a	24.1 a	4.8 a	23.5 a	3.0 ab	23.4 a	1.8 b	3.6 a		
Evaluation 2 <sup>t</sup>	Cultivar	2 WAP		6 WAP		9 WAP		11 WAP		13 WAP		Rating means		
		G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating			
		True Blue Improved	8.1 b	2.5 a	10.6 ab	3.0 a	17.2 a	4.0 a	22.6 a	4.0 a	25.1 a		4.3 a	3.7 a
		Pure Orange	8.4 ab	2.5 a	10.8 ab	2.8 a	16.3 a	3.8 a	22.0 a	4.3 a	27.2 a		4.3 a	3.6 a
		Red with Blotch	9.7 a	2.5 a	11.6 ab	2.8 a	17.1 a	3.8 a	21.0 a	4.0 a	24.0 a		3.5 a	3.4 a
	Lemon Yellow	8.2 b	2.5 a	10.3 b	3.0 a	15.1 a	4.0 a	19.6 a	4.0 a	22.6 a	3.8 a	3.6 a		
	Mulberry Shades	9.1 ab	2.5 a	12.9 a	3.5 a	21.8 a	4.8 a	27.5 a	4.0 a	30.0 a	3.3 a	3.7 a		

<sup>z</sup>Planted on 10 Oct. 2013.

<sup>y</sup>Data collection weeks after planting (WAP).

<sup>x</sup>Growth index = [(height+width<sub>1</sub>+width<sub>2</sub>)/3](n=4).

<sup>w</sup>Mean subjective rating with 0=dead plant, 1=poorest quality, and 5=exceptional quality (n=4).

<sup>v</sup>Mean subjective rating for all five observation dates (n=5).

<sup>u</sup>Means compared within columns with Tukey's HSD Test (P ≤ 0.05).

<sup>t</sup>Planted on 06 Feb. 2014.

**Table 2.4.** Trailing pansy (*Viola x witrockiana* Gams.) cultivar performance results from two evaluations at Auburn University's Plant Science Research Center in 2013-2014.

Evaluation 1 <sup>z</sup>	<i>Viola x witrockiana</i>										
	2 WAP <sup>y</sup>		5 WAP		9 WAP		13 WAP		15 WAP		Rating means <sup>v</sup>
	G.I. (cm) <sup>x</sup>	Rating <sup>w</sup>	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	
Golden Yellow	21.6 a <sup>n</sup>	3.8 a	27.6 ab	4.5 a	30.2 a	4.3 a	26.3 a	2.8 a	25.8 a	2.3 a	3.5 a
Yellow with Blotch	16.4 b	2.8 b	21.4 b	3.8 a	23.3 a	3.5 a	26.6 a	2.8 a	25.9 a	2.3 a	3.0 a
Yellow with Red Wing	21.4 ab	3.8 a	28.2 a	4.5 a	30.2 a	4.3 a	29.7 a	3.0 a	29.4 a	2.3 a	3.6 a
Blue with Blotch	20.3 ab	4.0 a	26.9 ab	4.8 a	28.8 a	4.8 a	28.7 a	2.8 a	28.6 a	2.5 a	3.8 a
<b>Evaluation 2<sup>t</sup></b>	<b>2 WAP</b>		<b>6 WAP</b>		<b>9 WAP</b>		<b>11 WAP</b>		<b>13 WAP</b>		<b>Rating means</b>
<b>Cultivar</b>	<b>G.I. (cm)</b>	<b>Rating</b>	<b>G.I. (cm)</b>	<b>Rating</b>	<b>G.I. (cm)</b>	<b>Rating</b>	<b>G.I. (cm)</b>	<b>Rating</b>	<b>G.I. (cm)</b>	<b>Rating</b>	
Golden Yellow	11.2 a	2.8 a	16.0 a	3.8 a	26.2 a	4.8 a	31.9 a	4.5 a	34.3 a	4.3 a	4.1 a
Yellow with Blotch	8.4 b	2.8 a	11.1 b	2.8 a	19.7 a	4.3 a	26.2 a	4.3 a	27.8 a	3.8 a	3.6 a
Yellow with Red Wing	10.4 a	2.8 a	13.0 ab	3.8 a	23.2 a	4.8 a	29.0 a	4.0 a	30.5 a	3.5 a	3.8 a
Blue with Blotch	10.3 a	2.8 a	13.1 ab	3.0 a	24.3 a	4.8 a	33.0 a	4.0 a	31.4 a	3.8 a	3.7 a

<sup>z</sup>Planted on 10 Oct. 2013.

<sup>y</sup>Data collection weeks after planting (WAP).

<sup>x</sup>Growth index = [(height+width<sub>1</sub>+width<sub>2</sub>)/3](n=4).

<sup>w</sup>Mean subjective rating with 0=dead plant, 1=poorest quality, and 5=exceptional quality (n=4).

<sup>v</sup>Mean subjective rating for all five observation dates (n=5).

<sup>u</sup>Means compared within columns with Tukey's HSD Test (P ≤ 0.05).

<sup>t</sup>Planted on 06 Feb. 2014.



**Table 2.5.** Viola (*Viola cornuta* L.) cultivar performance results from two evaluations at Auburn University's Plant Science Research Center in 2013-2014.

Evaluation 1 <sup>z</sup>	<i>Viola cornuta</i>										
	2 WAP <sup>y</sup>		5 WAP		9 WAP		13 WAP		15 WAP		Rating means <sup>v</sup>
	G.I. (cm)	Rating <sup>w</sup>	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	
Cultivar											
Violet Beacon	17.1 a <sup>u</sup>	3.8 a	20.7 a	4.3 a	23.8 a	5.0 a	23.7 a	3.0 a	23.6 a	2.8 a	3.8 a
Pink Halo	15.6 a	4.0 a	19.0 a	4.0 a	23.1 a	5.0 a	23.5 a	3.0 a	23.4 a	2.5 a	3.7 a
Primrose Blotch	17.5 a	4.0 a	22.1 a	4.5 a	25.0 a	4.8 a	25.5 a	2.8 a	25.5 a	3.0 a	3.8 a
Deep Marina Improved	16.0 a	3.8 a	20.4 a	4.3 a	23.6 a	5.0 a	24.5 a	3.5 a	24.4 a	3.0 a	3.9 a
<b>Evaluation 2<sup>z</sup></b>	<b>2 WAP</b>		<b>6 WAP</b>		<b>9 WAP</b>		<b>11 WAP</b>		<b>13 WAP</b>		<b>Rating means</b>
Cultivar	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	
Violet Beacon	9.1 a	3.5 a	11.6 a	3.5 a	21.8 a	5.0 a	28.7 a	4.0 a	31.3 a	4.0 a	3.9 a
Pink Halo	8.6 a	3.5 a	11.5 a	4.0 a	19.5 a	4.8 a	25.0 a	4.5 a	28.9 a	4.0 a	4.1 a
Primrose Blotch	9.5 a	3.5 a	11.3 a	4.0 a	18.4 a	4.8 a	23.5 a	4.8 a	27.3 a	4.3 a	4.2 a
Deep Marina Improved	8.2 a	3.5 a	11.3 a	4.0 a	20.5 a	5.0 a	27.3 a	4.0 a	25.5 a	3.8 a	4.0 a

<sup>z</sup>Planted on 10 Oct. 2013.

<sup>y</sup>Data collection weeks after planting (WAP).

<sup>x</sup>Growth index = [(height+width<sub>1</sub>+width<sub>2</sub>)/3](n=4).

<sup>w</sup>Mean subjective rating with 0=dead plant, 1=poorest quality, and 5=exceptional quality (n=4).

<sup>v</sup>Mean subjective rating for all five observation dates (n=5).

<sup>u</sup>Means compared within columns with Tukey's HSD Test (P ≤ 0.05).

<sup>t</sup>Planted on 06 Feb. 2014.

**Table 2.6.** Ornamental kale (*Brassica oleracea* L.) cultivar performance results from two evaluations at Dothan Area Botanical Gardens in 2013-2014.

Evaluation 1 <sup>2</sup> Cultivar	1 WAP <sup>y</sup>		4 WAP		10 WAP		12 WAP		Rating means <sup>t</sup>	
	G.I. (cm) <sup>x</sup>	Rating <sup>w</sup>	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating		
Redbor	29.4 a <sup>v</sup>	N/A	33.8 a	N/A	33.8 a	N/A	31.4 a	N/A		
Coral Prince	21.0 b	N/A	20.5 b	N/A	24.6 ab	N/A	23.4 ab	N/A		
Songbird White	18.4 b	N/A	19.7 b	N/A	17.1 b	N/A	15.6 b	N/A		
Kamome Pink	14.0 c	N/A	17.0 b	N/A	15.9 b	N/A	14.5 b	N/A		
Evaluation 2 <sup>u</sup> Cultivar	2 WAP		5 WAP		7 WAP		10 WAP		12 WAP	
	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating
Winterbor	22.5 a	N/A	27.2 a	3.3 a	31.8 a	N/A	36.9 a	3.7 a	38.9 a	3.7 a
Coral Prince	22.2 a	N/A	25.9 a	3.7 a	28.1 a	N/A	30.6 a	3.7 a	32.5 a	3.3 a
Songbird White	20.4 ab	N/A	18.4 a	3.0 a	19.8 a	N/A	21.1 a	3.7 a	21.9 a	2.7 a
Kamome Pink	16.6 b	N/A	20.0 a	3.7 a	21.5 a	N/A	22.4 a	3.3 a	22.8 a	3.0 a

<sup>2</sup>Planted on 17 Oct. 2013.

<sup>y</sup>Observation date weeks after planting (WAP).

<sup>x</sup>Growth Index = [(height+width<sub>1</sub>+width<sub>2</sub>)/3](n=3).

<sup>w</sup>Mean subjective rating with 0=dead plant, 1=poorest quality, and 5=exceptional quality (n=4).

<sup>v</sup>Means compared within columns with Tukey's HSD Test (P ≤ 0.05).

<sup>u</sup>Planted on 14 Feb. 2014.

<sup>t</sup>Mean subjective rating for all five observation dates (n=5).

**Table 2.7.** Pansy (*Viola x witrockiana* Gams.) cultivar performance results from two evaluations at Dothan Area Botanical Gardens in 2013-2014.

Evaluation 1 <sup>z</sup> Cultivar	<i>Viola x witrockiana</i>												
	1 WAP <sup>y</sup>		4 WAP		10 WAP		12 WAP						
	G.I. (cm) <sup>x</sup>	Rating <sup>w</sup>	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	
True Blue Improved	17.0 a <sup>v</sup>	N/A	16.2 a	N/A	15.3 a	N/A	14.3 a	N/A					
Pure Orange	12.0 a	N/A	13.6 a	N/A	13.2 a	N/A	13.3 a	N/A					
Red with Blotch	13.5 a	N/A	13.6 a	N/A	13.8 a	N/A	12.6 a	N/A					
Lemon Yellow	16.6 a	N/A	15.1 a	N/A	14.9 a	N/A	14.3 a	N/A					
Mulberry Shades	15.8 a	N/A	17.3 a	N/A	16.4 a	N/A	16.6 a	N/A					
<b>Evaluation 2<sup>u</sup></b>	<b>2 WAP</b>		<b>5 WAP</b>		<b>7 WAP</b>		<b>10 WAP</b>		<b>12 WAP</b>				
<b>Cultivar</b>	<b>G.I. (cm)</b>	<b>Rating</b>	<b>G.I. (cm)</b>	<b>Rating</b>	<b>G.I. (cm)</b>	<b>Rating</b>	<b>G.I. (cm)</b>	<b>Rating</b>	<b>G.I. (cm)</b>	<b>Rating</b>	<b>G.I. (cm)</b>	<b>Rating</b>	<b>Rating means<sup>t</sup></b>
True Blue Improved	8.0 a	N/A	12.7 a	3.0 a	14.8 a	N/A	18.4 a	4.7 a	19.5 ab	4.0 a			3.9 a
Pure Orange	8.4 a	N/A	12.7 a	3.3 a	14.3 a	N/A	19.4 a	4.7 a	21.4 ab	4.0 a			4.0 a
Red with Blotch	10.0 a	N/A	16.3 a	4.0 a	19.0 a	N/A	24.3 a	4.7 a	25.1 a	4.0 a			4.2 a
Lemon Yellow	9.2 a	N/A	12.9 a	4.0 a	14.2 a	N/A	17.6 a	4.0 a	18.0 b	3.0 a			3.7 a
Mulberry Shades	10.0 a	N/A	15.6 a	4.0 a	18.1 a	N/A	23.6 a	4.7 a	24.3 ab	4.0 a			4.2 a

<sup>z</sup>Planted on 17 Oct. 2013.

<sup>y</sup>Observation date weeks after planting (WAP).

<sup>x</sup>Growth index = [(height+width<sub>1</sub>+width<sub>2</sub>)/3](n=3).

<sup>w</sup>Mean subjective rating with 0=dead plant, 1=poorest quality, and 5=exceptional quality (n=4).

<sup>v</sup>Means compared within columns with Tukey's HSD Test (P ≤ 0.05).

<sup>u</sup>Planted on 14 Feb. 2014.

<sup>t</sup>Mean subjective rating for all five observation dates (n=5).

**Table 2.8.** Dwarf snapdragons (*Majus antirrhinum* L.) cultivar performance results from two evaluations at Dothan Area Botanical Gardens in 2013-2014.

Evaluation 1 <sup>z</sup> Cultivar	1 WAP <sup>y</sup>		4 WAP		10 WAP		12 WAP		Rating means <sup>t</sup>
	G.I. (cm) <sup>x</sup>	Rating <sup>w</sup>	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	
Sunset	15.4 a <sup>v</sup>	N/A	16.4 a	N/A	18.2 a	N/A	18.7 a	N/A	4.2 a
Plumblossom	15.6 a	N/A	16.8 a	N/A	20.0 a	N/A	20.8 a	N/A	4.0 a
Burgundy Bicolor	12.8 a	N/A	16.1 a	N/A	17.1 a	N/A	16.8 a	N/A	4.1 a
Rose Bicolor	14.6 a	N/A	15.6 a	N/A	17.4 a	N/A	16.9 a	N/A	4.0 a

Evaluation 2 <sup>z</sup> Cultivar	2 WAP		5 WAP		7 WAP		10 WAP		12 WAP		Rating means <sup>t</sup>
	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	
Sunset	11.3 a	N/A	16.4 a	4.0 a	19.7 a	N/A	25.3 a	4.0 a	30.0 a	4.7 a	4.2 a
Plumblossom	10.6 ab	N/A	16.6 a	4.0 a	19.9 a	N/A	25.5 a	3.7 a	30.8 a	4.7 a	4.0 a
Burgundy Bicolor	9.3 b	N/A	13.0 b	3.7 a	14.6 a	N/A	20.1 a	4.0 a	23.5 a	4.3 a	4.1 a
Rose Bicolor	9.0 b	N/A	16.0 ab	3.7 a	18.2 a	N/A	24.4 a	4.0 a	26.7 a	4.3 a	4.0 a

<sup>z</sup>Planted on 17 Oct. 2013.

<sup>y</sup>Observation date weeks after planting (WAP).

<sup>x</sup>Growth index = [(height+width<sub>1</sub>+width<sub>2</sub>)/3](n=3).

<sup>w</sup>Mean subjective rating with 0=dead plant, 1=poorest quality, and 5=exceptional quality (n=4).

<sup>v</sup>Means compared within columns with Tukey's HSD Test (P ≤ 0.05).

<sup>u</sup>Planted on 14 Feb. 2014.

<sup>t</sup>Mean subjective rating for all five observation dates (n=5).

**Table 2.9.** Trailing pansy (*Viola x witrockiana* Gams.) cultivar performance results from two evaluations at Dothan Area Botanical Gardens in 2013-2014.

		<i>Viola X witrockiana</i>															
Evaluation 1 <sup>z</sup>	Cultivar	1 WAP <sup>y</sup>			4 WAP			10 WAP			12 WAP						
		G.I. (cm)	Rating <sup>w</sup>	Rating <sup>w</sup>	G.I. (cm)	Rating	Rating	G.I. (cm)	Rating	Rating	G.I. (cm)	Rating	Rating				
Evaluation 1 <sup>z</sup>	Golden Yellow	16.2 a <sup>x</sup>	N/A	N/A	14.4 a	N/A	N/A	13.9 b	N/A	N/A	13.9 b	N/A	N/A				
	Yellow with Blotch	14.6 a	N/A	N/A	17.5 a	N/A	N/A	19.6 a	N/A	N/A	19.1 a	N/A	N/A				
	Yellow with Red Wing	13.1 a	N/A	N/A	14.7 a	N/A	N/A	12.6 b	N/A	N/A	14.4 b	N/A	N/A				
	Blue with Blotch	17.6 a	N/A	N/A	20.0 a	N/A	N/A	19.8 a	N/A	N/A	17.2 ab	N/A	N/A				
Evaluation 2 <sup>z</sup>		2 WAP			5 WAP			7 WAP			10 WAP			12 WAP			
Cultivar		G.I. (cm)	Rating	Rating	G.I. (cm)	Rating	Rating	G.I. (cm)	Rating	Rating	G.I. (cm)	Rating	Rating	G.I. (cm)	Rating	Rating	Rating means <sup>t</sup>
Golden Yellow		13.0 a	N/A	N/A	22.6 a	5.0 a	5.0 a	28.6 a	N/A	N/A	36.3 a	5.0 a	5.0 a	37.2 a	4.7 a	4.7 a	4.9 a
Yellow with Blotch		9.0 b	N/A	N/A	13.5 b	3.3 b	3.3 b	16.0 b	N/A	N/A	21.3 a	4.3 a	4.3 a	24.4 b	3.7 a	3.7 a	3.8 b
Yellow with Red Wing		10.6 ab	N/A	N/A	17.3 b	5.0 a	5.0 a	21.2 b	N/A	N/A	30.7 a	5.0 a	5.0 a	34.2 ab	4.7 a	4.7 a	4.9 a
Blue with Blotch		10.5 ab	N/A	N/A	17.0 b	4.0 b	4.0 b	21.6 ab	N/A	N/A	32.7 a	4.7 a	4.7 a	35.7 a	4.7 a	4.7 a	4.4 a

<sup>z</sup>Planted on 17 Oct. 2013.

<sup>y</sup>Observation date weeks after planting (WAP).

<sup>x</sup>Growth index = [(height+width<sub>1</sub>+width<sub>2</sub>)/3](n=3).

<sup>w</sup>Mean subjective rating with 0=dead plant, 1=poorest quality, and 5=exceptional quality (n=4).

<sup>v</sup>Means compared within columns with Tukey's HSD Test (P ≤ 0.05).

<sup>u</sup>Planted on 14 Feb. 2014.

<sup>t</sup>Mean subjective rating for all five observation dates (n=5).

**Table 2.10.** *Viola cornuta* L.) cultivar performance results from two evaluations at Dothan Area Botanical Gardens in 2013-2014.

Evaluation 1 <sup>z</sup> Cultivar	1 WAP <sup>y</sup>		4 WAP		10 WAP		12 WAP		Rating means <sup>t</sup>	
	G.I. (cm)	Rating <sup>w</sup>	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating		
Violet Beacon	18.7 a <sup>v</sup>	N/A	18.9 a	N/A	18.5 a	N/A	17.2 a	N/A	4.9 a	
Pink Halo	15.2 a	N/A	15.5 a	N/A	13.9 b	N/A	14.3 a	N/A	4.7 a	
Primrose Blotch	18.8 a	N/A	20.4 a	N/A	17.7 a	N/A	17.8 a	N/A	4.7 a	
Deep Marina Improved	15.7 a	N/A	17.5 a	N/A	16.4 ab	N/A	16.0 a	N/A	4.9 a	
Evaluation 2 <sup>u</sup> Cultivar	2 WAP		5 WAP		7 WAP		10 WAP		12 WAP	
	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating	G.I. (cm)	Rating
Violet Beacon	9.8 a	N/A	17.2 a	4.7 a	22.3 a	N/A	32.0 a	5.0 a	33.0 a	5.0 a
Pink Halo	9.1 a	N/A	15.6 a	4.7 a	18.7 ab	N/A	25.4 ab	4.7 a	28.0 a	4.7 a
Primrose Blotch	9.6 a	N/A	15.6 a	4.3 a	18.3 b	N/A	24.4 b	5.0 a	26.0 a	4.7 a
Deep Marina Improved	8.9 a	N/A	15.2 a	4.7 a	18.4 ab	N/A	25.0 ab	5.0 a	26.4 a	5.0 a

<sup>z</sup>Planted on 17 Oct. 2013.

<sup>y</sup>Observation date weeks after planting (WAP).

<sup>x</sup>Growth index = [(height+width<sub>1</sub>+width<sub>2</sub>)/3](n=3).

<sup>w</sup>Mean subjective rating with 0=dead plant, 1=poorest quality, and 5=exceptional quality (n=4).

<sup>v</sup>Means compared within columns with Tukey's HSD Test (P ≤ 0.05).

<sup>u</sup>Planted on 14 Feb. 2014.

<sup>t</sup>Mean subjective rating for all five observation dates (n=5).

**CHAPTER III**  
**PUBLIC PERCEPTIONS OF COOL SEASON ANNUAL ORNAMENTAL**  
**COMBINATION PLANTERS IN ALABAMA PUBLIC GARDENS**

**Abstract**

This study focused on public perceptions of color combinations of cool season annual ornamentals among different groups of garden guests that visited three public gardens in Alabama. A survey was developed to gather this information from Master Gardeners, university staff and faculty, students, horticulture professionals, and general public garden guests. The survey yielded 74 responses from the three locations: Dothan Area Botanical Gardens in Dothan, Alabama, the Auburn University Plant Science Research Center in Auburn, Alabama, and Huntsville Botanical Garden in Huntsville, Alabama. Sixteen different combination planters were displayed at each of the three public gardens. Identical versions of either paper or web-accessed mobile surveys were offered to participants from April to May, 2014 at each location. The majority of the respondents chose the paper version (83.8%) and were women (64.8%).

Based on a 9-point Likert scale, the three highest mean rating combinations across all the locations were Planter #5 (7.66) containing Nature® ‘Lemon Yellow’ pansy, Penny® ‘Deep Marina Improved’ viola, and ‘Songbird White’ ornamental kale; Planter #13 (7.28) containing Nature® ‘Mulberry Shades’ pansy, Nature® ‘Lemon Yellow’ pansy, and

'Winterbor' or 'Redbor' ornamental kale; and Planter #9 (7.21) containing Nature® 'Mulberry Shades' pansy, Wonderfall® 'Blue with Blotch' trailing pansy, and 'Kamome Pink' ornamental kale, respectively. When asked about purchasing plants seen in this survey experience over those advertised in magazines or catalogs, 33.3% of respondents indicated being "somewhat likely" and 37.5% indicated being "likely" to do so.

## **Introduction**

The Green Industry is composed of several business types that include ornamental plant breeders, greenhouse and nursery production facilities, and landscape installation and management firms. Over the past half-century, nursery crop producers have represented a growing segment of the Green Industry in the United States (Markus et al., 1992). Reflecting the increases of the nursery production field, landscape installation and management firms have become significant contributors to the Green Industry (Florkowski et al., 1994). The introduction of new, specialized plant material supports the growth of these nursery and landscape industries (Dunwell et al., 2001). It has been widely understood that a strong association exists between nurserymen and landscapers with both influencing the other (Garber et al., 1995). Although nursery and landscape professionals influence each other, consumers' preferences drive both groups by influencing which plants nurserymen grow and which plants landscape professionals chose for their clients (Phillips et al., 2007).

In horticultural marketing, it has been proven that product characteristics represent a dynamic part of consumers' purchasing decisions (Manalo, 1990). When desired plant characteristics are determined, nursery and landscape professionals can target specific



plant selections to satisfy consumer needs and demands (Phillips et al., 2007). Since consumer demand drives the industry, nursery and greenhouse professionals need to supply the marketplace with sufficient product types and quantities.

Previous research in horticultural marketing has shown which specific plant characteristics are important to consumers in a variety of groups and markets. For example, characteristics influencing consumer purchase decisions may include flower color, foliage color, number of unopened buds, and plant size (Swindle, 2013). Consumer preferences for various aspects of individual geraniums, edible flowers, and bell peppers have been established (Behe et al., 1999; Frank et al., 2001; Kelley et al. 2001). It has been documented that pricing, container size, and seasonal trends in plant sales, may also influence consumer demand of annual bedding plants (Phillips et al., 2007). Studies have also concluded the relative importance of providing lowest prices and extensive care information of container gardens (Mason et al., 2008). However, studies involving plant color combination or color harmony in container gardens have been nearly nonexistent.

As the result of a growing container gardening market, wholesale growers and retailers in the Green Industry are growing and offering ready-made annual combination jumbo plugs and containers for consumer purchase (Miller, 2001). These pre-planted products are designed to make hanging basket and container garden creations easier for the consumer. This marketing strategy is meant to make choosing favorable color combinations the only choices consumers need to make when selecting plants for container gardens. Studies conducted in Pennsylvania by Wehry et al. (2007), explored the marketing effects of colored containers, plant labels, and point of purchase material on consumers. Conclusions expressed a need for deviation from traditional product packaging norms

when offering promotional plant products in retail stores. Brightly colored pots and uniquely shaped plant labels with pictures were shown to exhibit the highest positive responses from survey participants.

Color harmony with respect to color combination has long been thought of as “two or more colours seen in neighboring areas which produce a pleasing effect” (Judd and Wyssecki, 1975). A study conducted by Chuang and Ou (2001), demonstrated participants’ favorability and description of contrasting, or complementary, colors as “harmonious.” It is widely accepted in the world of color theory that complementary and analogous color combinations are generally favored over monochromatic combinations. These colors are found on opposing sides of the color wheel, which is also divided into warm and cool colors (Color Calculator, 2015). Color temperature has been found to play an important role in affecting one’s mood. Studies have also shown that in North America, cool colors are typically more connected to feelings of pleasure than warm colors and warm colors are more connected to feelings of arousal than cool colors (Babin et al., 2003; Hyodo, 2011).

One study by Mason et al. (2008) focused strictly on container combination harmony among complementary, monochromatic, or analogous color mixtures. Three combinations of 12 total plant selections were used to survey participants on favorability of color harmony. Color harmony was shown to be only 6.4% of relative importance of consumer preference when purchasing container gardens compared to price at 70.7% and care information at 22.9%. Since no clashing colors were used in this study, limitations in this study were stated to be a lack of a perceivable range in color combinations that participants could identify. With the exception of this study, a lack of published research relative to consumer color combination preferences exists in the industry. By identifying

and addressing consumer perceptions for color combinations, wholesalers and retailers could possibly strengthen sales in portions of the market by providing pre-planted or ready-made annual combination packs for hanging baskets or container gardens that might appeal to a larger quantity of consumers.

Middle to upper-class homeowners have been the primary target markets for Green Industry products and services (Behe, 2006). However, as competition increases and industry growth slowed due to the economic instability in recent years, an investigation of renters as a potentially ignored or underserved market has been justified. As this market has grown, so too have container garden product sales due to general affordability, mobility, and limitations in available landscape space (Mason et al., 2008). However, a limited amount of research centered on consumers' perceptions of cool-season annual combinations associated with container gardening prompted the need for this research. This study was designed to reveal trends in consumers' and non-consumers' perceptions of plant color combinations and the favorability of 21 selections of cool-season annual ornamental species at three Alabama public gardens.

## **Materials and Methods**

The round planters used in this study were fabricated from a lightweight polymer resin material designed to resemble grey concrete or stucco. Planters measured 25 in in height, 31½ in in top diameter, and tapered to a base diameter of 17 ¾ in. Inside top diameter of the planting basin measured 25 ½ in. Planting took place on site at each of three public garden locations: Dothan Area Botanical Gardens (DABG) in Dothan, Alabama, the Auburn University Plant Science Research Center (AUPSRC) in Auburn, Alabama, and

Huntsville Botanical Garden (HSVBG) in Huntsville, Alabama. Planting at DABG was completed on October 17, 2013 by a collaborative effort from Auburn University (AU) graduate students from the Department of Horticulture and volunteers from the Wiregrass Master Gardener Association. Planting at the AUPSRC and HSVBG was completed on October 21 and 31, 2013, respectively, by AU horticulture graduate students.

As preparation, planters were filled to a depth of 12 in with crushed nursery cell packs to create a drainage void at the bottom of each planter. This was also done to decrease overall weight and conserve potting mix. Landscape fabric was cut to fit and placed on top of the crushed cell pack layer as a barrier between potting mix and drainage void. Jolly Gardener Pro-Line Custom Growing Mix (Jolly Gardener Products, Inc., GA), consisting of sphagnum peat, perlite, and pine bark fines, was used for all containers across the three locations. Planters were filled with 5.6 ft<sup>3</sup> of potting mix and watered thoroughly to allow natural settling to take place.

The 16 planter combinations were designed by combining three different cultivar selections for each planter (Table 3.1). Design criteria required each planter to contain at least one ornamental kale (*Brassica oleracea* L.) or dwarf snapdragon (*Antirrhinum majus* L.) selection. Pansy (*Viola x wittrockiana* Gams.) and viola (*Viola cornuta* L.) selections were used similarly in the planters due to their same general growth habitat, and each container received two of these *Viola* selections. All dwarf snapdragon, pansy, and viola selections were planted in groups of three to allow plants to fill out the planter over time. Due to the comparatively larger size of ornamental kale, one plant was used in the planters that featured these selections.

Ornamental kale cultivar selections 'Redbor,' and 'Winterbor' were used interchangeably in the study due to limited seed availability of 'Redbor.' 'Coral Prince,' 'Songbird White,' and 'Kamome Pink' were the other ornamental kale selections used. Dwarf snapdragon cultivar selections chosen from the Snapshot® Series were 'Sunset' and 'Plumblossom' (Ball Seed Co., 2014). Dwarf snapdragon selections chosen from the Montego® Series were 'Burgundy Bi-color' and 'Rose Bi-color.' Pansy cultivar selections were 'True Blue Improved,' 'Pure Orange,' and 'Red with Blotch' chosen from the Delta® series. 'Lemon Yellow' and 'Mulberry Shades' were selections chosen from the Nature® Series. Viola cultivars were 'Violet Beacon XP' and 'Pink Halo XP' of the Sorbet® Series and 'Deep Marina Improved' and 'Primrose Blotch' of the Penny® Series. New trailing pansy selections included the Wonderfall® Series 'Blue with Blotch,' 'Yellow with Blotch,' and 'Yellow with Red Wing'. 'Golden Yellow' came from the Cool Wave® Series (Ball Seed Co., 2014). Each of these 21 selections were planted two or three times throughout the 16 combinations.

Identical combinations were repeated between DABG, AUPSRC, and HSVBG. Planters were designed with the taller species of ornamental kale or dwarf snapdragons placed in the middle or back of planters and shorter species of pansies or violas placed around or in front of taller species, respectively. All pansy and dwarf snapdragon selections were planted to a depth of 4 in with ornamental kale being planted to a depth of 6 in to provide additional upright support. Planters were mulched with pine bark mini-nuggets to a depth of 1 in upon completion of planting and hand watered once more to encourage potting mix cohesion.

Potting mix contained no starter fertilizer charge. Total Gro Pansy Special (15:2:20; SDT Industries, Inc., Winnsboro, LA, USA) liquid fertilizer was applied at initial planting and every two weeks thereafter at a rate of 150 ppm N. This fertilization method continued throughout the fall and winter months from October, 2013 through February, 2014 for all three locations. Beginning in late February, 2014, liquid fertilization was discontinued and 4 oz of Osmocote (19:6:12; Everris International B.V., Geldermalsen, Netherlands) 3-4 month controlled release fertilizer was applied as a topdress to each container.

Planters were randomly designated consecutive numbers and placed in full sun within the grounds at AUPSRC and DABG in October, 2013. At HSVBG planters were placed on a nursery pad in full sun conditions adjoining the garden's greenhouse complex. Plant labels were designed for each plant selection used in each combination and placed in front of the given selection. Plant labels included the scientific name of each selection, including cultivar and series names, and names of the seed development companies. Larger combination labels identified the three plants used in each combination, the coinciding public garden logo, the AU Department of Horticulture logo, and the planter combination number. These labels were essential in guiding survey participants through the survey experience.

At DABG, the 16 planters were arranged to line the east entrance of the garden with approximately 25 ft between planters. At AUPSRC, planters were spaced on approximately 20 ft increments along the front sidewalk leading into the facility. At HSVBG, planters were grown and maintained on a nursery pad to monitor plant development through the winter months. Due to an extreme freeze event on 7 January 2014 when temperatures in Huntsville, Alabama dropped to 4°F (-15.6°C) most selections died. Upon request of HSVBG

administrators, planters were replanted when threat of extreme freeze had ended and were transferred into the garden grounds on 17 April 2014. When on site, the planters were placed in a semi-circular arrangement in a full sun location near the HSVBG's "Woodland Walk."

Throughout the growing season and duration of the surveys, planters were maintained by horticulture graduate students, the DABG and HSVBG staffs, Wiregrass Master Gardener volunteers and North Alabama Master Gardener volunteers. Maintenance duties included monitoring soil moisture, watering, weeding, removing debris, fertilizing, monitoring and controlling pests, and dead-heading when needed.

**Planter Combination Surveys.** Surveys were administered continuously from 1 April 2014 through 1 May 2014 at the AUPSRC and DABG locations. At HSVBG, surveys were administered a little later, from 18 April 2014 through 12 May 2014, due to delayed maturation of plants. Information boards were built to serve as survey stations and displayed near the planters at each public garden location for the purpose of recruiting survey participants, providing necessary survey materials, and identifying the purpose of the study to garden guests and participants. A flyer explaining the study and the study title were prominently displayed on each station's information board. A letter from the AU Institutional Review Board stating the approval of the study was also displayed. Paper surveys were supplied in a weatherproof box attached to the station along with clipboards and writing pens. A clearly labeled second box was provided on the opposite side of the station for completed paper surveys. Similar to other studies evaluating technology usage among horticultural consumers, an online version of the survey could be accessed by participants who wished to utilize a smartphone or other mobile device for the survey

(Behe et al., 2013). This was accomplished by providing both a QR code and a short URL link on the survey station's information board.

Surveys were composed of three sections. The first section collected general demographic information from participants such as age, gender, gardening experience level, gardening activities, and group affiliation (i.e. Master Gardener, student, horticulture professional, etc.). The second section was designed to collect participants' perceptions and preferences about each of the 16 combination planters. The same three questions were asked for each combination the participants viewed. In the first two questions, participants were asked to rate color combination and overall plant quality based on a nine point Likert type scale. The scale ranged from 1 to 9 with a score of 1 corresponding to "Dislike Extremely," a mid-range score of 5 corresponding to "Neither Like nor Dislike," and a score of 9 corresponding to "Like Extremely." Other choices included within this range were ascending or descending on the scale depending on the participants' varying degree of like or dislike for the particular combination. The third question asked participants to identify their favorite individual selection from the three plants within the combination.

The final section of the survey contained follow-up questions designed to evaluate the impact of the survey experience on participants. Participants were asked to rate how helpful they felt the experience was in expanding their appreciation for container gardening, how likely they were to purchase plants seen in the survey experience over those advertised in magazines or catalogs, and how likely they were to participate in container gardening in the future. Ratings were based on a 7-point Likert type scale ranging from 1, "Very Unlikely," to 7, "Very Likely." The survey concluded with a question



asking how many of the selections were new to the participant with the options “none,” “a few,” “half and half,” “several,” and “all” being offered.

All paper surveys were collected from stations on a daily basis by the principle investigator and a designated Master Gardener volunteer at the DABG and HSVBG sites. Completed surveys were held until the survey was closed. Online surveys were constructed and collected with qualtrics.com in partnership with Auburn University (Qualtrics.com, 2013). All survey results were coded and entered into a SPSS 21 database. Data were labeled and given values for frequencies and descriptive calculations with SPSS 21 (SPSS, 2013).

## **Results**

Over the one month of availability, the survey collected 74 responses across the three public garden locations. Most surveys were collected at AUPSRC (40.5%) followed by HSVBG (33.8%) and DABG (25.7%). The paper version of the survey was utilized by 83.8% of participants while only 16.2% participated in the online version. Of the surveyed participants, 64.8% were women, 32.4% were men, and 2.7% did not identify themselves as either. The age of most survey participants was 19 to 29 years old (35.1%), while the remainder of the participants reported ages as follows: 30-39 (9.5%), 40-49 (6.8%), 50-59 (13.5%), 60-69 (17.6%), 70-79 (8.1%), and non-response (9.5%). When asked about participants' involvement in home gardening, 85.1% indicated that they were involved while 10.8% were not, and 4.1% did not respond. Of the participants who indicated that they did take part in home gardening (n=62), 24.2% identified themselves as beginners, 43.5% as intermediate, and 32.3% as advanced. Participants practicing container

gardening equaled 61.1% while 38.9% did not. Participants were also asked about their affiliation with various organizations with the “Non-affiliated” and “Students” making up the largest groups at 31.4% each. Others ranked as follows: Master Gardeners 20.0%, University Faculty/Staff 11.4%, and Horticulture Industry Professionals 5.7%.

Color combination responses were totaled across all locations’ surveys, and mean ratings for each of the 16 planter combinations were determined (Table 3.1). The top three combinations were Planter #5 (7.66), Planter #13 (7.28), and Planter #9 (7.21) – all containing mixtures of both warm and cool complimentary colors. The last three ranked combinations, from 14<sup>th</sup> to 16<sup>th</sup>, were Planter #3 (6.07), Planter #10 (6.01), and Planter #2 (5.96) – containing more warm or cool monochromatic and analogous colors. The top rated combination, Planter #5, was made up of Nature® ‘Lemon Yellow’ pansy, Penny® ‘Deep Marina Improved’ viola, and ‘Songbird White’ ornamental kale. Planter #13 was Nature® ‘Mulberry Shades’ pansy, Nature® ‘Lemon Yellow’ pansy, and ‘Winterbor’/‘Redbor’ ornamental kale. Planter #9 was Nature® ‘Mulberry Shades’ pansy, Wonderfall® ‘Blue with Blotch’ trailing pansy, and ‘Kamome Pink’ ornamental kale. The lowest rated combination, Planter #2, was made up of Sorbet® ‘Pink Halo’ viola, Montego® ‘Rose Bicolor’ dwarf snapdragon, and ‘Kamome Pink’ ornamental kale. Planter #10 was made up of Cool Wave® ‘Golden Yellow’ trailing pansy, Snapshot® ‘Sunset’ dwarf snapdragon, and ‘Songbird White’ ornamental kale. Planter #3 was made up of Wonderfall® ‘Yellow with Blotch’ trailing pansy, Montego® ‘Burgundy Bicolor’ dwarf snapdragon, and ‘Redbor’/‘Winterbor’ ornamental kale.

Trends were analyzed between groups across the three public garden locations for indications that participants of a certain organizational affiliation might reflect the same

outcomes in ranking as the entire sample (Figure 3.1 & Figure 3.2). Respondents identifying themselves as “Intermediate” gardeners (N=27) more closely reflected the mean ratings of all participants as a whole. Although slightly different in order, the top three combination planters remained the same for this group: Planter #5 (7.44), Planter #13 (7.48), and Planter #9 (7.29). The three lowest ranked planter combinations among “Intermediate” gardeners exhibited similar trends with only Planter #8 (6.26) ranking slightly lower than Planter #2 (6.29). Planter #10 (6.00) and Planter #3 (6.22) ranked lowest among combinations for this group. Students and garden guests with no organizational affiliations accounted for 66.7% of these “Intermediate” gardening level participants.

Differences in color combination mean ratings of Planter #5, the highest rated combination, occurred between participants at DABG (8.47) and those that observed the planter at AUPSRC (7.67) and HSVBG (7.08) (Figures 3.3 & Figure 3.4). Mean ratings among all combination planters at HSVBG and AUPSRC appeared to be lower more often than ratings at DABG. Differences were few among participating organizational groups within HSVBG, PSRC, and DABG in rating means indicating that no organization at a specific location was more critical of combinations than another (data not shown).

Although twice as many women participated in the survey than men, there were no differences among how men and women perceived the top three-rated color combinations. No differences occurred in this category between participants with respect to age, gardening experience level, or whether or not they practice container gardening (data not shown).

When asked which plant selection was the favorite from each container, individual

plant selections receiving more than 50.0% of first place votes within each given combination occurred several times. Because three selections were included within each combination planter, 50.0% or higher was the level chosen that would reflect the majority of one selection's favorability among any given combination. 'Violet Beacon' (52.7%), 'Deep Marina Improved' (65.7%), 'Yellow with Red Wing' (52.1%), 'Mulberry Shades' (57.7%), and 'Blue with Blotch' (60.0%) were selections that received majority votes as favorites among at least one planter. These selections were mixtures of both warm and cool colors indicating that not one color temperature is more favorable than another. This could be further evidence to help support plant suppliers' choices in offering diverse mixtures of cool and warm colored plant selections to facilitate greater consumer satisfaction.

When asked whether the combination surveying experience helped expand personal knowledge of container gardening, 38.9% of participants indicated "Moderately" and 37.5% indicated "Very Much." The survey experience proved to expand personal knowledge of container gardening for participants at DABG (3.94) more than those at HSVBG (3.12) or AUPSRC (3.13). Mean comparisons showed DABG participants in this category selected "Very Much" while AUPSRC and HSVBG participants' personal knowledge of container gardening was more "moderately" expanded by the survey experience. Differences in this category did not occur among participants with respect to age, gender, gardening experience level, organizational affiliation, or whether or not they practice container gardening (data not shown).

When participants were asked how likely they were to purchase plants seen in this survey over those advertised in magazines or catalogs, 33.3% of participants were

“somewhat likely” and 37.5% were “likely” to do so. No differences in mean ratings within this category occurred with respect to location, gender, age, gardening experience level, organizational affiliation, or whether or not they practice container gardening (data not shown).

When participants were asked how likely they were to participate in container gardening in the future, women answered “Likely” more often than men who answered “Somewhat Likely.” Those participants who identified themselves as container gardeners were shown to be “Likely” to continue practicing container gardening, while those who did not identify themselves as container gardeners were “Somewhat Likely” to practice container gardening in the future. No other differences occurred within this category with respect to location, age, gardening experience level, or organizational affiliation (data not shown).

When asked if the survey experience introduced participants to plants they had not seen before, DABG participants reported “Half and half” while participants at HSVBG reported only “A few” being new. No differences occurred in this category among gender, age, gardening experience level, organizational affiliation, or whether or not they practice container gardening. Overall, participants among all locations reported “Half and half” of the plants featured in the survey were selections they had never seen before (data not shown).

## **Discussion**

Although sample size was low (N=74), observational trends from this study could prove useful for the continuation of container combination studies in the future. Former

work by Mason et al. (2008) stating consumers' preference for complementary color harmonies over monochromatic were verified by color combination ratings from this study. The top three rated combinations exhibited complementary characteristics - a combination of warm and cool colors - while the last two ranked combinations were monochromatic, a combination of warm and neutral or cool and neutral colors. Additionally, three out of the top five ranked color combinations included a combination of warm, cool and neutral colors all with mean ratings of 7 or higher.

Favorite plants from this study could also be used in conjunction with plant performance evaluation data to assist in identifying selections for statewide promotions. For example, individual plant selections receiving majority first place votes within each given combination, 'Violet Beacon' (52.7%), 'Deep Marina Improved' (65.7%), 'Yellow with Red Wing' (52.1%), 'Mulberry Shades' (57.7%), and 'Blue with Blotch' (60.0%), were some of the same selections receiving high ratings in the plant performance evaluations conducted during the same growing season.

The greatest differences among ratings appeared to occur more often between DABG and HSVBG survey locations. Factors contributing to these differences could be attributed to variation in plant growth stages from one location to the next. Plant development at HSVBG, the northern survey location, was delayed which seemed to cause lower overall plant display characteristics. This decrease in display characteristics compared to DABG could be the cause for lower overall color combination ratings in Huntsville, AL.

Similar to the differences in color combination ratings, the survey experience was shown to expand personal knowledge of container gardening to more respondents from

DABG than those at AUPSRC or HSVBG. Along a similar theme, more plants used in this survey experience were new to DABG respondents than other respondents. Both of these facts could be related to the limited number of other combination plant displays or educational opportunities available at DABG than compared to those offered at AUPSRC or HSVBG. Other demographic factors could be involved than were not explored in this study that might include overall educational background or yearly income of participants. Future surveys within Alabama public gardens on color combinations should explore population demographics of participants even more thoroughly to understand differences among respondents from one public garden to another.

Because women made up the majority of the sample and were shown to be more likely to participate in container gardening more frequently than men, it could be beneficial to the Alabama consumer market for future studies to target women for participation in container gardening surveys. Advertising to and compensating women among local garden clubs and Master Gardener groups could be a beneficial strategy in encouraging participation. Positive responses to the surveying experience and plant purchasing follow-up questions, indicate a great interest within consumer markets for the continuation of plant evaluations and combination studies to be conducted within Alabama public gardens. Overall, this work indicates continued backing for Alabama statewide plant evaluations with the additional element of plant combination surveys.

## Literature Cited

- Babin, B.J., D.M. Hardesty, and T.A. Suter. 2003. Color and shopping intentions: The intervening effect of price fairness and perceived affect. *J. of Business Res.* 56: 541-551.
- Behe, B., R. Nelson, S. Barton, C. Hall, C.D. Safley, and S. Turner. 1999. Consumer preferences for geranium flower color, leaf variegation, and price. *HortScience* 34:740-742.
- Behe, B.K. 2006. Comparison of gardening activities and purchases of homeowners and renters. *J. Environ. Hort.* 24:217-220.
- Behe, B.K., B.L. Campbell, C.R. Hall, H. Khachatryan, J.H. Dennis, and C. Yue. 2013. Smartphone use and online search and purchase behavior of North Americans: Gardening and non-gardening information and products. *HortScience* 48:209-215.
- Chuang, M. and L.C. Ou. 2001. Influence of a holistic color interval on color harmony. *Color Res. and Application* 26:29-39.
- Color Calculator. 2015. Sessions College for Professional Design. 8 April 2015. <<http://www.sessions.edu/color-calculator>>
- Dunwell, W.C., D. Fare, M.A. Arnold, K. Tilt, G. Knox, W. Witte, P. Knight, M. Pooler, W. Klingeman, A. Niemiera, J. Ruter, T. Yeager, T. Ranney, R. Beeson, J. Lindstrom, E. Bush, A. Owings, and M. Schnelle. 2001. Plant evaluation program for nursery crops and landscape systems by the Southern Extension and Research Activities/Information Exchange Group-27. *HortTechnology* 11:373-375.
- Florkowski, W.J., E.E. Hubbard, and G.L. Wade. 1994. Factors influencing the supply of four landscape services. *J. Environ. Hort.* 12:39-42.
- Frank, C.A., R.G. Nelson, E.H. Simonne, B.K. Behe, and A.H. Simonne. 2001. Consumer preferences for color, price, and vitamin C content of bell peppers. *HortScience* 36:795-800.
- Garber, M., K. Bondari, and G. Wade. 1995. Educational and marketing programs serving the landscape industry. *HortTechnology* 5:72-77.
- Hyodo, J. 2011. Can colors make me happy? The effect of color on mood; a meta-analysis. *Advances in Consumer Res.* 39:858-867
- Kelley, K.M., B.K. Behe, J.A. Biernbaum, and K.L. Poff. 2001. Consumer preference for edible-flower color, container size, and price. *HortScience* 36:801-804.
- Judd, D.B., and G. Wyszecki. 1975. *Color in business, science and industry*. 3rd ed. John Wiley & Sons Press, New York, N.Y.



- Manalo, A.B. 1990. Assessing the importance of apple attributes: An agricultural application of conjoint analysis. *North-eastern J. Agr. Resource Economics* 19:118-124.
- Markus, L.D., J.C. Foltz, J.F. Guenther, and R.R. Tripepi. 1992. Product and service attributes related to marketing nursery stock. *HortTechnology* 2:483-488.
- Mason, S.C., T.W. Starman, R.D. Lineberger, and B.K. Behe. 2008. Consumer preferences for price, color harmony, and care information of container gardens. *HortScience* 43:380-384.
- Miller, C. 2001. Surveys reveal container gardening popularity. National Gardening Association, South Burlington, VT. 13 July 2014.  
<<http://www.greenbeam.com/features/tour021901a.stm>>.
- Phillips, J., E.J. Holcomb, and K. Kelley. 2007. Determining interest in value-added planters: Consumer preference and current grower and retailer perceptions. *HortTechnology* 17:238-246.
- Qualtrics. 2013. Provo, Utah. <<http://www.qualtrics.com>>
- SPSS Inc. 2013. Statistical Package for the Social Sciences. Chicago, Illinois.
- Swindle, C.W. 2013. The Development of a Statewide Trial, Evaluation, and Promotion Program: Trialing summer annuals. Auburn Univ., Auburn, MS Thesis.
- Wehry, R.H., K.M. Kelley, R.D. Berghage, and J.C. Sellmer. 2007. Capturing consumer preferences and interests in developing a state plant promotional program. *HortScience* 42:574-580.

**Table 3.1.** Color combination rating survey results of 16 planters displayed at three Alabama public gardens from April to May 2014 at Dothan Area Botanical Gardens in Dothan, AL, Auburn University's Plant Science Research Center in Auburn, AL, and Huntsville Botanical Garden in Huntsville, AL.

<u>Planter #</u>	<u>Selection</u>	<u>Species<sup>z</sup></u>	<u>Color</u>	<u>Temp.<sup>y</sup></u>	<u>Mean Rating</u>
1	Cool Wave 'Golden Yellow'	TP	Yellow	W	7.10
	Sorbet XP 'Violet Beacon'	V	Lavender	C	
	'Songbird White'	OK	White	N	
2	Sorbet XP 'Pink Halo'	V	Light Pink	C	5.96 <sup>x</sup>
	'Kamome Pink'	OK	Pink	C	
	Montego 'Rose Bicolor'	DS	Bright Pink	C	
3	Wonderfall 'Yellow with Blotch'	TP	Yellow	W	6.07
	'Redbor' / 'Winterbor'	OK	Purple/Green	C	
	Montego 'Burgundy Bicolor'	DS	Deep Red	W	
4	Delta 'True Blue Improved'	P	Light Blue	C	6.30
	Delta 'Red with Blotch'	P	Deep Red	W	
	Snapshot 'Sunset'	DS	Yellow	W	
5	Nature 'Lemon Yellow'	P	Yellow	W	7.66 <sup>w</sup>
	Penny 'Deep Marina Improved'	V	Purple	C	
	'Songbird White'	OK	White	N	
6	Delta 'Pure Orange'	P	Orange	W	7.00
	Delta 'True Blue Improved'	P	Blue	C	
	'Coral Prince'	OK	White	N	
7	Wonderfall 'Yellow with Red Wing'	TP	Yellow/Red	W	6.25
	Delta 'Red with Blotch'	P	Deep Red	W	
	Montego 'Burgundy Bicolor'	DS	Deep Red	W	
8	Penny 'Primrose with Blotch'	V	Light Yellow	W	6.27
	Montego 'Rose Bicolor'	DS	Bright Pink	C	
	'Redbor' / 'Winterbor'	OK	Purple/Green	C	
9	Wonderfall 'Blue with Blotch'	TP	Deep Purple	C	7.21
	Nature 'Mulberry Shades'	P	Brown	W	
	'Kamome Pink'	OK	Pink	C	

<b>10</b>	Cool Wave 'Golden Yellow'	TP	Yellow	W	6.01
	Snapshot 'Sunset'	DS	Yellow	W	
	'Songbird White'	OK	White	N	
<b>11</b>	Sorbet XP 'Violet Beacon'	V	Lavender	C	6.28
	Delta 'Pure Orange'	P	Orange	W	
	Snapshot 'Plumblossom'	DS	Light Pink	C	
<b>12</b>	Wonderfall 'Yellow with Red Wing'	TP	Yellow/Red	W	6.23
	Penny 'Deep Marina Improved'	V	Purple	C	
	Snapshot 'Plumblossom'	DS	Light Pink	C	
<b>13</b>	Nature 'Lemon Yellow'	V	Yellow	W	7.28
	Nature 'Mulberry Shades'	P	Brown	W	
	'Redbor' / 'Winterbor'	OK	Purple/Green	C	
<b>14</b>	Wonderfall 'Blue with Blotch'	TP	Deep Purple	C	6.82
	Sorbet XP 'Pink Halo'	V	Light Pink	C	
	Montego 'Rose Bicolor'	DS	Bright Pink	W	
<b>15</b>	Wondeferfall 'Yellow with Blotch'	TP	Yellow	W	6.49
	Penny 'Primrose with Blotch'	V	Light Yellow	W	
	'Coral Prince'	OK	White	N	
<b>16</b>	Delta 'True Blue Improved'	P	Blue	C	6.25
	Wonderfall 'Yellow with Red Wing'	TP	Yellow/Red	W	
	'Kamome Pink'	OK	Pink	C	

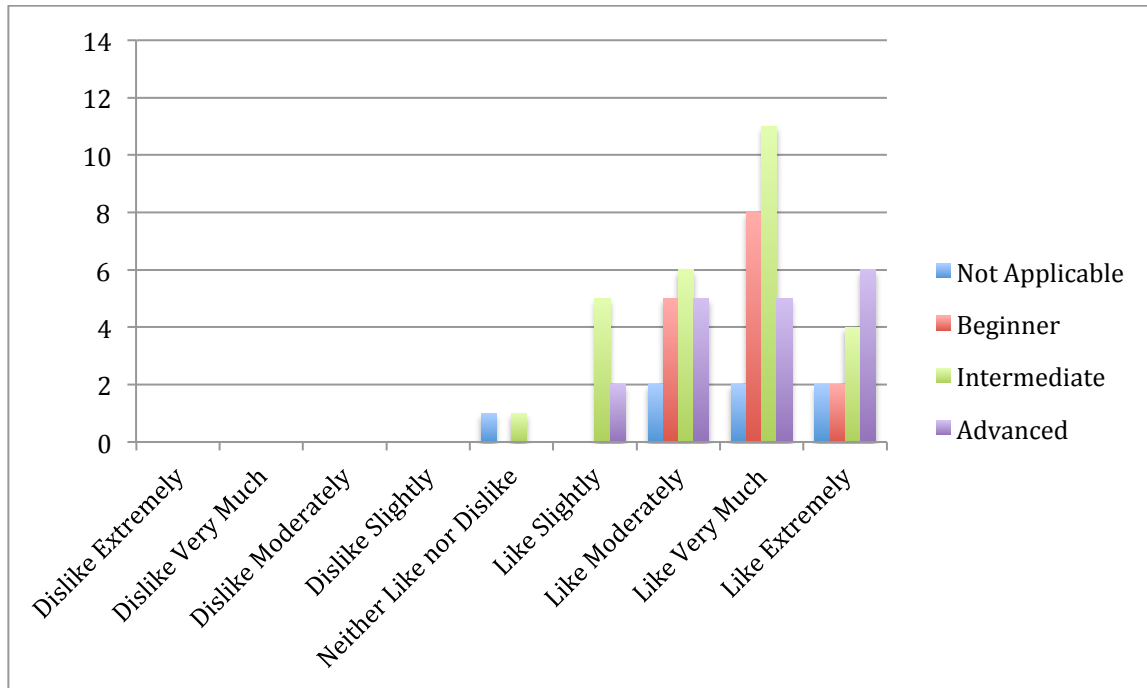
<sup>z</sup> Species abbreviated as shown: Ornamental Kale (OK), Pansy (P), Trailing Pansy (TP), Viola (V), or Dwarf Snapdragon (DS).

<sup>y</sup> Each selection's bloom or foliage color temperature characterized as warm (W), cool (C), or neutral (N) (Color Calculator, 2015).

<sup>x</sup> Lowest mean rating on a 9-point Likert-type scale.

<sup>w</sup> Highest mean rating on a 9-point Likert-type scale.

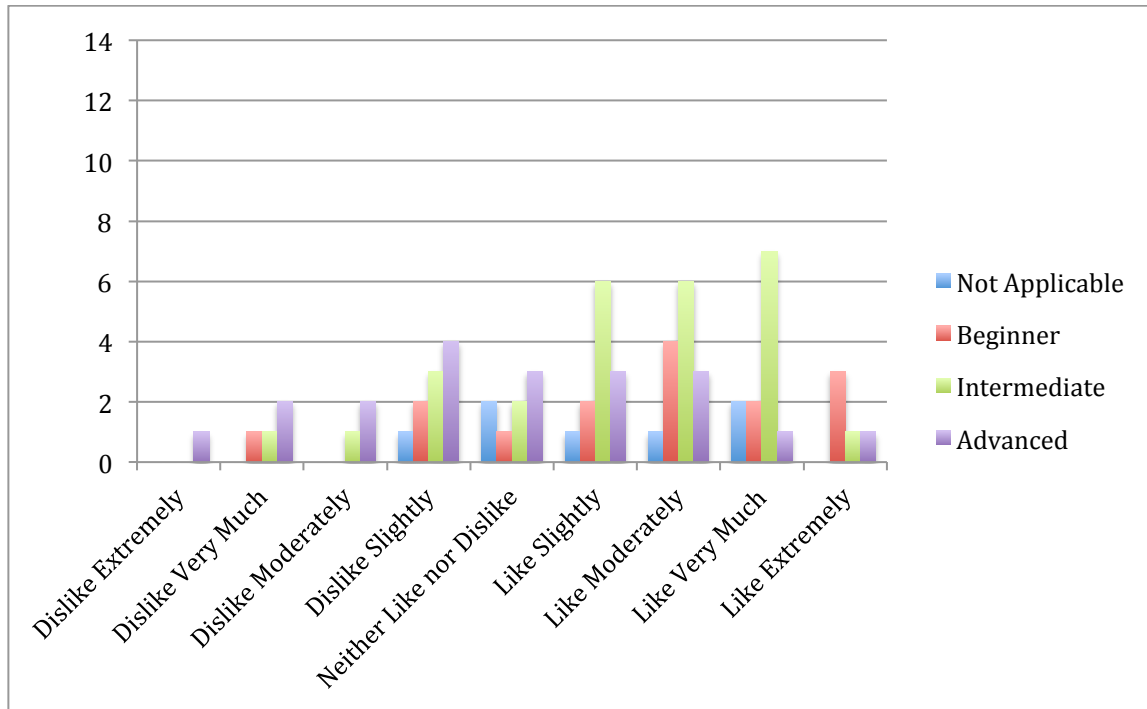
**Figure 3.1.** Color combination ratings for the highest rated planter combination, Planter #5<sup>z</sup>, among gardening experience level groups (Not Applicable<sup>y</sup>, Beginner, Intermediate, and Advanced) (Mean rating = 7.66).



<sup>z</sup> Container included Nature ‘Lemon Yellow’ pansy, Penny ‘Deep Marina Improved’ viola, and ‘Songbird White’ ornamental kale.

<sup>y</sup> Respondents not identifying with any gardening level.

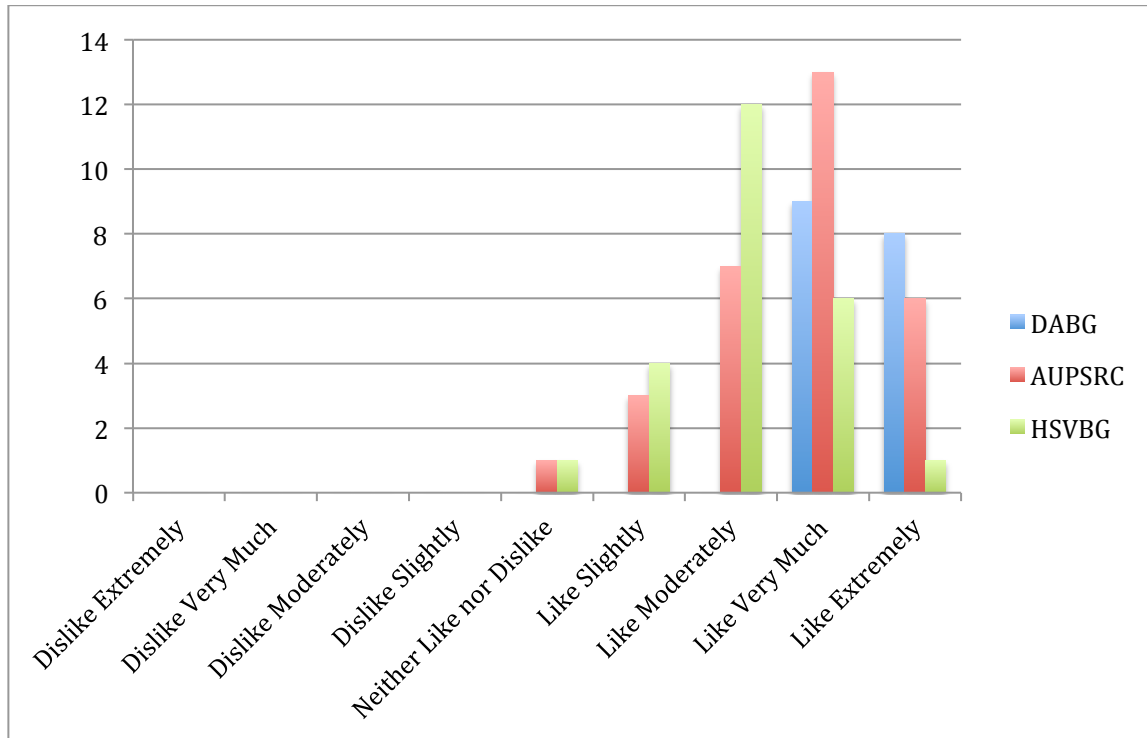
**Figure 3.2.** Color combination ratings for the lowest rated planter combination, Planter #2<sup>z</sup>, among gardening experience level groups (Not Applicable<sup>y</sup>, Beginner, Intermediate, and Advanced) (Mean rating = 5.96).



<sup>z</sup> Container included Sorbet 'Pink Halo' viola, Montego 'Rose Bicolor' dwarf snapdragon, and 'Kamome Pink' ornamental kale.

<sup>y</sup> Respondents not identifying with any gardening level.

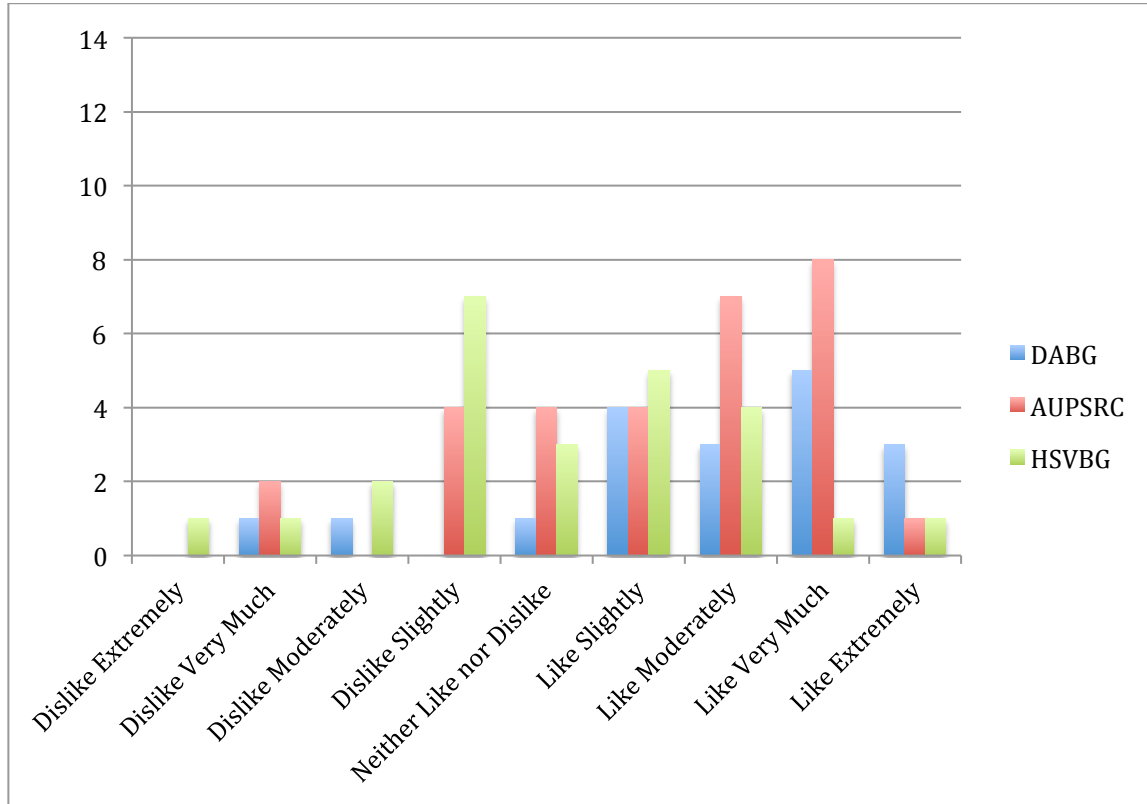
**Figure 3.3.** Color combination mean ratings for the highest rated planter combination, Planter #5<sup>y</sup>, for participants at Dothan Area Botanical Gardens in Dothan, AL (DABG)(8.47), Auburn University’s Plant Science Research Center in Auburn, AL (AUPSRC)(7.67), and Huntsville Botanical Garden in Huntsville, AL (HSVBG)(7.08).<sup>z</sup>



<sup>y</sup> Container included Nature ‘Lemon Yellow’ pansy, Penny ‘Deep Marina Improved’ viola, and ‘Songbird White’ ornamental kale.

<sup>z</sup> Mean rating from all locations = 7.66.

**Figure 3.4.** Color combination mean ratings for the lowest rated planter combination, Planter #2<sup>y</sup>, for participants at Dothan Area Botanical Gardens in Dothan, AL (DABG)(6.78), Auburn University’s Plant Science Research Center in Auburn, AL (AUPSRC)(6.20), and Huntsville Botanical Garden in Huntsville, AL (HSVBG)(5.08).<sup>z</sup>



<sup>y</sup> Container included Sorbet ‘Pink Halo’ viola, Montego ‘Rose Bicolor’ dwarf snapdragon, and ‘Kamome Pink’ ornamental kale.

<sup>z</sup> Mean rating from all locations = 5.96.

## **CHAPTER IV**

### **FINAL DISCUSSION**

In today's rapidly developing horticultural markets, improved methods for introducing and promoting new products and services are vital to strengthen connections between the Green Industry and consumers. Past studies have identified the desire from Alabama's Green Industry and consumers for the development of a plant evaluation and promotion program (Harris, 2008; Swindle, 2013). However, with lack of sufficient resources and monetary support being the greatest limitations in the establishment of such a program, little has been accomplished by a single organization toward encouraging its development statewide. The formation of partnerships between Auburn University (AU) Department of Horticulture's Master of Science in Public Horticulture, Dothan Area Botanical Gardens (DABG) in Dothan, AL, the Auburn University Plant Science Research Center (AUPSRC) in Auburn, AL, and Huntsville Botanical Garden (HSVBG) in Huntsville, AL began in the summer of 2013. The goal of these partners was to initiate a statewide plant evaluation effort. These partnerships grew to include Alabama Green Industry members that would provide plants, materials, and information for the initiation of this work. These members included the Alabama Nursery and Landscape Association (ALNLA) in Auburn, AL, Young's Plant Farm, Inc. in Auburn, AL, Interiorscapes, Inc. in Birmingham, AL, Martin's Nursery, Inc. in Semmes, AL, Van der Giessen Nursery, Inc. in Wilmer, AL, and Blooming



Colors, Inc. in Auburn, AL. From there, two Master Gardeners (MG) associations joined as partners. The DABG, AUPSRC, and HSVBG administrations and staffs joined in by providing expertise, materials, hands-on assistance, garden space, and promotion of the research.

The Wiregrass Area Master Gardeners Association and North Alabama Master Gardeners Association provided material, hands-on assistance at the DABG and HSVBG research sites.

With these partners working together operation, maintenance, material, and land costs were spread throughout the participating groups keeping the financial burden on a single organization would be reduced. Benefits for the partnering organizations were exhibited in a variety of ways including the promotion of the partners' products and services, acquisition of required volunteer service hours for MG volunteers, colorful seasonal flower displays for the public gardens, and plant performance and color combination perception data that can be referenced by the Green Industry and consumers. Auburn University (AU) Department of Horticulture's Master of Science with a certificate in Public Horticulture Program gained valuable connections with Alabama's botanical gardens and Master Gardener associations that could prove valuable for internships, service projects, and learning outreach opportunities in the future.

By partnering to make this research happen, participants moved closer toward the broader goals and benefits of:

- Identifying plant selections that exhibit superior ornamental qualities throughout Alabama's USDA hardiness zones 7b through 8b (USDA, 2012).
- Identifying plant selections and color combinations that appeal to the public and potential consumers.

- Connecting Alabama’s public garden guests and potential consumers with Master Gardener organizations, the Alabama Cooperative Extension System, Alabama’s Green Industry, and the AU Department of Horticulture.
- Building relationships within these partnerships that encourage the development of future collaborative efforts by these groups.

Formation of these partnerships as modeled through this research can potentially help disperse costs and benefits throughout several organizations for future studies. Through a network of qualified and dedicated personnel like Alabama’s Master Gardeners, Auburn University’s Public Horticulture students, regional extension agents, and Green Industry associates, the operation of a statewide plant evaluation program could mutually benefit the missions of all partners involved

Based on findings from the performance evaluation studies at DABG and AUPSRC, several cultivar selections of cool-season annual ornamentals were identified that could be excellent choices for introduction and promotion throughout Alabama. Empirical data collected through growth index measurements and visual subjective ratings were useful in identifying plant selections that exhibited superior display characteristics in Central and Southeastern Alabama locations. Selections that appeared multiple times as top performers within species included: Nature® series ‘Mulberry Shades’ and ‘Lemon Yellow’ pansies, ‘Redbor’ and ‘Coral Prince’ ornamental kale, Snapshot® series ‘Sunset’ and ‘Plumblossom’ dwarf snapdragons, Penny® series ‘Deep Marina Improved’ and ‘Violet Beacon’ violas, and the new Cool Wave® series ‘Golden Yellow’ and ‘Yellow with Red Wing’ trailing pansies. Although many other selections demonstrated good to exceptional

characteristics at different times in the study, these selections appeared to perform consistently near the top of their groups for multiple evaluations and locations.

Combination planter surveys at DABG, AUPSRC, and HSVBG were useful in identifying consumer and non-consumer perceptions of cool-season ornamental annual color combinations. This study also reflected trends observed in other plant combination studies where consumers chose complimentary colors over monochromatic or analogous combinations (Mason et al., 2008). Combinations earning the highest average ratings were 'Lemon Yellow' pansy, 'Deep Marina Improved' viola and 'Songbird White' ornamental kale; 'Mulberry Shades' pansy, 'Lemon Yellow' pansy, and 'Redbor' ornamental kale; and 'Mulberry Shades' pansy, 'Blue with Blotch' trailing pansy, and 'Kamome Pink' ornamental kale. Several of the highest ranking combinations included those containing plants that were among the highest ranked plants from the field performance evaluations. This information could prove useful to the Green Industry in demonstrating the value of these selections to consumers in multiple applications.

With regard to the color combination surveys, women made up the majority of respondents. More specifically, they made up the majority of participants who identified themselves as container gardeners. Future studies in this area could be assisted by targeting garden clubs and MG associations, groups having been traditionally comprised of mostly women, for participation in color combination surveys. These select groups of women could be beneficial in providing indicative feedback on color combinations to represent larger consumer markets. Additionally, 76.4% of participants that participated in this study reported the survey experience expanded their appreciation for container gardening "Moderately" to "Very Much." Participants were 70.8% "Somewhat Likely" and

“Likely” more willing to purchase plants seen throughout the survey experience than those advertised in catalogs or magazines. This information indicates plant evaluation surveys within public gardens and universities could play a valuable role in developing a more elaborate evaluation program within these and other public gardens, including Alabama.

The addition of plant performance evaluations at Birmingham Botanical Gardens in Birmingham, AL and HSVBG could present a more thorough representation of the performance of plant selections in north-central and northern Alabama for USDA hardiness zones 8a and 7b, respectively. In partnering with botanical gardens for the purpose of evaluating plant selections, it is important for partners to adhere to the missions of botanical gardens and other participating groups. For example, during this study a record freeze that occurred throughout Alabama on January 7, 2014 severely damaging many plants in the combination planter study at HSVBG. Because the damage to plants was extensive, a request was made by HSVBG administration for the plants to be replanted in order for the planters to remain displayed in the garden. Displaying and maintaining quality plant material is vital for the continuation of plant evaluation partnerships within public gardens. Levels of flexibility in research parameters and maintenance requirements and responsibilities should be agreed upon by all partners at the onset of future work in order to reach partners’ desired goals.

As observed throughout this study, combining both the plant evaluations and color combination studies into planters at the public garden locations could prove beneficial in a number of ways. From an installation standpoint, container planting at DABG and HSVBG appeared more accessible and enjoyable for volunteers. Many made comments about their favorability of planting into the large planters over planting in flower beds. Tools and soil

amendments required to facilitate proper in-ground plantings would be minimized. Flexibility in placement of the planters would also exist making it much easier for public garden administrations to change locations of the combination displays from year to year if necessary. Maintenance on planter combinations also seemed to be easier for volunteers to manage because the need for bending over to ground level wasn't required. From a research standpoint, combination planter studies would allow for greater consistency in potting media, fertilization, and physical dimensions across all locations. This consistency would likely increase the accuracy of visible differences of plant performance between selections from each location.

Now that initial partnerships have been formed between these groups, an opportunity exists to strengthen them through continued collaboration and involvement. Alabama's Green Industry plays a vital role in supplying quality plant material to the state and other consumer markets throughout the Southeastern U.S. Support and sponsorship of publicly operated plant performance evaluations can help to ensure the sustainability, credibility, and success of the statewide plant production industry. As other states' Green Industries have seen various benefits from the creation of plant evaluation and promotion programs, so too could the Green Industry and public gardens in Alabama.

## Literature Cited

- Harris, E. 2008. A National Overview of Plant Selection/Introduction Programs and a State Survey of Growers and Retailers to Determine the Potential for an Alabama Plant Selection/Introduction Program. Auburn Univ., Auburn, MS Thesis.
- Mason, S.C., T.W. Starman, R.D. Lineberger, and B.K. Behe. 2008. Consumer preferences for price, color harmony, and care information of container gardens. *HortScience* 43:380–384.
- Swindle, C.W. 2013. The Development of a Statewide Trial, Evaluation, and Promotion Program: Trialing Summer Annuals. Auburn Univ., Auburn, MS Thesis.
- USDA. 2012. The United States Department of Agriculture. Plant Hardiness Zone Map. 4 Mar. 2015. <<http://planthardiness.ars.usda.gov/PHZMWeb/#>>