AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF KENTUCKY COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT, LEXINGTON, KY, 40546

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UNIVERSITY OF KENTUCKY
College of Agriculture, Food and Environment

Fruit and Vegetable

2014 RESEARCH REPORT

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2014 Fruit and Vegetable Crops Research Report

Edited by Shubin K. Saha, John Snyder, and Chris Smigell

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Cover: Seedless Watermelon 'Indiana' has a unique exterior rind pattern and excellent quality..

Acknowledgments

Grants from the Agricultural Development Board through the Kentucky Horticulture Council have allowed an expansion of the field research and demonstration program to meet the informational and educational needs of our growing vegetable and fruit industries.

Important note to readers:
The majority of research reports in this volume do not include treatments with experimental pesticides. It should be understood that any experimental pesticide must first be labeled for the crop in question before it can be used by growers, regardless of how it might have been used in research trials. The most recent product label is the final authority concerning application rates, precautions, harvest intervals, and other relevant information. Contact your county's Cooperative Extension office if you need assistance in interpreting pesticide labels.

This is a progress report and may not reflect exactly the final outcome of ongoing projects. Please do not reproduce project reports for distribution without permission of the authors.

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Contents

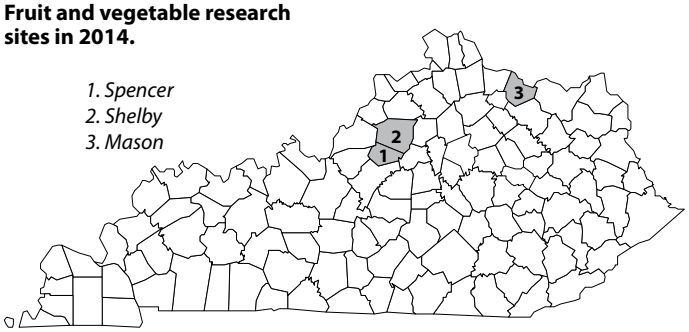
The 2014 Fruit and Vegetable Crops Research Program

Shubin K. Saha, Department of Horticulture

Fruit and vegetable production in Kentucky continues to grow. The 2014 Fruit and Vegetable crops research report includes results for more than 18 field research plots and demonstration trials. This year fruit and vegetable research and demonstration trials were conducted in three counties in Kentucky, including: Mason, Shelby, and Spencer (see map, right). Research was conducted by faculty and staff from several departments within the University of Kentucky College of Agriculture including: Horticulture, Plant Pathology, and Entomology. This report also includes collaborative research projects conducted with faculty and staff at Kentucky State University.

Variety trials included in this year's publication include: seedless watermelon, cantaloupe, bell peppers, kohlrabi, broccoli, blueberries, blackberries, raspberries, apples, peaches, and grapes. Additional research trials included evaluation of trapping methods for spotted wing drosophila and evaluating attractants for natural enemies of arthropod pests. Variety trials provide us with much of the information necessary to update our recommendations in our Vegetable Production Guide for Commercial Growers (ID-36). However, when making decisions about what varieties to include in ID-36, we factor in performance of varieties at multiple locations in Kentucky over multiple years. We may also collaborate with researchers in surrounding states to discuss results of variety trials they have conducted. Only then after much research and analysis will we make variety recommendations for Kentucky. The results presented in this publication often reflect a single year of data at a limited number of locations. Although some varieties perform well across Kentucky year after year, others may not. Here are some helpful guidelines for interpreting the results of fruit and vegetable variety trials:

Fruit and vegetable research sites in 2014.



Our Yields vs. Your Yields

Yields reported in variety trial results are extrapolated from small plots. Depending on the crop, individual plots range from 8 to 200 plants. Our yields are calculated by multiplying the yields in these small plots by correction factors to estimate per-acre yield. For example, if you can plant 4,200 tomato plants per acre (assuming 18" within row spacing) and our trials only have 10 plants per plot, we must multiply our average plot yields by a factor of 420 to calculate per acre yields. Thus, small errors can be greatly amplified. Furthermore, because we do not include factors such as drive rows in our calculations, our per-acre yields are typically much higher than what is found on an average farm. Due to the availability of labor, research plots may be harvested more often than would be economically possible. Keep this in mind when reviewing the research papers in this publication.

Statistics

Often yield or quality data will be presented in tables followed by a series of letters (a, ab, bc, etc.). These letters indicate if the yields of the varieties are statistically different. Two varieties may have average yields that appear to be quite different. For example if Tomato Variety 1 has an average yield of 2,000 boxes per acre and Variety 2 yields 2,300 boxes per acre one would assume that Variety 2 had a greater yield. However, just because the two varieties had different average yields, does not mean that they are *statistically or significantly* different. In the tomato example, Variety 1 may have consisted of four plots with yields of 1,800, 1,900, 2,200, and 2,100 boxes per acre. The average yield would then be 2,000 boxes per acre. Tomato Variety 2 may have had four plots with yields of 1,700, 2,500, 2,800, and 2,200 boxes per acre. The four plots together would average 2,300 boxes per acre. The tomato varieties have plots with yield averages that overlap, and therefore would not be considered statistically different, even though the average per acre yields for the two varieties appear to be quite different. This example also demonstrates variability. Good varieties are those that not only yield well, but have little variation. Tomato Variety 2 may have had similar yields as Variety 1, but also had much greater variation. Therefore, all other things being equal, Tomato Variety 1 may be a better choice, due to less variation in the field.

Statistical significance is shown in tables by the letters that follow a given number. For example, when two varieties have yields followed by completely different letters than they are significantly different; however, if they share even one letter then statistically they are no different. Thus a variety with a yield that is followed by the letters "bcd" would be no different than a variety followed by the letters "cdef," because the letters "c" and "d" are shared by the two varieties. Yield data for followed by the letters "abc" would be different yield data followed by "efg."

Lastly when determining statistical significance we typically use a *P* value of 0.05. In this case, *"P"* stands for probability and the 0.05 means that we have a 5% chance that our results are real and not simply due to chance or error. Put another way, if two varieties are said to be different at $P<0.05$, then at least 95% of the time those varieties will be different. If the *P* value is 0.01, then 99% of the time those varieties will be different. Different *P* values can be used, but typically $P < 0.05$ is considered standard practice.

This method may be confusing, but without statistics our results wouldn't be useful. Using statistics ensures that we can make more accurate recommendations for farmers in Kentucky.

Mason County On-Farm Commercial Vegetable Demonstration

Tracey Parriman, Cooperative Extension, and Shubin K. Saha, Horticulture

Introduction

An on-farm commercial plasticulture demonstration was completed in Eastern Kentucky in 2014. The grower was in Mason County and grew approximately one-half acre of mixed vegetables. This grower sells produce three times a week at the local farmers market and also supplies a small café with weekly cut flowers and produce. This year was the growers' second growing vegetables for market in addition to producing value-added products such as jalapeno jelly and pickled relishes.

Materials and Methods

The University of Kentucky Horticulture Department provided a bed-shaper/plastic layer. A walk-behind plastic layer was borrowed from Campbell County Extension Office. All other inputs including plastic mulch, drip tape, vegetable transplants, fertilizer, and pesticides were provided by the grower. The grower recorded basic information regarding the 2013 growing season which used no plastic or irrigation and the 2014 growing season using these new methods. The Mason County horticulture agent and the University of Kentucky vegetable specialist made periodic visits to the site in order to provide assistance with disease management and any other production issues.

The vegetable plot was treated as all natural, using only OMRI-approved pesticides and fertilizers. The demonstration plot utilized the bed shaper/plastic layer to form raised beds with black plastic mulch to a height of six to eight inches as well as a walk behind plastic layer, which lays plastic flat and does not mound the soil. The black plastic provides dual utility by providing transplants with warm soil early in the season while helping to maintain moisture and provide weed control later in the season.

Results and Discussion

The 2014 growing season in Eastern Kentucky presented fairly mild temperatures with adequate rainfall for most of the season. Cool, wet weather conditions in the spring led to an early disease problem. The grower experienced significant crop loss in tomatoes due to early blight damage. Later in the season he also experienced significant losses in bell peppers due to anthracnose. The grower attempted to prevent the spread of early blight in his tomatoes by removing infected foliage and by applying preventative fixed copper sprays, but overall did not report a good year for tomatoes. The grower intends to employ a fungicide spray schedule in future seasons.

A major barrier facing this grower was lack of labor. Weed pressure was not an issue until late in the summer. Without a sufficient labor force, weeds became an issue as well as some crops were left unharvested.

The grower got a late start with installing the drip irrigation system this year and made no applications of fertilizer before or after planting. Luckily, the vegetable plot had fairly nutrient-rich soil. Next season, the producer is looking to experiment with fertigation in the hopes of increasing crop fertility and yields.

Overall, the grower saw improved results in yield using the raised and flat plastic mulch beds and is planning to use this practice in subsequent growing years. No objective data were collected comparing the results of the raised versus the flat laid beds. The grower reported harvesting twice the amount of beans and peppers in 2014 compared to 2013.

On-Farm Commercial Vegetable Demonstrations

Ty Cato and Shubin K. Saha, Horticulture

Introduction

Two on-farm commercial vegetable production demonstrations were conducted in the north-central part of the state in Shelby and Spencer counties. These locations were chosen due to their proximity to Jefferson County and the recent surge in vegetable production to supply the Louisville area demand for locally grown food. One grower in Shelby County and one grower in Spencer County were chosen for this demonstration. The Shelby County grower produced heirloom tomatoes on 0.9 acres for local farmers' markets, restaurant sales, and an on-farm store. The grower in Spencer County produced mixed vegetables on 0.42 acres for use at his fine dining establishment in Louisville, Ky.

Materials and Methods

The growers were provided with plastic mulch and drip tape for up to 1 acre of production. The University of Kentucky Horticulture Department also provided a bed-shaper/plastic layer, a water-wheel transplanter, and a plastic mulch lifter to remove the mulch at the end of the growing season. All other inputs including fertilizer, pesticides, irrigation pumps, and labor were provided by the grower. The grower recorded basic information such as yield data, input costs, etc. An extension associate from the Department of Horticulture made weekly visits to provide assistance with disease management, harvesting practices, and any other production issues needing attention. The extension

associate was also involved in planning and preparing field days to display commercial vegetable production techniques to other growers interested in producing vegetables.

The two plots used conventional production techniques. This included the use of synthetic fertilizers and pesticides. The two demonstrations used raised beds with plastic mulch sealed on top of the beds. The height of the beds ranged from six to eight inches and the plastic used was either black 1 mil for early season crops or white on black 1 mil for late season crops. The black plastic provides transplants with the heat that they need early in the growing season, whereas the white on black plastic reflects the heat of the sun away from the bed, reducing heat stress on transplants set in the heat of the summer.

Results and Discussion

The 2014 growing season presented some problems for commercial producers in north-central Kentucky. The first problem occurred at the Spencer County plot, manifesting as a large whitefly infestation in the tomatoes. Before too much damage was done, the problem was mitigated using pyrethroid insecticides.

Second, periods of heavy rain in July promoted the development of septoria leaf blight on tomatoes in the Spencer County plot. The disease spread rapidly in the warm, wet weather, as it spreads by splashing rain. Combined with early blight, septoria severely damaged tomato foliage, thus limiting yields. The grower tried to slow disease development and dispersal of inoculum using fungicides such as fixed coppers and chlorothalonil.

Powdery mildew became a problem later, affecting pumpkins, summer squash, and cucumbers primarily. Most heavily damaged summer squash plantings were removed and replanted, because of rapid plant growth and quick fruit set. As powdery mildew is expected in cucurbits most years in Kentucky, a preventative fungicide program should have been implemented shortly after transplanting. An example of such a fungicide program can be found in the cucurbit chapter of the ID-36, "Commercial Vegetable Production Guide."

The only major problem experienced by the Shelby County grower was an unorthodox suckering (pruning) of the tomato plants. This technique caused the plants to be stunted and have greatly reduced yields. The yields were a little more than one third of what they should have been based on USDA standard yields. However, due to the nature of heirloom varieties, it is not uncommon to see yields close to fifty percent of what you would expect from a hybrid variety.

Weed pressure was only a problem in certain beds at the Spencer County plot. The weeds between beds were removed with tillage. The Shelby County grower used Sudex (sorghum-sudan grass hybrid) between the beds and mowed it occasionally to keep the height minimal for ease of harvesting.

Profitability of the two demonstrations varied greatly. Diminished yields, due to abiotic and biotic factors contributed to negative profits by the Shelby County grower (Table 1). Initial start-up costs for conventional growers greatly reduced profitability as well. These initial costs were for one-time investments (e.g. equipment) that could be amortized over the useable life of the product, thus leading to increased profits in the years to come. However, the Spencer County grower made more than $5,000 in profit. Considering that less than 0.5 acre was used, that is a good return on his investment. It is likely the different marketing tactics of the two producers affected the profitability as well with the Spencer County grower using it in his own restaurant in Louisville.

Table 1. Costs and profits for mixed vegetable plots, Shelby and Spencer counties, 2014.

	Shelby	**Spencer**
Plot Acreage	**0.9**	**0.42**
Inputs		
Plants and Seeds	$1628.66	$599.65
Fertilizer	457.80	227.00
Plastic Mulch	91.99	45.20
Drip Lines	91.99	45.20
Fertilizer Injector and Irrigation Fittings	1553.65	399.43
Herbicide	N/A	N/A
Insecticide	63.62	310.00
Fungicide	468.18	111.30
Water	490.00	350.00
Manual Labor	10,457.00	5600.00
Machine Labor (Fuel cost)	100.00	2500.00
Marketing	2992.76	N/A
Miscellaneous	2807.41	N/A
Total Expenses	21202.97	10187.78
Yield	11,685lb.	*
Revenue	19938.00	15336.00
Profit	-$1264.97	$5148.22

* Yields for mixed vegetable production vary based on crops.

Fruit and Vegetable Disease Observations from the Plant Disease Diagnostic Laboratory, 2014

Julie Beale, Brenda Kennedy, Sara Long, Kenny Seebold and Nicole Gauthier, Plant Pathology, and Shubin K. Saha and Shawn Wright, Horticulture

Introduction

Diagnosis of plant diseases is an ongoing educational and research activity provided to residents of the Commonwealth by the UK Department of Plant Pathology, College of Agriculture, Food and the Environment, and the Agricultural Experiment Station. The Plant Disease Diagnostic Laboratory (PDDL) is made up of two branches: main campus in Lexington and UK Research and Education Center in Princeton. Two full-time diagnosticians and a full-time diagnostic assistant are employed in the PDDL. Plant Pathology and Horticulture Extension Specialists provide additional diagnostic expertise and formulate general and case-specific management recommendations for samples. County extension agents submit the majority of diagnostic samples on behalf of their local growers and home gardeners (87%), although some samples are submitted directly by growers. Computer-based laboratory records are maintained to provide information used in conducting plant disease surveys, identifying new disease outbreaks, and formulating educational programs. All diagnoses of plant diseases are reported to a national repository. Diagnostic records are retained in the PDDL for a period of five years.

Materials and Methods

Visual examination is the initial step in processing plant disease samples. In most cases, microscopy is part of the visual assessment. Following visual and microscopic examination, some specimens require specific tests such as moist chamber incubation, isolation of pathogens onto culture media, enzyme-linked immunosorbent assay (ELISA), polymerase chain reaction (PCR) assay, nematode extraction, or soil pH and soluble salts tests. Once a diagnosis has been made, a report is compiled including a description of the sample condition, tests conducted, findings and recommendations. This report is sent electronically to the grower and county Extension agent and copied to any Extension specialists involved in the diagnosis.

Results and Discussion

Fruit and vegetable samples comprised roughly one-quarter of the approximately 2,500 plant specimens examined in 2014. Nearly one-half of fruit and vegetable samples were from commercial growers. Fruit and vegetable disease diagnosis involves a great deal of investigation into the possible causes of disease symptoms. Fruits and vegetables are high value crops for which a high proportion of diagnostic samples require specialized testing and/or consultation with UK Extension plant pathology and horticulture specialists.

Abundant rain during the spring and early summer with generally cool spring temperatures favored development of fungal and oomycete diseases in many crops. Late summer moisture promoted downy mildew, other foliar diseases and fruit rots near harvest. The following summary includes the predominant diseases submitted as diagnostic samples as well as a description of several unusual or significant diseases of fruit and vegetable crops.

New, Emerging, and Problematic Fruit and Vegetable Diseases in Kentucky

Tomato spotted wilt (TSW) cases were numerous for the third consecutive year in solanaceous crops. In field production, incidence of infected plants is typically low in a given field and symptoms usually appear in early summer (May-June). However, in greenhouse/high tunnel structures, higher incidence and much earlier symptom appearance (March) were observed. TSW was detected in greenhouse cucumber transplants this year; this is an unusual diagnosis on cucurbits, but the virus was present in solanaceous crops in the same greenhouse.

Phytophthora blights were problematic mid- to late-season as foliar, crown and particularly fruit rots on various crops, including strawberry (*P. fragariae*), pepper and cucurbits (*P. capsici*), and tomato (*P. infestans, P. nicotianae*). Wet conditions favor infection and spread of these pathogens; build-up of inoculum in affected sites may present problems for future fruit and vegetable production, depending on future weather or irrigation patterns.

Tree Fruit Diseases

Pome fruits: Fire blight (*Erwinia amylovora*) primary (blossom) infections occurred at high levels on apple in late March-early April; shoot blight was also common on apple. Pears were less severely affected by fire blight in general. Moderate levels of foliar fungal diseases of apple developed, particularly cedar-apple rust (*Gymnosporangium juniperi-virginianae*), scab (*Venturia inaequalis*) and frogeye leaf spot (*Botryosphaeria obtusa*), due to frequent rains in spring. Blister spot (Pseudomonas syringae pv. papulans) was diagnosed on 'Mutsu' apple from a single location.

Stone fruits: Fruit (and ornamental) *Prunus* sp. were damaged by extremely low winter temperatures, which allowed development of Leucostoma canker (*Leucostoma cincta*) on injured branch tissues. Wet weather promoted development of bacterial leaf spot (*Xanthomonas campestris* pv. *pruni*) on plum and cherry and defoliating levels of cherry leaf spot (*Coccomyces hiemalis*) on cherry.

Small Fruit Diseases

Grapes: Anthracnose (*Elsinoe ampelina*) and black rot (*Guignardia bidwellii*) were common. Leaf blight (*Isariopsis clavispora*) was diagnosed from several locations as a late-season foliar disease, similar to the previous year. Crown gall (*Agrobacterium vitis*) and Armillaria root rot (*Armillaria mellea*) were also diagnosed.

Brambles: Winter injury reduced bramble fruit production (particularly raspberry). Cane blight (*Leptosphaeria coniothyrium*) was the most frequently diagnosed of the fungal cane diseases on blackberry.

Blueberries: Root and collar rot (*Phytophthora cinnamomi*) was common on blueberry. Various fungal stem canker/blight diseases were also seen (*Botyrosphaeria* sp., *Phomopsis* sp.). Anthracnose fruit infections (*Glomerella cingulata*) and leaf rust (*Pucciniastrum vaccinii*) were unusual finds on blueberry.

Strawberries: Common leaf spot (*Mycosphaerella fragariae*) and angular leaf spot (*Xanthomonas fragarieae*), which are both favored by wet conditions and may have similar early symptoms, were common. Spring rains also favored leather rot (*Phytophthora cactorum*), which was diagnosed early in the season; while late summer rainy periods promoted Phytophthora crown rot (*P. cactorum*) and Rhizoctonia fruit rot (*Rhizoctonia fragariae*) developing as a soft rot of fruits (September). The crown rot phase of anthracnose (*Glomerella cingulata*) was seen from a number of areas.

Vegetable Diseases

Beans and peas: Foliar/pod diseases, including angular leaf spot (*Phaeoisariopsis griseola*), anthracnose (*Glomerella lindemuthiana*) and rust (Uromyces appendiculatus) were common due to frequent rains.

Cole crops: Few diseases were observed on cole crops.

Cucurbits: Alternaria leaf infection (*Alternaria* sp.) was an unusual find on greenhouse cucumber and watermelon seedlings from two counties. Alternaria leaf blight (*Alternaria cucumerina*) was common in field and home garden cucumbers. Bacterial wilt (*Erwinia tracheiphila*) was a problem on cantaloupe early in the season in areas where striped cucumber beetle pressure was high. Downy mildew (*Pseudoperonospora cubensis*) and powdery mildew (*Sphaerotheca fuliginea*) became problems later in the season on cucumber and pumpkin. Cucurbit fruit rots included cottony leak (*Pythium* sp.) on watermelon and pumpkin, Phytophthora fruit rot (*Phytophthora capsici*) on pumpkin and winter squash, and anthracnose (*Colletotrichum orbiculare*) also on pumpkin and winter squash. Other diseases found this season included Fusarium crown rot (*Fusarium oxysporum f.sp. solani*) on watermelon and Choaonephora fruit rot (*Choanephora cucurbitarum*) on pumpkins in Central and Eastern Kentucky, respectively.

Peppers: Bacterial spot (*Xanthomonas campestris* pv. *vesicatoria*), Sclerotinia stem rot (*Sclerotinia sclerotiorum*) and Phytophthora fruit blight (*Phytophthora capsici*) were seen occasionally on pepper.

Tomatoes: Pythium root rot (*Pythium* sp.) was observed in greenhouse-produced transplants. Leaf mold (*Fulvia fulva*) was prevalent in greenhouse/high tunnel systems but was also observed at high levels in field production where air movement was limited. Also common in greenhouse/high tunnel systems were timber rot (*Sclerotinia sclerotiorum*), stem canker (*Botrytis cinerea*), Fusarium wilt (*F. oxysporum* f.sp. *lycopersici*) and Fusarium crown and root rot (*F. oxysporum* f.sp. *radicis-lycopersici*). Tomato spotted wilt virus was more common than usual (see above). Late blight (*Phytophthora infestans*) affected tomato plantings in certain areas, although it did not develop extensively. The foliar diseases early blight (*Alternaria solani*) and Septoria leaf spot (*Septoria lycopersici*) were common in field production and home gardens.

Other vegetables: Both common rust (*Puccinia sorghi*) and southern rust (*Puccinia polyspora*) as well as bacterial soft rot (Erwinia sp.) were diagnosed on sweet corn, and scurf (*Monilochaetes infuscans*) was diagnosed on sweet potato from several locations.

Fruits and vegetables are high value crops. Because many of them are new or expanding crops in Kentucky and involve production systems unfamiliar to Kentucky growers, disease diagnosis and management is critical. The PDDL is an important resource for extension agents and the growers they assist. The PDDL encourages county extension agents to include in their programming the importance of accurate disease diagnosis and timely sample submission. The information gained from diagnostic analyses will help improve production practices and reduce disease occurrences and epidemics.

The PDDL relies on funds from the National Plant Diagnostic Network and IPM grants to help defray some of the laboratory operating costs.

References

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UK Ag Weather Center, Kentucky Climate Summary. Available at: http://wwwagwx.ca.uky.edu/ky/climate.

Rootstock Effects on Apple and Peach Tree Growth and Yield

Dwight Wolfe, Doug Archbold, June Johnston, and Ginny Travis, Horticulture

Introduction

Although apple and peach are the principal tree fruits grown in Kentucky, the hot and humid summers and heavy clay soils make their production more difficult here than in some neighboring tree fruit producing regions. The hot, humid summers lead to high disease and insect pressure in Kentucky orchards. Despite these challenges, orchards can offer high per-acre income and are suitable for rolling hills and upland soils.

Identification of improved rootstocks and cultivars is fundamental for advancing the Kentucky tree fruit industry. For this reason, Kentucky cooperates with 39 other states and three Canadian provinces in the Cooperative Regional NC-140 Project entitled, "Improving Economic and Environmental Sustainability in Tree Fruit Production through Changes in Rootstock Use." The NC-140 trials are critical to Kentucky growers, allowing access to and testing of new rootstocks from around the world. The detailed and objective evaluations allow growers to select the most appropriate rootstocks for Kentucky.

The NC-140 orchards are research trials that also serve as demonstration plots for visiting fruit growers, extension personnel, and researchers. The data collected from these trials helps establish base-line production and economic records for the various orchard system/rootstock combinations that can be used by Kentucky fruit growers.

Materials and Methods

Grafts of known cultivars on the various rootstocks were produced by nurseries on the West Coast and distributed to cooperators. Kentucky's NC-140 rootstock plantings are located at the UK Research and Education Center (UKREC) at Princeton. They are:

- The 2009 peach rootstock trial compares fourteen rootstocks with 'Redhaven' as the scion cultivar. Eight trees of each rootstock were planted in a randomized complete block design with eight replications (blocks). Trees were planted in March 2009 on a 16-ft x 20 ft. spacing.
- The 2010 apple rootstock trial is a planting of 'Aztec Fuji' apple on thirty-one different rootstocks with four blocks per rootstock and up to three trees per rootstock per block. It was planted in March 2010. The experimental design was a randomized complete block design, and trickle irrigation was installed a month after planting. Heavy spring rains resulted in many of the graft unions sinking below ground level. Many of the trees were dug up, reset, and allowed to resettle through the summer. The heights of the graft unions above the soil line now average five inches with a range of three to seven inches.

Orchard floor management for these trials consisted of 6.5 ft. bare ground, herbicide-treated strips with mowed sod alleyways. Trees were fertilized and sprayed with pesticides according to local recommendations. Yield and trunk circumference measurements were recorded for both trials and trunk cross-sectional area (TCSA) was calculated from the trunk circumference measurements taken 12 inches above the graft union for apple, and six inches above for peach. Cumulative yield efficiency was the cumulative yield (total of all the annual yields) divided by the current year's trunk cross-sectional area. The TCSA is an indicator of the proportion of nutrient resources a tree was putting into fruit production relative to vegetative growth. Tree height and canopy spread (the average of the within-row and across-row tree widths) were recorded at the end of the 5th and the final (usually the 10th) seasons of each trial. Fruit size was calculated as the average weight (oz.) per fruit. All data were statistically analyzed using SAS v.9.3[3].

Results and Discussion

The 2014 growing season in Kentucky was a challenging one for most fruit growers. The first polar vortex of the year dropped temperatures from 49 °F on January 5 to -1 °F on January 6 in Princeton, KY. A spring freeze on the morning of April 16 caused additional damage.

Monthly precipitation averages for 2014 were below normal for January, March, May, June, and July. February, April, and August monthly averages were 0.6, 2.3, and 2.2 inches above normal respectively.

Monthly temperature averages were generally 4 degrees below normal for January, February, March, and July. Temperatures were 2 degrees above normal for April, May, and June. Fruit maturity was normal to about a week later than normal.

2009 Peach Rootstock Trial

Mortality, Julian dates for 90% bloom and 10% fruit maturity, cumulative yield, yield, size, trunk cross-sectional area (TCSA), and cumulative yield efficiency varied significantly among the fourteen rootstocks in this trial (Table 1). Trees on Krymsk 1 and Bright's Hybrid have had the highest mortality rates, 62.5% and 50%, respectively. The time of 90% bloom averaged less than a day from first to last with scions on Microbac, Bright's Hybrid, Controller 5, and Krymsk1 were the earliest and those on HBOK32 and HBOK10 the latest. Maturity was the latest for scions on *P. americana*, and earliest by about three days for scions on HBOK 10. Microbac continues to be the most vigorous rootstock and Krymsk 1 the least vigorous in this trial. Yield per tree was highest for scions on Atlas and lowest for scions on Krymsk 1. Cumulative yield was highest for Atlas, but was not significantly different from that of Lovell, KV010-123, Guardian, Viking, or KV010-127. Scions on Controller 5 had the highest cumulative yield efficiency. Fruit size was largest for trees on Lovell. Number of rootsuckers did not differ significantly among rootstocks.

2010 Apple Rootstock Trial

In 2012, a G.11 was lost due to deer damage; a B.9 broke at the graft union; and two trees on M.9 NAKBT337 were lost possibly from winter injury. Three trees (one with M.9 Pajam 2 and two trees with B.71-7-22) succumbed to fire blight infections in 2013, and seventeen trees succumbed in 2014 to the results of fire blight in 2013 (including two on B.64-194, five on M.26 EMLA, two on Supporter 3, one on PiAu51-11, four on M.9 NAKBT337, and three on M.9 Pajam2).

No significant differences were observed this year for average weight per fruit, but mortality, cumulative yield (the combined yield per tree from 2012 through 2014), yield per tree for 2014, TCSA, and cumulative yield efficiency varied significantly among the 31 rootstocks (Table 2). Trees on PiAu 9-90, and B70-20-20 rootstocks are the largest, and trees on B.7-20-21 and B.71.7-22 are the smallest. Yield was greatest for scions on G.5087 and G.5222 and lowest on B.7-20-21 Root sucker growth was highest for scions on B.70-20-20 followed by G.202TC. Scions on G.4003, G.5087, and G.5222, had the highest cumulative yield efficiency.

References

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Midwest Tree Fruit Pest Management Handbook. University of Kentucky College of Agriculture Cooperative Extension Service, Publication ID-93.

SAS Institute Inc., Cary, N.C., USA.

Table 1. 2014 results for the 2009 NC-140 peach rootstock planting, Princeton, KY.

Rootstock[1]	Tree Mortality (% lost)	Julian Date of 90% Bloom	Julian Date of 10% Maturity	Cum. Yield (2011-2014) (lbs/tree)	2014 Yield (lbs/tree)	Fruit Weight (oz/fruit)	Number of Root Suckers per tree	TCSA (sq. in)	Cum.Yield Efficiency (2011-2014) (lbs/sq in TCSA)
Microbac	0	99	192	159	46.0	4.5	2.4	19.9	8.1
Guardian	0	99	190	191	69.7	5.4	0	19.9	9.6
Viking	25	100	191	185	63.1	5.2	0	19.1	9.6
Lovell	0	100	192	204	72.2	5.8	0	18.6	11.1
Krymsk 86	0	99	192	155	43.6	4.7	0	18.2	8.5
Bright's Hybrid	50	99	190	146	58.7	4.7	0	17.8	8.1
Atlas	0	100	190	216	88.0	5.7	0	17.3	12.4
KV010-127	0	100	191	178	60.1	5.1	0	16.9	10.5
KV010-123	12	100	190	197	70.2	5.4	0	16.8	11.6
HBOK 32	12	100	190	158	54.3	5.6	0	14.7	10.9
HBOK 10	0	100	189	160	55.7	5.5	0	13.9	11.5
Controller 5	0	99	191	143	55.4	4.5	2.5	10.8	13.3
P. americana	25	99	193	89	22.0	3.8	1	9.6	9.2
Krymsk 1	62	99	192	39	1.5	.	0	6.6	5.5
Mean	13	100	191	158	54.3	5.1	0.4	15.7	10.0
LSD (5%)	29	0.3	2	44	26.0	0.6	NS	2.9	2.3

[1] Arranged in descending order of trunk cross-sectional area (TCSA) for each rootstock.

Table 2. 2014 results for the 2010 NC-140 apple rootstock trial, Princeton, KY.

Rootstock[1]	Initial Number of Trees	Tree Mortality (% lost)	Cum. Yield (2012-2014) (lbs/tree)	2014 Yield (lbs/tree)	Fruit Weight (oz/fruit)	Number of root suckers per tree	TCSA (sq. in.)	Cum. Yield Efficiency (lbs/sq in TCSA)
PiAu 9-90	4	0	31.9	3.3	6.8	5.8	12.6	2.1
B.70-20-20	12	0	27.5	4.4	7.0	12.1	12.5	1.8
PiAu 51-11	11	9	24.6	2.2	6.8	0.8	9.7	2.6
B.7-3-150	12	0	31.9	5.5	7.4	1.1	9.7	3.4
B.70-6-8	12	0	27.5	5.3	6.7	0.5	9.5	2.9
B.67-5-32	12	0	23.8	3.7	6.9	3.8	8.6	2.6
M.26 EMLA	8	45	30.4	5.1	7.9	0.7	8.2	4.1
B.64-194	7	29	17.6	2.6	6.8	0.6	8.2	2.0
G.202 N	11	0	44.0	6.8	7.3	8.0	7.9	5.6
G.5222	8	0	58.5	18.9	7.0	6.0	7.1	8.5
G.935 N	10	0	49.3	8.4	7.1	4.8	6.7	7.5
G.935 TC	4	0	26.4	3.3	6.3	5.0	6.6	4.4
G.3001	3	0	30.1	4.2	7.2	1.3	6.5	4.3
G.4814	4	0	39.6	8.6	7.2	6.5	6.4	6.1
G.4004	9	0	41.6	14.1	7.7	7.3	5.8	7.1
M.9 Pajam2	4	44	26.8	3.5	6.5	8.4	5.6	4.5
G.202 TC	8	0	32.3	5.3	8.0	9.5	5.5	6.1
G.11	12	13	40.3	9.0	6.8	1.4	5.4	7.5
M.9 NAKBT337	5	50	35.4	7.9	7.3	3.5	5.2	6.2
Supp.3	12	40	38.3	7.3	6.1	0.0	4.8	8.0
G.4214	1	0	21.1	6.2	7.4	6.3	4.8	4.8
G.5087	2	0	40.9	19.4	6.2	3.0	4.8	9.2
B.10	2	0	26.4	9.5	6.9	0.1	4.8	5.7
G.41 TC	4	0	32.3	6.6	5.4	3.0	4.7	4.5
G.4013	12	0	14.7	6.6	4.8	2.5	4.6	3.2
G.4003	7	0	29.3	9.9	6.8	3.1	3.3	9.4
G.41 N	3	0	22.7	11.9	6.7	1.0	3.3	7.1
G.2034	12	0	14.3	4.0	5.9	5.5	2.2	6.0
B.9	2	8	10.3	4.6	5.8	3.2	1.9	5.8
B.7-20-21	12	0	3.5	1.8	4.8	0.7	1.8	2.1
B.71-7-22	10	20	3.5	3.1	6.7	1.5	1.1	3.3
Means	NA	8.3	28.3	6.9	6.7	3.8	6.1	5.1
LSD (0.05)	NA	36	17.6	7.9	NS	6.0	2.7	3.4

[1] Arranged in descending order of the fall trunk cross-sectional area (TCSA) for each rootstock.

Fruit Baits for Trapping and Management of Spotted Wing Drosophila for Organic Growers of Primocane Fruiting Blackberries

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Introduction

Spotted wing drosophila (SWD), *Drosophila suzukii*, is a new pest of economically valuable small fruit and tree fruit crops in Kentucky. The U.S. Department of Agriculture confirmed that the spotted wing Drosophila fly was present in south-central Kentucky in 2012. The SWD had already spread across Kentucky in 2013. This fruit fly is originally from Asia and can be destructive to softer skinned fruits, such as blueberries, blackberries, and raspberries. However, later-ripening small-fruit crops, such as primocane-fruiting raspberries and blackberries, are at the highest risk.

The SWD, unlike other fruit flies, lay their eggs inside fresh fruit, often before harvest. Aside from the superficial scars left by the female's ovipositor, most damage is done by the maggots feeding inside the fruit. After several days, the skin collapses allowing fungal attack. It is possible, however, for the SWD to leave no visible impact on the fruit, and will be only detectable once the fruit is picked and prepared for eating. The SWD completes its life cycle in less than two weeks. Unfortunately, there can be 10 or more generations each year, with females each laying 200 to 600 eggs. The SWD larvae do not attack humans ingesting the larvae; however, damaged and infested fruit could be more likely to contain other microbial contaminants.

Trapping and pest monitoring has been the basis of IPM programs for decades. However, SWD traps have not been good predictors of population sizes nor do trap captures necessarily occur before fruit infestation. Traps are placed in the canopy of the crop as the female SWD prefer to rest during the day in dark, dense locations. Traps can be made out of a one-quart, clear deli container with about one inch of bait solution to which one drop of dish soap has been added. Initially traps were baited with apple cider vinegar, but yeast and sugar baits and other baits have been shown to catch flies 1 to 2 weeks earlier than just apple cider vinegar. There are a range of insecticides for conventional producers; however, they must rotate among insecticides with different modes of action (IRAC Group) to prevent/delay resistance. For organic producers, Entrust is an option, which is allowed in organic bramble production. However, spraying every 3 to 5 days will likely be needed for good control and will raise production costs. The objective of this study is to determine the attractiveness of fruit containing lure baits (blackberry and pawpaw) compared to a control without fruit, for monitoring SWD presence and numbers.

Table 1. Numbers of Male Spotted Wing Drosophila (SWD), Female SWD, and other Drosophila captured using the three different baits.

Trap Baits	M SWD	F SWD	Other Drosophila
Blackberry	55	69	85 ab
Pawpaw	45	56	105 a
Yeast	79	70	34 b
Significance	NS	NS	*

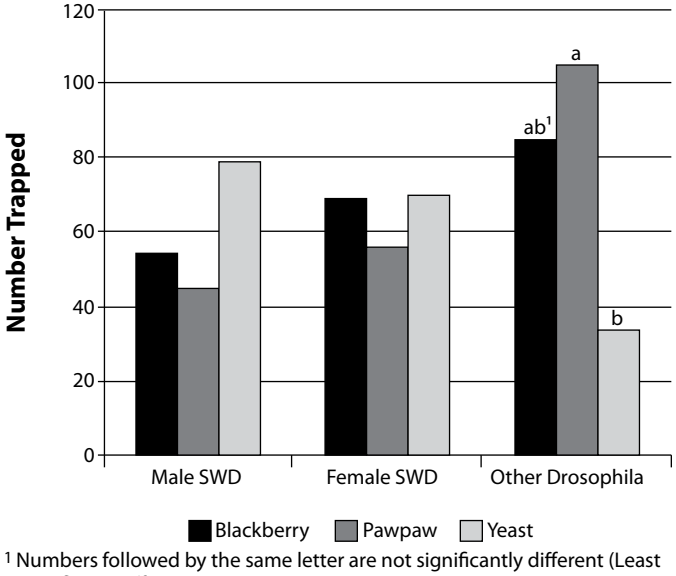
Numbers followed by the same letter are not significantly different (Least Significant Difference P = 0.05)

Materials and Methods

SWD traps were made from red drink cups (18 oz.) by melting holes around half the circumference of the cups and were baited with a 150 ml per cup solution of either yeast, sugar and water (control); 1 part ripe pawpaw fruit pulp extract to 4 parts yeast, sugar, and water; or 1 part blackberry extract to 4 parts yeast, sugar, and water, with four replicates of each bait. The blackberry and pawpaw pulp had been collected in the fall of 2013 and frozen until use. Traps were placed in an existing primocane-fruiting blackberry variety trial within the planting at the KSU Research and Demonstration Farm in Frankfort, Ky. Each of the 3 treatments had 4 reps, for a total of 12 cups. Plots were arranged in a completely randomized design, with four replicated plots of 2 cultivars, 'Prime Jan®' and 'APF-45®,' including 5 plants of each cultivar per block (total of 20 plants of each cultivar) in a 10 foot plot. Spacing was 2 feet between each plant, and 5 feet between groups of 5 plants, with each row being 70 feet in length. Rows were spaced 14 feet apart. This trial was planted on the certified organic land and managed with organic practices following the National Organic Program standards.

The SWD traps were placed in the field on September 22 and September 29. Traps were collected after three days, brought back to the lab, and transferred to containers with 70% ETOH.

Figure 1. Numbers of Male SWD, Female SWD, and other Drosophila captured using the three different baits.



[1] Numbers followed by the same letter are not significantly different (Least Significant Difference P = 0.05).

SWD males and females were identified and enumerated. ANOVA and LSD means separation were performed using CoStat Statistical Software (CoHort Software, Monterey, CA).

Results and Discussion

All baits—blackberry, pawpaw, and control traps—captured similar numbers of male and female SWD. The blackberry and pawpaw fruit baits actually captured significantly more non-SWD fruit flies. The SWD, unlike other fruit flies, lay their eggs inside fresh fruit, compared to other fruit fly species that are more attracted to rotting fruit. The volatile compounds with the fermentation of the blackberry and pawpaw baits, therefore likely was more attractive to the non-SWD and unfortunately not as attractive to SWD. Based on this limited study, yeast base baits without fruit extract still appear to be the optimal bait for capturing SWD and should continue to be used in a management program for developing a SWD spray schedule. Additional trapping periods and baits should be evaluated.

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Erect Thornless Blackberry Cultivar Trial

Dwight Wolfe, June Johnston, and Ginny Travis, Horticulture

Introduction

Blackberries are an important small fruit crop grown in Kentucky. Demand for this fruit at farmer's markets is strong and generally exceeds supply. Producers are looking for better cultivars that are productive and have berries with good size and flavor. Resistance to Orange Rust and Rosette is also a consideration among growers. Three thornless erect cultivars (Natchez, Osage, and Ouachita) and two selections (A-2434T and A-2491T) all from John Clark's breeding program at the University of Arkansas were evaluated at the UK Research and Education Center, Princeton, Ky.

Materials and Methods

Twenty plants each of five cultivars, Natchez, Osage, Ouachita, and two numbered cultivars, A-2491T and A-2434T, were planted in the spring of 2013. Plants were spaced 2.5 feet apart within 12.5-foot long plots in rows spaced 18 feet between rows. Only one cultivar was allocated to each plot and each row contained five plots. Cultivars were randomized in a randomized block design with each row being one block. Trickle irrigation was installed, and plants were maintained according to local recommendations. Fruit was harvested twice weekly from June 20 through July 21, 2014, and yield and fruit size were recorded. Fruit size was calculated as the average weight (grams per berry) of 25 fruits. Berries were rated for taste on a 5 point scale with 1 being undesirable and 5 being excellent.

Table 1. Summary of results for 2014 from the blackberry cultivar trial at UKREC, Princeton, KY.

Cultivar	Harvest period	Yield (lbs/plot[z])	Size (grams/berry)	Taste
Ouachita	June 26 – July 21	13.0	5.3	4.8
Osage	June 23 – July 15	8.5	4.1	5.00
A-2491-T	June 26 - July 21	7.0	4.0	5.00
A-2434-T	June 23 – July 15	6.9	5.6	4.5
Natchez	June 20 - July 15	6.9	7.1	4.2
LSD (0.05)	NA	6.1	0.6	0.5

[z] Plot size = 225 ft2

Results and Discussion

Yields varied from an average of 13.0 lb. per plot for Ouachita to 6.9 lb. per plot for Natchez (Table 1) to 13.0 lb. per plot Ouachita. Average berry size for the season varied from 7 grams for Natchez down to 4 grams for A-2491T. Berries ripened over about a four-week period from about June 20 through about July 21, with Natchez ripening first. Ouachita and A-2491-T were the latest to ripen coming in a week later than Natchez but were also still ripening a week after Natchez was finished. Osage and A-2491T were rated the highest for taste (5.0), with Natchez rated the lowest (4.2). These data are preliminary and the trial will be carried on for several more years.

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Annual Plasticulture Strawberry Floating Row Cover and Variety Evaluation

Shawn Wright, Horticulture

Introduction

Growers across Kentucky are looking for high-value specialty crops to help diversify their farming enterprises. Locally produced strawberries are a highly desired crop by consumers and grow well in Kentucky. While the matted row production system is well established we are seeking to improve recommendations for the annual plasticulture system. This system has the potential to be highly profitable because berries produced in this system will ripen approximately one month sooner than the earliest matted-row berries and can be sold for a price premium. Yields per acre are also higher than with the traditional matted row system.

Materials and Methods

This study was completed at the University of Kentucky Horticulture Research Farm in Lexington, Ky., on a Maury Silt Loam soil. Strawberry runner tips of Albion, B1463, Benecia, Camerosa, Camino Real, Chandler, Festival, Flavorfest, Radiance, and San Andreas were planted in 50-cell plastic plug trays filled with Pro-Mix BX general growing medium (Premier Horticulture, Inc.) on Aug. 6-7, 2013, and were rooted with a mist system and allowed to grow for 5 weeks. Plugs were transplanted in double rows on Sept. 12, 2013, onto pre-made black plastic covered raised beds that had been constructed on Aug. 7 with a Kenco bedshaper and plastic layer. Three hundred pounds of 19-19-19 were broadcast prior to bed shaping. Raised beds were 6 foot on center. Plants were 12" apart in the row and 12" between rows, offset. Chateau® WDG (flumioxazin) was applied over the beds but prior to laying the plastic at 3 oz./acre for winter annual weed control). Individual plots were 10 feet long containing 20 plants. Insecticides were not needed. The row middles were seeded with annual ryegrass in early September prior to transplanting the strawberries and Select 2EC (clethodim) was applied at 8 oz./acre in late March to kill the ryegrass. One application of Switch 62.5 WG (cyprodinil and fludioxinil) at 12 oz./acre plus Captan 50 WP at 4 lb./acre was applied at early bloom to control botrytis. Drip irrigation was available but was not needed until Spring at which time 10 pounds of actual N per acre was injected once a week for 3 weeks after uncovering the plants but prior to bloom.

Agribon AG-19 floating row cover (0.55 oz./sq. yd.) and Chandler strawberries were used for the winter protection study. In the variety trial, 2 layers of row cover were applied the first week in Nov. 11, 2013. In the row cover management trial there were four treatments (0.55 oz./sq. yd., 0.55 oz./sq. yd. + 0.55 oz./sq. yd., 1.1 oz./sq. yd. + 0.55 oz./sq. yd., and 1.1 oz./sq. yd. with the first application of row covering being applied Nov. 11, 2013 and the second application, if needed applied Jan. 1, 2014. Experimental design was a randomized complete block.

Berries were picked once or twice a week as necessary beginning May 12, 2014, and ending June 3, 2014. Total berry weight per plot was determined and individual berry weights for 20 berries per plot were measured at harvest.

Results and Discussion

Block 3 never established properly and was dropped from the analysis. Table 1 shows the average pounds per acre, average berry weight (ounces), and comments for the variety trial. Consumer preference testing was conducted from a small sample of individuals (n=8) for comments. While San Andreas was the most productive, the berry flavor was not as good as our standard recommendations Chandler and Camerosa. Perhaps with further experimentation we could develop San Andreas as a fresh market berry but it may have potential for value-added products. Flavorfest is being added to our list of recommended varieties for production in Kentucky because of its very good yields, berry attractiveness, and outstanding flavor. Albion and Festival are not productive enough to be profitable. At this time, B1463 is not being considered for commercial release. Benecia and Camino Real were tart berries, but if we had been able to harvest more frequently to pick at optimum ripeness they may have performed better on consumer preference testing. Camino Real was consistently the largest berry and would have potential if marketed as individual berries for dipping in chocolate. Radiance had a nice traditional red coloration but the taste was bland and the berries were very firm even when color was fully developed.

Table 1. Varietal characteristics.

Variety	lbs/acre	oz	comments
San Andreas	21598.8	0.57	Tart, oblong shape, firm berry
Camerosa	19564.6	0.56	Mild flavor, can be firm if not fully ripe
B1463	14945.0	0.53	Very good flavor, smaller than Flavorfest
Camino Real	14468.2	0.71	Tart, large berry,
Chandler	14444.7	0.53	Good flavor, tends to have hollow berries
Flavorfest	14345.9	0.63	Best flavor, nice color and shape
Radiance	13450.9	0.61	Bland, firm, nice color
Benecia	12142.7	0.66	Tart, firm texture
Albion	9208.9	0.62	Good flavor
Festival	6693.2	0.53	Good flavor

Table 2. Yield as average ounces per plant per week using different floating row cover treatments.

Treatment[1]	Rep.	1st	2nd	3rd	Total	Aveage	lbs/acre
0.55	1	1.6	4.8	4.7	11.1	11.4	12421
0.55	2	2.2	4.6	4.9	11.7		
0.55+0.55	1	4.3	7.5	4.7	16.5	15.8	17263
0.55+0.55	2	2.9	7.3	4.9	15.1		
1.1	1	3.5	5.7	4.3	13.5	13.7	15015
1.1	2	3.1	7.4	3.5	13.9		
1.1+0.55	1	4.1	7.3	3.5	14.8	12.0	13087
1.1+0.55	2	2.7	3.8	2.6	9.1		

[1] Row cover application timing, first number is the row cover weight applied on 11 November 2013 and the second number is the row cover weight applied on 1 January 2014

Table 2 shows average per plant per week yields for different floating row cover treatments. Previous results from the 2012 and 2013 season also show a general trend for higher yields per plant with sequential application of lighter weights fabric versus a single application of equivalent weight. Typically our coldest weather of the season doesn't arrive until early in the new year however there is also more management involved with two layers of row covers versus a single layer. We believe that spring row cover management can be utilized more effectively and plan on further research with these techniques to find the most cost-effective strategy for growers.

Acknowledgements

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Hops Status Report, 2011-14

Shawn Wright, Horticulture

Hops (*Humulus lupulus*) is an herbaceous plant with a perennial crown and annual climbing stems (bines). Rhizomes are planted in hops yards to produce the female cones that contain essential oils used to provide aroma and flavor for beer. Some people also are investigating the use of hops cones for aromatherapy and various craft products. Given the rapid increase in microbreweries, the demand for certain hops has increased substantially. USDA figures show that total U.S. production has risen from 55 million pounds in 2004 to 69 million pounds last year in 2013. The majority of this production is concentrated in the west, where disease pressure is much lower, but there is local demand for Kentucky grown hops to be used in Kentucky Proud products. We established a hops yard at the Robinson Center for Appalachian Resource Sustainability (RCARS) in Breathitt County, Kentucky, to examine growth of some common varieties and to determine common pest problems and susceptibility to disease.

Materials and Methods

This study was completed at RCARS. Soils are Nolin-Grigsby Series formed in mixed alluvium derived from sandstone, siltstone, and shale with moderate permeability. Soil test results indicated that phosphorus and potassium were in an acceptable range (72 ppm P, 101 ppm exchangeable K). Lime was added to bring soil pH to 6.5. One kg of 19-19-19 was added to each plot in the spring at first shoot emergence.

Five varieties (Cascade, Chinook, Mt. Hood, Nugget, and Newport) were planted on June 1, 2011, in a randomized complete block design with 3 replications, 5 plants per plot (n=15). Rhizomes were planted 4 feet apart in the row with fifteen feet between rows. Rhizomes were replanted as needed on May 16, 2012. Trellis posts were cut at RCARS and are 30 feet long with 5 feet in the ground and 25 feet from ground to the top wire. The bottom catch wire is high tensile steel and is at eight inches from the ground. Top wire is 1/8" 7x19 vinyl coated galvanized cable. A boat trailer winch was used to lower each top wire and bailer twine was attached between the lower catch wire and the top wire with two strands per crown every spring. Irrigation was available but was not used. No insecticides or fungicides were used. Weed control primarily was hand cultivation with spot application of glyphosate to control perennial weeds.

Each spring, bines are cut off the second week of May close to our frost-free date. The first 4 bines that emerge are then allowed to grow and trellised up the bailer twine. Remaining bines that emerge are removed every three weeks throughout the season until mid-August.

Results and Discussion

In 2011, of the 15 bines per variety, only seven Cascade bines, three Nugget, one Mt. Hood, and 1 Nugget grew enough to produce any cones, so harvest data was not collected. Over the winter of 2012, there was significant loss of Chinook (11 of 15) and Newport (10 of 15), there was moderate loss of Mt. Hood (6 of 15), and minor loss of Cascade (2 of 15) and Nugget (1 of 15). Hops were hand harvested the last week of August in 2012 and 2013. After harvest they are spread on screen racks out of the sun and allowed to dry to 10 percent moisture. Yield per plot for 2012 and 2013 are shown in Table 1. In 2014, plants were not harvested to allow for observation during the College of Agriculture Field Day.

Weeds are a significant issue and require constant attention, as hops are not very competitive with weeds. Japanese beetles are the major insect pest and can cause significant defoliation. Diseases observed include downy mildew and Phoma wilt.

Primary demand for local hops seems to be for aromatic varieties that can be used for craft brewery fresh hop brews where the hops are harvested and added to the batch within 24 hours of harvest. Bittering types that can be added earlier in the brewing process are readily available as dried pellets and unless desired for a completely local brew may not be as profitable for Kentucky growers.

Table 1. Hops dry weight (ounces) per plot (n=5) and general observations in 2012 and 2013.

Variety	Rep	2012	2013	Comment
Cascade	1	18.0	22.3	Very productive, aromatic and bittering type
Cascade	2	19.2	18.5	
Cascade	3	11.5	17.6	
Nugget	1	4.3	5.6	Moderately productive, aromatic and bittering type
Nugget	2	4.8	8.9	
Nugget	3	1.1	7.3	
Chinook	1	3.6	5.0	Erratic establishment, aromatic and bittering type
Chinook	2	6.0	6.6	
Chinook	3	0.5	4.2	
Mt. Hood	1	1.5	3.4	Not very productive, aromatic type
Mt. Hood	2	1.5	1.1	
Mt. Hood	3	4.8	4.6	
Newport	1	1.1	2.1	Difficult to establish, bittering type
Newport	2	3.1	4.2	
Newport	3	1.7	0.9	

Beneficial Insects in Blackberries Baited with Methyl Salicylate-Based Lures

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Introduction

Kentucky ranks tenth in the nation among states producing blackberries. Approximately 368 acres of blackberries are grown annually. Demand for locally grown and damage-free blackberries usually exceeds the supply.

Pests such as aphids and spider mites may damage the buds and leaves of blackberries. These insects are of great concern to growers. Insecticides are currently the primary means of managing insects in blackberries.

Developing sustainable production methods, including utilizing beneficial insect attractants, such as a methyl salicylate-based lure, is important for the success of organic farmers. Thus, the objective of this study was to quantify the species diversity of beneficial insects in blackberry plantings baited with methyl salicylate and to assess the abundance of aphids over two growing seasons.

Materials and Methods

Eight blackberry sites, including six grower collaborators, were located in several counties in central Kentucky. Three sites were certified organic and the other five sites had no pesticides applied. Sites were characterized as market garden, urban garden, small peri-urban farm, or farm based on site size and location.

Four sticky traps and posts were placed in all plots and two PredaLure® lures were placed in each of the four PredaLure® baited sites. Sticky traps were collected weekly, placed in labeled freezer bags and taken to the laboratory where beneficial insects and aphids were identified using an illuminated magnifier. This study was conducted during the blackberry growing seasons of 2011 and 2012.

Table 1. Total beneficial insect abundance in PredaLure baited and non-baited plots.

Pairs		Least Sq Mean	Std. Error
Market Garden	A	127.5	31.03
Urban Garden	A	93.25	31.03
Small Peri-urban Farm	A	111.75	31.03
Farm	A	169.75	31.03
α=0.050			
pair leverage, p=0.3923			

Averages followed by the same letter are not significantly different.

Table 2. Beneficial insect diversity calculated per sampling year.

Year		Least Sq Mean	Std. Error
2011	A	0.398	0.0296
2012	A	0.298	0.0296
α=0.050			
year leverage, p=0.1280			

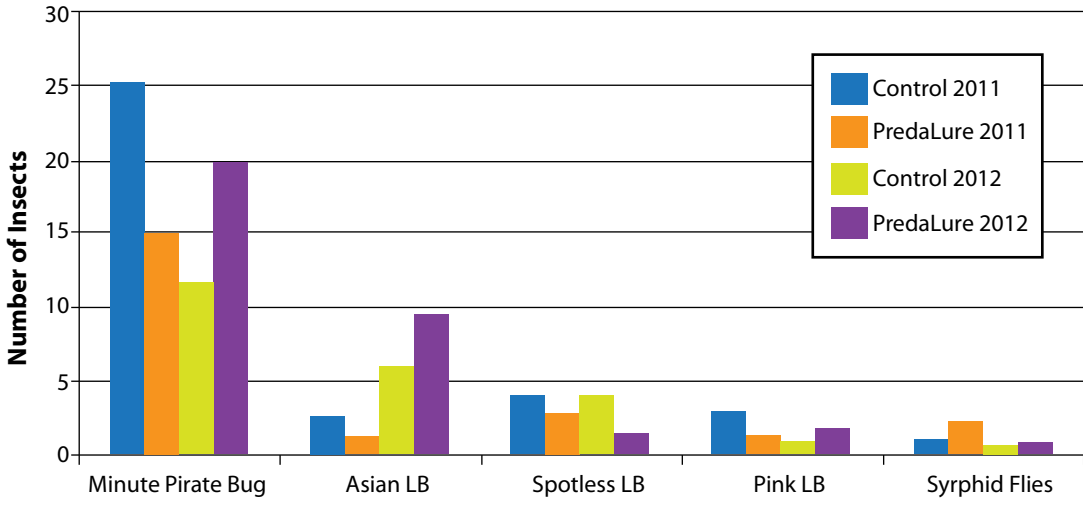
Averages followed by the same letter are not significantly different.

Averages were calculated by week and treatment type. Statistical analyses were performed using JPM statistical software v9 and Microsoft Excel.

Results and Discussion

Eight species of lady beetles were identified among all of the blackberry plantings. The most abundant beneficial insects were the minute pirate bug, (*Orius insidiosus*), the multicolored Asian lady beetle (*Harmonia axyridis*), the spotless lady beetle (*Cycloneda munda*), pink lady beetle (*Coleomegilla maculata*),

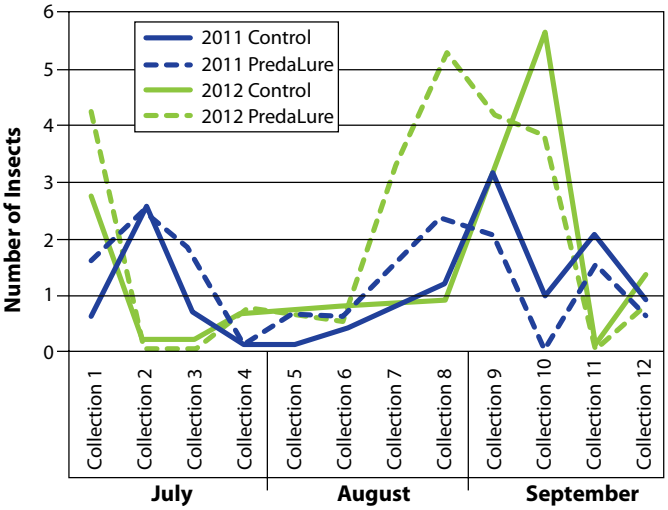
Figure 1. Average per trap for the most abundant beneficial insects in PredaLure baited and non-baited plots.



and syrphid flies (Figure 1). All other beneficial insects were found in very low numbers. No difference was shown in the effect of PredaLure® among the four site types (Table 1) or between years (Table 2) on beneficial insect abundance or diversity, respectively. No trend in the abundance of aphids was observed between treatments or years (Figure 2).

Methyl salicylate had no effect on overall beneficial insect abundance or aphid populations. Results could have been influenced by the surrounding vegetation, e.g., fruiting and non-fruiting trees and shrubs, vegetable plantings, row crops, or mixed grass and forb pastures. The size of the blackberry planting may also affect how many insects were found in these areas, while the location may affect which species are found. Based on these results for the blackberry planting locations, methyl-salicylate baited lures did not increase the abundance of beneficial insects at baited sites. Additional research should be performed examining deployment strategies of the lures and having a greater number of sampling locations in each of the four categories of sites.

Figure 2. Weekly average number of aphids per trap.



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Wine and Seedless Table Grape Cultivar Evaluation Trial in Kentucky

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Introduction

The climate in Kentucky is well suited to produce a variety of wine and table grape cultivars. However, spring frosts, cold winter temperature fluctuations and long, warm, humid summers pose challenges to growing grapes in Kentucky. Successful production is determined by the use of proper cultural practices and matching cultivar and rootstock to a specific site. The primary types of grapes grown in Kentucky are *Vitis vinifera* (European), interspecific hybrids, and *Vitis aestavalis* (Norton). Although interspecific hybrids and Norton are less sensitive to the continental climate in Kentucky, *V. vinifera* cultivars often produce more desirable wines and potentially have the highest economic gain for grape growers and wine makers. However, *V. vinifera* cultivars are more susceptible to winter injury and diseases, often resulting in lower yields and increased labor inputs. A cultivar trial consisting of table, interspecific hybrid, and *V. vinifera* grape cultivars was conducted to assess and improve fruit and wine quality through cultural management, and rootstock and clone selection. The following research update is intended to provide the 2014 season production and cultivar performance results.

Materials and Methods

Two research vineyards were planted in the spring of 2006 at the University of Kentucky Horticulture Research Farm (UKHRF) in Lexington, KY. Vineyard one consists of five table grape and 20 American/hybrid cultivars. Each cultivar in vineyard one has four replications with three vines per replication (12 vines total) in a randomized complete block design. All cultivars were planted at 545 vines/acre (8 ft. between vines and 10 ft. between rows) and trained to a 6-foot single high wire bilateral cordon. Vines were planted as own-rooted vines with the exception of Chambourcin, Chardonel, Vidal blanc, and Traminette that were additionally planted on the rootstocks 101-14, 3309, and 5C respectively. Additional hybrid cultivars including: own-rooted Chambourcin, Frontenac Gris, and Marquette were added to this planting in 2008. Vineyard two was established in 2006 and consists of 15 European cultivars (*Vitis vinifera*) and 21 different clones. Each cultivar and clone of cultivar has four replications with four vines per replication (16 vines total) in a randomized complete block design. All vines were planted on the rootstock 101-14, spaced at 622 vines/acre (7 ft. between vines and 10 ft. between rows) and trained to vertically shoot positioned (VSP)

Table 1. Yield components for the 2013 Vinifera wine grape cultivar trial, UK Horticulture Research Farm.

Cultivar/Clone	Harvest Date	Yield per Acre[1] (tons)	Yield per Foot[2] (lb)	Shoots Per Foot of Cordon[3]	% Culled Clusters[4]	Cluster Weight (g)
White						
Chardonnay #15	Sep 10	0.5	0.3	2.6	3	144
Chardonnay #37	Sep 10	1.4	0.8	3.3	5	170
Chardonnay #4	Sep 10	0.3	0.2	2.6	2	199
Chardonnay #43	Sep 10	1.4	0.7	3.5	2	162
Chardonnay #76	Sep 10	0.9	0.5	3.5	5	148
Pinot Grigio #146	Aug 27	0.6	0.3	2.4	23	294
Pinot Grigio #152	Aug 27	0.8	0.5	2.3	29	192
Pinot Grigio #4	Aug 27	0.5	0.3	2.6	30	183
Riesling #12	Sep 2	3.7	2.0	3.7	11	171
Riesling #17	Sep 2	2.4	1.4	3.5	12	151
Riesling #9	Sep 2	4.7	2.5	3.9	14	186
Rkatsiteli	Sep 10	2.2	1.5	4.4	3	269
Red						
Limberger	Aug 15	1.3	0.7	3.1	1	203

1 Yield per acre calculated using 7ft x 10ft vine/row spacing, with 622 vines per acre.
2 Total yield divided by the total length of cordon = yield per linear foot of cordon.
3 Total number of shoots divided by the total length of cordon = shoots per linear foot of cordon.
4 Percentage of harvested clusters having ≥ 30% damage

Table 2. Yield components for the 2014 American/hybrid wine grape cultivar trial, UK Horticulture Research Farm.

Cultivar/ Rootstock	Harvest Date	Yield per Acre[1] (tons)	Yield per Foot[2] (lb)	Shoots Per Foot of Cordon[3]	% Culled Clusters[4]	Cluster Weight (g)
White						
Aromella	Aug 11	4.7	2.3	5.0	0	129
Cayuga	Aug 11	4.9	2.4	4.9	0	178
Chardonel/C-3309	Sep 10	5.0	2.5	4.7	0	315
Chardonel/OR	Sep 10	3.2	1.6	4.2	0	219
Frontenac Gris	Aug 21	2.7	1.6	5.4	8	139
Seyval Blanc	Aug 29	4.2	2.1	4.5	11	238
Traminette/5C	Sep 9	4.6	2.4	5.2	4	146
Traminette/OR	Sep 9	3.7	1.8	4.8	2	103
Vidal/5C	Sep 9	5.6	2.9	4.8	1	212
Vidal/OR	Sep 9	5.9	3.0	5.0	1	204
Vignoles	Aug 29	1.7	0.8	5.9	51	99
Villard Blanc	Aug 28	6.0	3.2	5.7	1	185
Red						
Chamb/101-14	Sep 23	5.5	2.7	4.8	4	276
Chamb/OR	Sep 23	1.0	0.8	5.1	0	181
Chancellor	Sep 9	4.6	2.3	5.5	0	167
Corot Noir	Sep 4	4.8	2.3	4.3	3	192
Foch	Aug 15	3.1	1.6	5.4	54	137
Frontenac	Aug 21	3.6	1.8	4.4	13	142
GR7	Aug 28	3.9	2.1	5.4	8	128
Marquette	Aug 15	1.9	1.0	5.1	29	102
Noiret	Sep 9	3.0	1.5	4.5	0	153
Norton	Oct 1	3.2	1.6	5.8	5	96
St. Vincent	Sep 9	8.5	4.2	5.1	0	257

1 Yield per acre calculated using 8ft x 10ft vine/row spacing, with 545 vines per acre.
2 Total yield divided by the total length of cordon = yield per linear foot of cordon.
3 otal number of shoots divided by the total length of cordon = shoots per linear foot of cordon.
4 Percentage of harvested clusters having ≥ 30% damage

bilateral cordons. Additional European cultivars including: Cabernet Sauvignon #8, Malbec, Petite Verdot, Rkatsitelli, Touriga, Tinto Cao, and Pinot Noir were added to this planting in 2008.

Standard commercial cultural management practices were implemented in both vineyards. In March of 2013 vines were spur pruned to retain approximately 8 count buds per linear foot of vineyard row. No herbicide or tillage was utilized to control winter annual weeds. Summer annual weeds were controlled with a single banded application of post-emergent herbicide (glyphosate) in July and followed by single spot spray where necessary. Most vines expressed normal to high vigor and no nitrogen fertilizer was applied during any part of the 2014-growing season. Disease and pest control were in accordance with the Midwest Commercial Small Fruit and Grape Spray Guide (ID-94).

Crop and vine balance were achieved by shoot thinning to 3-4 shoots per foot of cordon (*V. vinifera*) and 4-6 shoots per foot of cordon (hybrid) in mid-May and by cluster thinning to appropriate crop loads, post fruit set (berries bb size). Bird netting was not applied in the 2014-growing season due to very little bird pressure. Fruit maturity and harvest dates were determined by taking a 100 berry sample per cultivar, starting at veraison, to monitor the progression of total soluble solids (TSS) (Atago Digital Refractometer), pH (Hannah 222 pH meter) and titratable acidity (TA) (end point titration of pH 8.2 using 0.100 N sodium hydroxide) until harvest. Each vine was harvested separately to determine the total number of clusters and yield/vine. Table grape

Table 3. Fruit composition for the 2014 American/hybrid wine grape cultivar trial, UK Horticulture Research Farm.[1]

Cultivar/Rootstock	100 Berry Wt. (g)	TSS[2] (%)	Juice pH	TA[3] (g/L)
White				
Aromella	181	15.9	3.0	13.3
Cayuga	331	17.1	3.2	10.8
Chardonel/C-3309	270	22.3	3.3	9.5
Chardonel/OR	256	22.7	3.5	9.5
Frontenac Gris	115	25.2	3.3	13.5
Seyval Blanc	218	20.6	3.3	6.6
Traminette	218	20.6	3.3	6.6
Traminette/5C	215	19.8	3.4	7.7
Vidal/5C	223	20.5	3.5	8.6
Vidal/OR	221	19.7	3.4	6.1
Vignoles	167	22.8	3.2	13.7
Villard	267	16.8	3.0	12.9
Red				
Chamb/101-14	259	21.7	3.5	9.5
Chamb/OR	239	22.0	3.6	9.8
Corot Noir	238	16.2	3.6	5.6
Chancellor	222	20.9	3.3	7.5
Foch	119	22.2	3.3	10.7
Frontenac	127	22.3	3.3	15.2
GR7	175	20.6	3.5	10.1
Marquette	129	25.1	3.2	15.3
Noiret	242	17.5	3.4	7.9
Norton	145	23.9	3.7	10.5
St. Vincent	334	19.4	3.2	11.4

1 Fruit samples were collected and analyzed on harvest dates listed in Table 1.
2 TSS = total soluble solids measured as °Brix in juice.
3 T.A. = Titratable acidity measured as grams of tartaric acid per liter of juice.

Table 4. Fruit composition for the 2014 table grape cultivar trial, UK Horticulture Research Farm.[1]

Cultivar/Rootstock	Berry Wt. (g)	TSS[2] (%)	Juice pH	TA[3] (g/L)
Einset	215	18.1	3.1	6.8
Jupiter	276	16.3	3.2	9.1
Marquis	528	16.7	3.4	4.5
Mars	275	15.2	3.1	6.0
Neptune	457	20.1	3.4	7.4
Reliance	215	17.2	2.9	9.4

[1] Fruit samples were collected and analyzed on harvest dates listed in Table 2.
[2] TSS = total soluble solids measured as °Brix in juice.
[3] T.A. = Titratable acidity measured as grams of tartaric acid per liter of juice.

Table 5. Fruit composition for the 2014 vinifera wine grape cultivar trial, UK Horticulture Research Farm.[1]

Cultivar/Clone #	Berry Wt. (g)	TSS[2] (%)	Juice pH	TA[3] (g/L)
White				
Chardonnay	177	19.9	3.5	8.2
Pinot Grigio	172	17.7	3.3	8.6
Riesling #12	179	16.8	3.1	11.7
Riesling #17	171	15.9	3.1	12.2
Riesling #9	189	16.2	3.2	11.1
Rkatsiteli	264	17.6	3.1	9.1
Red				
Limberger	176	17.5	3.1	15.2

[1] Fruit samples were collected and analyzed on harvest dates listed in Table 3.
[2] TSS = total soluble solids measured as °Brix in juice.
[3] T.A. = Titratable acidity measured as grams of tartaric acid per liter of juice.

clusters were selectively harvested at two to three harvest dates dependent upon evenness of ripening and fruit chemistry. A final 100-berry sample was taken at harvest to determine fruit chemistry (TSS, pH and TA) and berry weight.

Results and Discussion

Freezing temperatures experienced during December (2013) and January (2014) resulted in extensive damage to most *V. vinifera* wine grape cultivars at the UKHRF. Temperatures reached as low as -5.8 °F, resulting in nearly 100% primary bud mortality in all *V. vinifera* vines except Riesling, Rkatsiteli, Pinot Gris, and Chardonnay. Substantial primary bud mortality led to extremely low shoot densities, with less than 3 shoots per linear foot of vineyard row expressed by most *V. vinifera* vines. Although many *V. vinifera* vines were not killed outright, shoots were predominantly derived from secondary, tertiary, and latent bud positions with most vines expressing weaker than average shoot vigor. The true extent of vine damage to *V. vinifera* cultivars will not likely be determined until the 2015 season, where injury to perennial vine structures (trunks and cordons) will likely be more fully expressed under the stress of potentially higher cropload than that observed in 2014. Riesling (3.6 tons/acre) and Rkatsiteli (2.2 tons/acre) were the only *V. vinifera* cultivars to achieve commercially significant yield in 2014 (Table 1). Cluster rot due to rain-induced berry splitting was the predominant cause of damaged (culled) fruit in both Pinot Gris and Riesling clones (Table 1). An unforeseen advantage to the freeze damage associated with the destruction of primary buds in all *V. vinifera* cultivars was the nearly 2-3 week delay of both bud break and veraison which provided an opportunity for cultivars like Chardonnay, Riesling, and Pinot Gris to ripen under less pressure from Green June Beetle (GJB) feeding, which are usually in peak flight during normal ripening times for these cultivars.

Table 6. Yield components for the 2014 table grape cultivar trial, UK Horticulture Research Farm.

Cultivar/ Rootstock	Harvest Date	Yield per Acre[1] (tons)	Yield per Foot[2] (lb)	Shoots Per Foot of Cordon[3]	% Culled Clusters[4]	Cluster Weight (g)
Einset	July 30	3.0	1.5	4.2	0	122
Jupiter	July 25	3.3	1.7	4.7	1	149
Marquis	Aug 15	5.9	2.9	4.3	0	341
Neptune	Sep 10	1.1	0.6	4.2	0	367
Reliance	July 27	5.6	2.7	4.6	3	265

[1] Yield per acre calculated using 8ft x 10ft vine/row spacing, with 545 vines per acre.
[2] Total yield divided by the total length of cordon = yield per linear foot of cordon.
[3] Total number of shoots divided by the total length of cordon = shoots per linear foot of cordon.
[4] Percentage of harvested clusters having ≥ 30% damage

Freezing temperatures experienced during December (2013) and January (2014) did not affect primary bud mortality rates for any American and interspecific hybrid wine grape cultivars with average shoot fruitfulness and vine cropload being within range of historical yield potential (Table 2). Cooler than average nighttime temperatures, combined with frequent rain events in July and August led to delayed harvest dates for many of the earliest ripening cultivars and higher than average juice titratable acidity for nearly all cultivars in 2014 (Table 3). In general, fruit rot incidence was relatively low with one exception; untimely rains led to a 51% reduction in yield of Vignoles vines which led to a relatively high incidence of bunch rot complex (Table 2). Damage caused by GJB in 2014 was less than average likely due to cooler temperatures that delayed onset of veraison in most cultivars. Regardless of this delay, the early ripening cultivars Foch, Frontenac, Frontenac Gris, Marquette, GR7, and Seyval blanc all expressed some degree of cluster rot caused by GJB feeding (Table 2). Fruit chemistry for hybrid, V. *vinifera,* and table grape cultivars generally expressed desirable aroma profiles at lower than average pH, and sugar accumulation while expressing higher than average titratable acidity values in 2014 (Table 3, Table 4, Table 5). Wines produced at the UKHRF during the 2014 season have the potential to be of exceptional quality. Yield of table grape cultivars was directly proportional to individual vine vigor, with harvest dates determined based upon development of both flavor and fruit integrity (Table 6).

The vineyards at the University of Kentucky Horticulture Research Farm are planted in a unique site and vines are carefully managed in a research setting. All sites in Kentucky will not be able to sustain an economically viable crop of all varieties. It is imperative to evaluate each grape growing site and match variety and rootstock to that specific site.

Acknowledgements

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Rabbiteye Blueberry Variety Trial

Chris Smigell, John Strang, and John Snyder, Horticulture

Consumer interest in blueberries has motivated Kentucky farmers to increase blueberry acreage from 200 in 2007 to around 350 acres in 2012, according to USDA statistics. This trial has been continued to evaluate rabbiteye blueberry variety adaptation to Central Kentucky growing conditions. Rabbiteye varieties typically have shorter chilling requirements than highbush varieties. Consequently rabbiteye flower buds may begin developing and opening earlier than those of the highbush varieties, and thus have a greater chance of being damaged or killed by late spring frosts. Rabbiteye blueberries also have the potential to extend blueberry harvesting in Kentucky for about a month more than highbush varieties.

Materials and Methods

The trial was established at the Horticultural Research Farm in Lexington in the spring of 2004. Plants were acquired from Fall Creek Nursery, Lowell, Ore.; Finch Nursery, Bailey, N.C.; DeGrandchamp's Farm, South Haven, Mich.; and from Jim Ballington at North Carolina State University, Raleigh, N.C. Originally highbush, southern highbush, and rabbiteye varieties were planted. Two years ago most of the highbush and southern highbush varieties were removed except for a few for comparative purposes.

Plants were set on raised beds of Maury silt loam soil into which peat and composted pine bark mulch had been incorporated and the soil pH had been adjusted from 5.6 to 4.6 by applying 653 lb. of sulfur per acre. Seventy pounds of phosphorus were applied per acre and incorporated into the field prior to bed shaping and planting. Five replications of individual plant plots were set in rows running east to west in a randomized block design. The rabbiteye blueberries were planted with 6 ft. between plants and 12 ft. between rows. All plants were mulched with a three foot wide, six inch layer of wood chips.

Plants have been fertilized yearly with Osmocote Plus 5-6 month controlled release (15-9-12) fertilizer that contains six trace elements and magnesium at the rate of 1 oz. per plant in March, April, May, June, and July. In 2014, Sulforix and Captan were applied for disease control and Surflan and glyphosate for weed control.

Fruit were harvested once a week. Twenty five berries from each plant were weighed to determine average berry size at each harvest and fruit were rated subjectively by the same evaluator at all harvests for taste and appearance several times during the season.

Results

Precipitation averages for 2014 were below normal for January, March, May, June, and July. February, April, and August monthly averages were 0.6, 2.3, and 2.2 inches above normal, respectively. Monthly temperature averages were about 4° F below normal for January, February, March, and July. Temperatures were 2° F above normal for April, May, and June. None of the plants exhibited any winter injury despite a low of -5.2° F on January 5.

Harvest and fruit size data are shown in Table 1. Powderblue (rabbiteye) had higher yields than Spartan (highbush) NC-1827, Star (southern highbush), Lenoir (southern highbush), and Climax (rabbiteye). Columbus berries were larger than those of other varieties while NC-1827 and Lenoir tended to have some of the smaller berry sizes in the trial. Lenoir berries tasted significantly better than other varieties. Berry appearance for all varieties was very good, although Spartan, Star, and Lenoir were rated slightly lower in appearance that other varieties.

Harvest began on Star (southern highbush) and Spartan (highbush) varieties almost a week earlier than NC-1827, Lenoir, and Climax and 36 days earlier than the other rabbiteye blueberries. Harvest was completed on Star and Lenoir by July 15, but continued on Powderblue, Columbus and Onslow until September 8.

Acknowledgments

The authors would like to thank the following persons for their hard work and assistance in the successful completion of this trial: Dave Lowry, Kraipop Pintatam, Supamit Songsaengchan, Joseph Tucker, and Emily Vollbrecht.

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Table 1. Rabbiteye and highbush yields, berry weights, taste and appearance ratings, and harvest dates.

Variety (Type)[1]	Yield[2] (lbs/A)	Berry wt (oz/25 berries)	Berry taste (1-5)[3]	Berry appearance (1-5)[4]	First harvest date	Last harvest date
Powderblue (R)	8030 a	1.1 cd	3.8 cd	4.9 a	31 July	8 Sept
Columbus (R)	5760 ab	1.7 a	3.8 cd	4.8 a	31 July	8 Sept
Ira (R)	5360 ab	1.2 bcd	3.9 bcd	4.9 a	31 July	29 August
Onslow (R)	3450 ab	1.4 b	3.7 cd	4.7 a	31 July	8 Sept
Tifblue (R)	3010 ab	1.2 bcd	4.0 bc	4.7 a	31 July	18 August
Spartan (HB)	2980 b	1.2 bcd	4.1 b	3.7 b	25 June	31 July
NC1827 (R)	2840 b	0.9 e	3.6 d	4.6 a	1 July	21 July
Star (SH)	2840 b	1.3 bc	3.6 d	4.0 b	25 June	15 July
Lenoir (SH)	2450 b	1.0 de	4.4 a	4.0 b	1 July	15 July
Climax (R)	2160 b	1.3 bc	3.8 cd	4.7 a	1 July	21 July

1 Type: HB = highbush, SH = southern highbush, R = rabbiteye
2 Numbers followed by the same letter are not significantly different (LS Means, P = 0.05)
3 Berry taste: 1 = poor; 5 = excellent
4 Berry appearance 1=poor, 5=excellent

Second and Third Year Data from the Advanced Thorny and Thornless Primocane-fruiting Blackberry Selection Trial at Kentucky State University

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Introduction

Kentucky has a climate that is favorable for blackberry production and the number of farms with blackberry acreage in the state has increased from 271 in 2007 to 368 in 2012. Blackberry plants are unusual among fruit crops in that they have perennial root systems, but have biennial canes. There are two cane types, primocanes, or first year canes, which are usually vegetative, and floricanes, which are the same canes and flower and produce fruit the next growing season. Floricanes then die after fruiting and need to be removed. Primocane-fruiting blackberries have the potential to produce two crops per year, with a normal summer crop (floricane) and a later crop on the current season primocanes. Primocane-fruiting blackberries flower and fruit from mid-summer until frost, depending on temperatures, plant health, and the location in which they are grown. Growers can reduce pruning costs by mowing canes in late winter to obtain a primocane crop only; this also provides anthracnose, cane blight, and red-necked cane borer control without pesticides. Relying only on a primocane crop also avoids potential winter injury of floricanes.

The first commercially available primocane-fruiting blackberry varieties, 'Prime-Jim®' and 'Prime-Jan®,' were released by the University of Arkansas in 2004. 'Prime-Ark®45' was released for commercial use in 2009. Fruit size and quality of primocane-fruiting blackberries can be affected by the environment. Summer temperatures above 85°F can greatly reduce fruit set, size, and quality on primocanes, which results in substantial reductions in yield and fruit quality in areas with this temperature range in summer and fall. With the exception of 'Prime-Ark®Freedom,' all available primocane-fruiting blackberry selections are thorny and erect. The objective of this study was to determine if thorny and thornless advanced selections developed by the University of Arkansas (UARK) Blackberry Breeding Program were superior to Prime-Ark®45 in terms of yield and fruit quality under Kentucky growing conditions.

Materials and Methods

In June 2011, a blackberry variety trial was established at Kentucky State University (KSU). Plants of the commercially available primocane-fruiting cultivar Prime-Ark 45® (thorny erect, primocane-fruiting) and the Arkansas Primocane-fruiting (APF) selections of thorny or thornless (T) advanced selections (APF-153 T, APF-156 T, APF-158, APF-172, APF-185 T, APF-190 T, and APF-205 T) from the UARK blackberry breeding program, were planted at the KSU Research and Demonstration Farm, in Frankfort, Kentucky. Plants were arranged in a randomized complete block design, with 4 blocks, including 5 plants of each cultivar per block (total of 20 plants of each cultivar) in a 10 foot plot. Spacing was 2 feet between each plant, and 5 feet between groups of 5 plants; with each row being 70 feet in length. Rows were spaced 14 feet apart. This trial was planted on the certified organic land and managed with organic practices following the National Organic Program standards. Weed control was achieved by placing a 6-8 inch deep layer of straw around plants, adding straw when necessary and hand weeding. Plants were irrigated weekly with t-tape laid in the rows. Floricanes in the spring of 2013 began producing ripe fruit in June 2013 for most selections and were harvested each Monday and Thursday until a killing frost (26°F) on October 25, 2013.

Results and Discussion

Floricanes in the spring of 2013 began producing ripe fruit in June, 2013. Primocane fruit production began in late July or early August for most selections in 2013 and 2014. Fruit production continued until frost (Table 1). APF-158 had the highest yield at 7146 lb/acre. However, all other selections had yields that were much lower. Yields of other selections in this trial ranged from 5636-760 lb/acre. Prime-Ark 45® had a yield of 3795 lb/acre. APF-153 T had the largest average berry size at 6.26 g. APF-172, APF-185T, and APF-190T had the smallest berry size, which were below 4.5 g (Table 1). The average high for July 2013 was 81.9°F. Growing conditions in 2013 were mild; there were 40 out of 122 days with a daily high temperature above 85°F from June through September. Temperatures also were mild in 2014 with 42 out of 122 days over 85°F from June through September with an average high in July of 81.8°F. APF-158 also had the highest yield in 2014 at 3458 lb/acre, while APF-185 T had the lowest at 418 lb/acre (Table 1). Prime-Ark® Freedom had the largest berry size (6.65 g) and APF-190 T the smallest (3.98 g). Overall, APF-

Table 1. Yield and berry weight in 2013 and 2014 for seven advanced primocane-fruiting selections from the University of Arkansas Blackberry Breeding Program and the primocane-fruiting cultivar 'Prime-Jan®' that were established at the Kentucky State University Research Farm in June 2011.

Selection	2013 Fruit Weight (g)	2014 Fruit Weight (g)	2013 Yield (lb/acre)	2014 Yield (lb/acre)	2013 Harvest Date	2014 Harvest Date
Prime-Ark 45	4.87 cd	4.68 bc	3795 c	1650 bc	6/24-10/22	7/25-10/24
Prime-Ark Freedom	6.26 a	6.65 a	760 d	648 e	6/27-10/22	7/25-10/24
APF-156 T	4.86 cd[1]	4.44 cd	1976 d	517 e	6/27-10/22	7/29-10/24
APF-158	5.23 bc	4.95 bc	7147 a	3458 a	6/24-10/22	7/25-10/24
APF-172	4.16 e	4.65 bcd	3507 c	2095 b	6/24-10/22	7/19-10/24
APF-185 T	4.23 e	4.44 cd	868 d	418 e	6/24-10/22	8/7-10/10
APF-190 T	4.40 de	3.98 d	5636 b	949 de	6/24-10/18	7/25-10/24
APF-205 T	5.45 b	5.32 b	1329 d	1376 cd	6/27-10/22	7/29-10/24

[1] Numbers followed by the same letter are not significantly different (Least Significant Difference P = 0.05)

The 'Black Magic™' and 'Prime-Ark®45' Thorny Primocane-fruiting Blackberry Trial at Kentucky State University

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Introduction

In Kentucky, more than 670 farms grow berry crops, including blackberries that are valued at more than $2,600,000 annually. Kentucky's climate is well-suited for blackberry production. Blackberry plants are unusual among fruit crops in that they have perennial root systems, but have biennial canes. Two cane types exist: primocanes, or first-year canes, which are usually vegetative, and floricanes, which are the same canes that flower and produce fruit the next growing season. Floricanes die after fruiting and need to be removed. Primocane-fruiting blackberries have the potential to produce two crops per year, with a normal summer crop (floricane) and a later crop on the current season primocanes. Primocane-fruiting blackberries flower and fruit from mid-summer until frost, depending on temperatures, plant health, and the location in which they are grown. Growers can reduce pruning costs by mowing canes in late winter to obtain a primocane crop only; this method also provides anthracnose, cane blight, and red-necked cane borer control without pesticides. Relying only on a primocane crop also avoids potential winter injury of floricanes.

The thorny primocane-fruiting blackberry varieties, 'Prime-Jim®' and 'Prime-Jan®,' were released by the University of Arkansas in 2004. In Kentucky trials, 'Prime-Jan®' has higher yields and larger fruit than 'Prime-Jim®.' 'Prime-Ark®45' was recently released for commercial production by the University of Arkansas, but has not been tested in Kentucky. Fruit size and quality of primocane-fruiting blackberries can be affected by the environment. Summer temperatures above 85°F can greatly reduce fruit set, size, and quality on primocanes; which results in substantial reductions in yield and fruit quality in areas with this temperature range in summer and fall. The objective of this study was to determine whether 'Prime-Ark®45' is superior to 'Prime-Jan®' in terms of yield and fruit quality under Kentucky growing conditions. Here we report production from the trial in its third year after establishment.

Materials and Methods

In June 2012, a blackberry trial was planted at the KSU Research and Demonstration Farm on certified organic land. The planting contained three replicate blocks each of the selections 'Black Magic™' and 'Prime-Ark®45', both primocane fruiting selections from the University of Arkansas. Plants were arranged in a completely randomized design, with 3 replicate plots each containing 5 plants of each selection (total of 15 plants of each selection) in 10 foot plots. This trial was managed with organic practices following the National Organic Program standards. A combination of cultivation, hand weeding, and straw mulch was used for weed control. Drip irrigation was used as needed. Floricanes were removed in March so only a primocane crop was produced. Primocanes were tipped on all selections at one meter beginning in early June to promote lateral branching and flowering. Ripe fruit were harvested from the plants twice weekly, Tuesday and Friday, from July through October.

Results and Discussion

Primocane fruit were harvested from late-July until frost in late-October (Table 1). The average high for July 2013 was 81.9°F. Growing conditions in 2013 were mild; there were 40 out of 122 days with a daily high temperature above 85°F from June through September. Temperatures were also mild in 2014 with 42 out of 122 days over 85°F from June through September with an average high in July of 81.8°F. In 2013, 'Black Magic™' had a larger berry size and a higher yield, but the differences were not significant. In 2014, 'Prime-Ark® 45' had a larger yield, but again, the difference was not significant. 'Black Magic™' did have a significantly larger berry size (5.36 g vs. 4.31 g) in 2014. The University of Arkansas Blackberry Breeding Program recommends that commercial producers plant 'Prime-Ark®45' due to the superior shipping quality of the firmer fruit of 'Prime-Ark®45.' Due to softer fruit, 'Black Magic™' is recommended for U-pick and on-farm sale production practices as well as home gardeners. Year to year yield characteristics will need to be further evaluated; however, the data suggests that 'Prime-Ark®45' and 'Black Magic™' have a large fruit size and yields well in Kentucky. 'Prime-Ark®45' as well as 'Black Magic™' should be considered by commercial growers interested in producing primocane fruiting blackberries.

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Table 1. Yield and berry weight in 2013 and 2014 for the thorny primocane- fruiting blackberry cultivars 'Black Magic™' and 'Prime-Ark®45' from the University of Arkansas Blackberry Breeding Program that were established at the Kentucky State University Research Farm in June 2012.

Selection	2013 Fruit Weight (g)	2014 Fruit Weight (g)	2013 Yield (lb/ acre)	2014 Yield (lb/ acre)	2013 Harvest Date	2014 Harvest Date
Black Magic	5.11 a	5.36 a	1479 a	1026 a	7/29-10/22	8/7-10/24
Prime-Ark 45	4.9 a	4.31 b	1071 a	1501 a	7/29-10/22	7/29-10/24

[1] Numbers followed by the same letter are not significantly different within the same column (Least Significant Difference P = 0.05)

Kohlrabi Variety Evaluation

Chris Smigell, John Strang, and John Snyder, Horticulture, and Pam Sigler, Program and Staff Development

Introduction

Kohlrabi is a vegetable in the brassica family of vegetables, which includes broccoli, cabbage, kale, cauliflower and Brussels sprouts. It is shaped like a turnip, but is really an enlarged stem. Its taste and texture are similar to broccoli. Kohlrabi offer growers another crop to expand farm market sales. Eight kohlrabi varieties were evaluated in a spring replicated trial to determine their performance under Central Kentucky conditions. Culinary evaluations were conducted to assess consumer varietal preferences.

Materials and Methods

Varieties were seeded on March 23, 2014, into 72-cell plastic plug trays filled with ProMix MP multipurpose organic media (Premier Horticulture, Inc.) at the University of Kentucky Horticulture Research Farm in Lexington. Greenhouse-grown transplants were set into black plastic-covered raised beds on 6 ft. centers using a water wheel setter on May 9. Beds were marked off into 10 ft. long plots. Each contained 40 plants of one variety, set six inches apart, in double rows spaced 12 inches apart. Plots were replicated four times in a randomized, complete block design.

Fifty pounds per acre of nitrogen, phosphorus and potassium were applied as 19-19-19, prior to planting, and tilled in. Approximately one cup of starter solution (6 lb. of 10-30-20 in 100 gallons of water) was applied to each plant at transplanting. The plot was drip-irrigated as needed. Javelin BT insecticide (1.5 lb./A) was applied twice for caterpillar control.

Kohlrabi (which are actually the plants' stems) were harvested at a diameter of 2 to 3 inches. Harvesting began June 5, and continued at three to four-day intervals through June 23. Marketable kohlrabi were weighed and counted, and number of culls recorded. Kohlrabi uniformity was rated in the field. Ten kohlrabi from each replication were measured (length and width) and one kohlrabi from each replication was evaluated for external and internal appearance, raw product taste, and internal fiber development.

Consumer panels were conducted on four days at different locations including public libraries and on the University of Kentucky campus. Thirty-three adults participated. Participants completed a survey about shopping and eating patterns of vegetables related to kohlrabi. Participants viewed the kohlrabi whole and sliced and sampled raw and diced kohlrabi, and rated their opinions. The participants were diverse in age (19 years to 66+) and ethnicity. Eighty-six percent were women.

Results and Discussion

The spring season was cool, wet, and good for kohlrabi production. Harvest yield and variety characteristics data are shown in tables 1 and 2. Varieties are ranked based on total marketable yield by weight. The top varieties based on Horticultural Research Farm and consumer evaluations were Kolibri (purple), Winner, Grand Duke, and Kossak.

Horticultural Research Farm Evaluations

Quickstar, Kolibri, Winner, and Kossak tended to produce the higher marketable yields in terms of weight, however there were no statistical differences between varieties in number of marketable kohlrabi per acre (Table 1). Korridor and Purple

Table 1. Kohlrabi yield data.

Variety	Yield (lbs/A)		Yield (kohlrabi/A)[1]		Cull (%)[2]	Stem uniformity (1-5)[3]	
Quickstar	7696	a[1]	15,400	a	7	4.1	a
Kolibri	7342	a	14,400	a	12	4.3	a
Winner	6260	ab	14,400	a	9	4.0	a
Kossak	6136	ab	12,100	a	7	4.5	a
Korridor	5852	ab	12,000	a	26	4.6	a
White Vienna	5515	ab	11,800	a	18	2.4	b
Grand Duke	5196	ab	13,400	a	16	4.1	a
Purple Vienna	4291	b	10,100	a	25	2.7	b

1 Numbers followed by the same letter are not significantly different (Duncan Multiple Range Test LSD P = 0.05).
2 Cull percentage of total kohlrabi number.
3 Stem uniformity: 1 = poor; 5 = excellent.

Table 2. Kohlrabi variety characteristics.

Cultivar	Seed Source	Days to Harvest[1]	Exterior Appearance (1-5)[2]		Internal Appearance (1-5)[2]	Width/ Height Ratio[4]	Taste Raw (1-5)[2]	Internal Fibers (1-5)[5]	Comments
Quickstar	RU, SI	37-49	4.6	a[3]	4.0	1.35	3.6	1.0	purple streaks on some; a few split culls; sulfur aftertaste
Kolibri	JO	45	4.7	a	3.9	1.31	4.5	1.0	Purple, several split and small culls
Winner	CL	57	4.3	a	4.9	1.26	4.6	1.0	Some small ones; tender, juicy
Kossak	JO	80	4.4	a	4.7	1.15	4.8	1.0	Several small culls; no splits; sweet; vigorous plants
Korridor	JO	42	4.5	a	4.6	1.22	4.3	1.0	Small plants; several split culls, some small culls
Early White Vienna	RU	58	3.5	b	4.5	1.11	4.3	1.3	Mix of round and flat ones; several split culls
Grand Duke	RU	55	4.4	a	4.8	1.26	4.0	1.3	A few with purple spots, culls due to small size
Purple Vienna	CL	55	3.6	b	4.8	0.91	2.6	1.3	Purple, off-types; culls due mostly to oblong shape

1 Days to harvest from seed catalogues.
2 Appearance and taste ratings: 1=poor; 5=excellent.
3 Numbers followed by the same letter are not significantly different (Duncan Multiple Range Test LSD P = 0.05).
4 Width/height ratio based on the avg. width and height of 10 turnips per replicate; values > 1 indicate wider, or squatter roots.
5 Internal fiber ratings: 1 = no fibers; 5 = excessive fibers.

Vienna tended to have higher numbers of cull stems, while Early White Vienna and Purple Vienna kohlrabi showed less shape and size uniformity. Purple Vienna plots had some green, off-type kohlrabi.

Quickstar and Kolibri, a purple variety, were the two earliest maturing varieties. Both had nice external and internal appearances; however Quickstar had a lingering sulfur aftertaste, although this might not be a problem if it is grown as a fall crop. Winner ranked highly for internal appearance and taste and was the best mid-season variety. Kossak, an 80-day fall storage variety, ranked very high for external and internal appearance and taste. This variety, when grown to six inches in diameter, remained fiber free and had an outstanding taste. Splitting can be a problem with kohlrabi and this was noted on some varieties, but was not excessive. Early White Vienna, Grand Duke, and Purple Vienna showed some slight fiber formation toward the end of the season.

Consumer Panel Evaluations

Ninety percent of the participants were the primary food purchaser and meal preparers in their homes. Forty-six percent shop at a farmers market less than once a month, 39% shop at them 2 to 3 times per month, 7% shop weekly, and 7% never shop at a farmers market. Seventy-six percent prepare meals daily and 17% prepare meals 2 to 3 times per week.

The participants were asked if they could recognize these cole crops: broccoli, Brussels sprouts, cabbage, cauliflower, collard greens, kale, turnips, and kohlrabi (Figure 1). Forty-two percent (N=14) of the participants reported that they could identify kohlrabi if seen at a farmers market. The vegetables more often purchased by participants were: broccoli (58% weekly, 36% monthly), cabbage (27% weekly, 33% monthly), cauliflower (24% weekly, 36% monthly), kale (21% weekly, 21% monthly), and Brussels sprouts (9% weekly, 39% monthly). Fifteen percent (N=5) had purchased or prepared kohlrabi, with one person reporting eating kohlrabi weekly while the others had eaten them once to four times per year.

Participants rated each kohlrabi variety for appearance (whole and cut) and taste (texture and flavor). All varieties received high ratings for appearance and taste. Consumer taste panel evaluations are ranked based on the overall score, a composite of whole and cut appearance, texture, and taste (Table 3). Kohlibri, Grand Duke, Winner, and Kossak received the highest overall rating scores. After tasting kohlrabi, 96% will consider purchasing in the future.

In Kentucky, total marketable yield is not a primary grower consideration in selecting a variety since sales are limited and most are sold directly to consumers. Consumers use appearance as a primary consideration at the market, while texture and taste are the basis for repeat sales.

Kolibri, a purple variety, was rated the highest for exterior and internal appearance. It also had high texture and flavor ratings and had the highest overall score. Grand Duke, Winner, and Kossak also had high overall scores. Purple Vienna was rated as tending to have the best flavor of the group but lacked somewhat in appearance compared to other varieties.

Table 3. Consumer panel evaluation of kohlrabi appearance and taste.

	Appearance[1] (1-5)		Taste[1] (1-5)		Overall Score[2]
Variety	Whole	Cut	Texture	Flavor	
Kolibri	4.22	3.97	4.17	3.77	4.03
Grand Duke	3.78	3.81	4.21	3.96	3.94
Winner	3.81	3.74	4.28	3.89	3.93
Kossak	4	3.5	4.44	3.71	3.91
Purple Vienna	3.56	3.38	4.1	4.11	3.79
Quickstar	3.78	3.68	4.07	3.54	3.77
Korridor	3.91	3.87	3.93	3.38	3.77
Early White Vienna	3.69	3.55	4	3.52	3.69

[1] Appearance: 1 = poor; 5 = excellent
[2] A composite scoring of whole and cut appearance, texture, and taste

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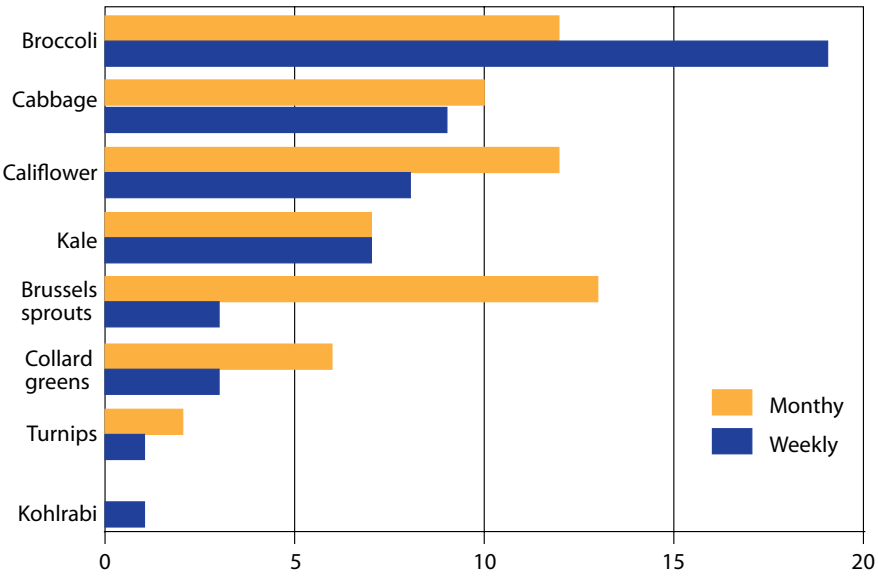
Figure 1. Percent of survey participants eating cole crop types monthly or weekly.



Fall Broccoli Cultivar Trial 2012-2013

Shawn Wright, Darrell Slone, and John Snyder, Department of Horticulture

Broccoli is a nutritious crop with strong, local demand but warm summer temperatures often make early summer production in Kentucky difficult. Varieties that will grow well from late summer into autumn could provide a good source of income, increase the availability of nutritious produce, and help meet the demand for more locally produced commodities in restaurants and schools. In Eastern Kentucky, growers often plant cabbage and various greens but broccoli production has been limited in part by lack of information on production practices and variety information. This study was conducted to demonstrate the potential of this production system and to select some varieties for further study.

Materials and Methods

This study was completed at the Robinson Center for Appalachian Resource Sustainability (RCARS) in Breathitt County, Ky. Soils are Nolin-Grigsby Series formed in mixed alluvium derived from sandstone, siltstone, and shale with moderate permeability.

Twenty-four varieties selected for a range of characteristics were seeded on July 9 and 10, 2012 into 98-cell plastic plug trays filled with ProMix BX general growing medium (Premier Horticulture, Inc.). Plants were grown for six weeks and then were set into the field on August 20 and 21. For the 2013 planting, twelve varieties from 2012 were selected for a range of maturity and characteristics as well as disease resistance and were seeded on July 8, 2013, using similar trays and growing media. Plants were grown out for seven weeks and transplants were set into the field on August 29. Raised planting beds with drip irrigation were covered with white-on-black plastic, white side up, and with 150 pounds of 19-19-19 per acre spread in the bed at formation. Drip irrigation was not needed either year. Beds were six feet on center. The plugs were set using a water-wheel transplanter with approximately one cup of starter solution (5 lb. of 10-30-20 in 100 gallons of water) applied at transplanting. Plants were eight inches apart in double rows with 12 inches between rows. Each plot row was 20 feet long and contained 60 plants. In 2012, varieties were replicated nine times and in 2013 four times, in randomized complete block designs. Weeds were controlled between the rows with cultivation and spot spraying of glyphosate where needed. No fungicides were applied either year; in 2012 weather conditions did not allow application and none were needed in 2013. Coragen at 4 oz./acre was applied once in 2013 for cabbage looper control.

Number of heads and weight per plot were measured each year. Observations were recorded on bead size as consumer preference is for smaller bead size compared to larger for fresh consumption. We also determined whether a variety was best as a single crown cut variety or was more suitable for bunching several heads together for sale.

Results and Discussion

There was a significant year effect because of distinctly different weather conditions between 2012 and 2013. Autumn 2012 was wetter than normal with over 10% more moisture and it was significantly cooler than normal with an average temperature of 55.8° F which was 2.4°F cooler than normal. These weather conditions were reflected in much more disease pressure in 2012 leading to only two harvests. Autumn 2013 was significantly drier than normal with less than 60% of average rainfall. It was also 1.3° F cooler than average but still warmer than 2012. These weather conditions were reflected in much more disease pressure in 2012 leading to only two harvests vs. five harvests in 2013. Downy mildew and bacterial soft rot were the primary diseases that caused such a low harvest in 2012 and there was also significant brown bead, a physiologic issue that causes the florets to turn brown. Broccoli frogeye, also known as cat-eye in some regions, is a physiological condition where excessive or uneven temperatures cause differential development in the inflorescence.

Data were analyzed using SAS and means separated using Duncan's Multiple Range Test. Tables 1 and 2 show mean weights (lb.) and mean head number, for 2012 and 2013, respectively. Means with the same letter are not significantly different. Table 3 lists general varietal characteristics. Hollow stem may be considered undesirable and we collected data on the number of heads having hollow stems at harvest (data not shown). Belstar, Diplomat, Blue Wind, Avenger, Ironman, and Windsor all averaged over 50% hollow stems, and Destiny, Amadeus, Major, Imperial, Emerald Jewel, Bay Meadows, and Gypsy averaged between 40-50% hollow stems. Concord, Monaco, Marathon, Maverick, Patron, Everest and Green Magic had between 25-40% hollow stems. Only Alborada, Emerald Crown, Green Gold and Expo had less than 25% hollow stems. Typically the smaller stemmed

Table 1. Mean weights and head numbers per plot 2012.

Variety	Mean wt (lbs)		Head number	
Green Gold	8.5	A	10.4	AB
Major	8.5	A	12.1	A
Emerald Crown	8.0	AB	10.9	AB
Gypsy	7.8	ABC	10.4	AB
Green Magic	7.8	ABC	11.4	A
Destiny	7.2	ABCD	9.3	ABCD
Amadeus	6.8	ABCDE	10.3	AB
Windsor	6.8	ABCDE	10.2	AB
Maverick	6.6	ABCDE	9.7	ABC
Diplomat	5.8	ABCDEF	7.1	CDE
Patron	5.2	BCDEFG	9.8	ABC
Imperial	5.0	CDEFG	6.7	DE
Bay Meadows	4.4	DEFGH	8.8	BDC
Everest	4.1	EFGH	9.3	ABDC
Ironman	3.5	FGHI	6.1	FE
Emerald Jewel	3.0	FGHIJ	5.9	FE
Alborada	2.6	GHIJ	4.4	EFGH
Avenger	2.1	HIJ	3.4	FGH
Belstar	1.9	HIJ	5.2	EFG
Monaco	1.8	HIJ	3.1	GH
Marathon	1.5	HIJ	2.7	GHI
Concord	1.0	IJ	2.1	HI
Blue Wind	0.4	J	10.8	AB
Expo	0.2	J	0.3	I

varieties do not produce a large crown and are best suited for bunching whereas the varieties with a large dome head that are cut as a single crown typically have larger stems. Imperial and Ironman were suitable for both as they had nice dome-shaped heads, but small stems that allowed bunching.

This study shows that there is potential for fall broccoli production in Eastern Kentucky. Growers could market their produce direct to the consumer, through the auctions, or through the farm-to-school program. Emerald Crown, Green Gold, and Destiny would be three varieties that should be tried for commercial production based upon this study. For home garden production, consumers should focus upon varieties that have good disease resistance.

Table 2. Mean weights and head numbers per plot 2013.

Variety	Mean wt (lbs)		Head number	
Emerald Crown	28.2	A	47.2	A
Green Gold	24.8	AB	38.7	BC
Everest	24.2	AB	47.2	A
Destiny	23.6	AB	40.2	ABC
Imperial	21.8	BC	43.0	ABC
Ironman	19.6	BCD	28.2	D
Belstar	19.6	BCD	26.0	D
Green Magic	18.1	CD	38.5	BC
Major	17.8	CD	42.5	ABC
Diplomat	17.8	CD	36.7	C
Windsor	15.6	DE	45.5	AB
Expo	12.6	E	13.2	E

Table 3. General varietal observations.

Variety	Seed Source	Bead Size	Head Characteristics	other
Alborada	BE	Medium	Crown cut	early
Amadeus	JS	Small	Bunching	
Avenger	SK	Small	Crown cut	large stem
Bay Meadows	SY	Medium	Crown cut	
Belstar	BE	Small	Crown cut	large stem
Blue Wind	JS	Large	Crown cut	early variety
Concord	SY	Large	Crown cut	
Destiny	SK	Small	Bunching	lots of brown bead
Diplomat	SK	Small	Bunching	medium stem
Emerald Crown	SK	Fine	Crown cut	frog eye
Emerald Jewel	SK	Small	Crown cut	
Everest	SY	Medium	Bunching	small stem
Expo	SK	Fine	Crown cut	large stem
Green Gold	SK	Fine	Crown cut	downy mildew
Green Magic	SK	Small	Crown cut	frog eye
Gypsy	SK	Large	Crown cut	flat head
Imperial	SK	Fine	Crown cut/Bunching	good color
Ironman	SM	Fine	Crown cut/bunching	nice dome
Major	JS	Large	Bunching	small stem
Marathon	SK	Large	Crown cut	large stem
Maverick	SK	Medium	Crown cut	
Monaco	SY	Small	Crown cut	large stem
Patron	SK	Small	Crown cut	
Windsor	ST	Small	Bunching	small stem

Kentucky Bell Pepper Variety Trial, 2014

Shubin K. Saha and Lucas Hanks, Horticulture

Introduction

Bell pepper (*Capsicum annum* L.) is the eighth-largest fresh market vegetable with respect to area of production in Kentucky. Bell peppers were grown on 162 acres accounting for 2.3% of the total fresh market vegetable acreage in 2013. Bell peppers are grown in various areas across the state both in open field and high tunnels. Most of the producers are smaller, however there is one large wholesale operator in Pulaski County and one new wholesale operator in Scott County. In the 1980s there was a fairly significant amount of processing pepper production in the state, but due to consecutive losses over a few years due to bacterial leaf spot, the processors closed facilities and left the state. Given the increased demand for local food and the quality of pepper that can be produced in the state, there is likely opportunity for continued growth in bell pepper acreage.

Variety selection continues to be one of the primary decisions producers make each season to meet their needs with respect to high yield, resistance to abiotic disorders (ex. blossom end rot), and good fruit uniformity. Harvest maturity for timing of market windows is also generally a consideration for producers. Aristotle has been and remains one of the primary bell pepper varieties grown east of the Mississippi River, accounting for approximately 60% of the market. The objective of the experiment was to evaluate fifteen bell pepper varieties grown under Midwestern United States growing conditions at the University of Kentucky Horticulture Research Farm in Lexington, Ky.

Materials and Methods

The experiment was established when seeds of fifteen bell pepper varieties were sown in 50-cell black seedling flats (Landmark Plastic, Akron, Ohio) on April 11, 2014, using Jiffy-Mix #17 (Jiffy Products of America, Lorain, Ohio) as the transplant production media. All varieties were transplanted in the field in their designated plot based on the randomized complete block design on 21 May 2014. Experimental plots were 30 ft. in length. Beds were spaced on 6 ft. centers with double rows. In a given bed there was a 12 inch in-row spacing and 15 inches between rows. There were three replicates of each variety and 30 plants in each plot. Plants were trellised around the perimeter of each double row with 30 inch wood stakes and string.

Pre-plant fertilization consisted of 109 lb. of urea (46-0-0) and 120 lb. of sulfate of potash (0-0-50) per acre based on soil nutrient analysis and fertility recommendations of the ID-36 Vegetable Production Guide for Commercial Growers. Raised beds were formed and covered in black plastic mulch (4 ft x 1 mil, Filmtech Plastics of the Sigma Plastics Group, Lyndhurst, N.J.), while drip tape (8-inch emitter spacing, 30 gph/100 ft., Aqua Traxx, The Toro Company, Bloomington, MN) was installed under the plas-

tic to allow for irrigation during the season as needed. Fertigation applications at 10 lb. N per acre were made weekly alternating calcium nitrate and potassium nitrate from June 4 to Aug. 29. Weeds on shoulders of the beds were weeded by hand and with the use of scuffle hoe. Row middles were cultivated for weed management.

A preventative fungicide program was utilized as found in ID-36, "Vegetable Production Guide for Commercial Growers." Fungicides/bactericides utilized included: Nordox, Manzate Prostik, Chlorothalonil, and Cabrio. Scouting was conducted on a weekly basis for arthropod pests. Insecticide and/or miticide applications were made based on the scouting report. Insecticides used included: Mustang Max, Baythroid XL, Brigade 2, Montana, Javelin, Assail, Oberon, and Dipel.

Fruit were harvested once per week for a total of nine harvests from July 16 to Sept. 12. Fruit were graded using USDA guidelines. Thirty fancy fruit from each variety (ten from each replication over the entire harvest) were evaluated for diameter, length, wall thickness, and average number of lobes. Yield data were analyzed by general linear model and means were separated with Fisher's least significant difference test using SAS statistical programs (SAS Institute, Cary, N.C.). Conversion to acres was done assuming a plant population of 14,500 plants per acre.

Results and Discussion

Yields in 2014 ranged from 132-166 lb. per plot or approximately 64,000-81,000 lb. per acre (tables 1 and 2). Karisma had greater total fruit weight per plot (166.7 lb.) over nine harvests as compared to the standard (Aristotle) and all other varieties with the exception of Currier and Bastille (Table 1). For the total weight and fruit number, fancy grade fruit accounted for 38% of the total number and 48% of the total weight for Karisma (Table 1). Currier and Bastille also had similar distributions of fancy fruit relative to the total.

During the early harvest period, Currier had greater total fancy fruit weight as compared to eight of the varieties in the trial (Table 3). Varieties that had comparable fancy fruit weight in this period include: Aristotle (standard), ACX251Y, Excursion II, Karisma, Bastille, and Vanguard. During the middle three harvests, there were no significant differences in yield amongst any of the varieties. However, Vanguard and Aristotle had middle harvest of fancy fruit weight per plot at 12.8 lb. and 4.8 lb. respectively (Table 4). For the last three harvests, Karisma and Excursion II had greater fancy fruit weight per plot compared to six of the fifteen varieties (Table 5). Other varieties that did not statistically differ from those two for fancy fruit weight include: E3, Islamorada, Currier, Aristotle (standard), ACX297, Bastille, and Vanguard (Table 5).

Fancy grade fruit characteristics differed significantly amongst all varieties for diameter, height, number of lobes, but not for wall thickness. Rampart had significantly greater average fruit diameter (4.09 in.) than all varieties with the exception of Enforcer, Vanguard, Bastille, and Islamorada (Table 6). All varieties were similar to Aristotle (standard) with respect fruit diameter except Rampart and Excursion II, which were 4.09 and 3.67 inches respectively (Table 6). Aristotle had greater average fruit height as compared to the other varieties with the exception of Currier, Bayonet, ACX251Y, ACX297, Islamorada, Bastille, and Vanguard (Table 6).

From a practical perspective, there are varieties that are comparable to the industry standard, Aristotle in commercial production systems worth trying. Based on a single year of evaluation, varieties that could be comparable or better in yield and fancy fruit characteristics include: Karisma, Currier, and Bastille. However, at minimum an additional season's worth of data to confirm the results would be best. The results do show promise of new options for bell pepper producers.

Table 1. Pepper harvest per plot[z], 2014 (July 16–September 12), 9 harvests.

		Total Marketable Fruit		Fancy Fruit		Number 1 Fruit		Number 2 Fruit		Cull Fruit	
Variety	Seed Company[y]	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)
Karisma	Harris Moran	390.0	166.7 ay	147.7 a	80.3 a	207.7 bcd	79.4 bcd	34.7 bcde	7.1 c	24.3 cd	9.4
E3	Enza Zaden	382.0	149.9 bc	118.3 abcd	58.6 bcde	225.0 b	82.7 bc	38.7 bcde	8.7 bc	21.3 cd	7.9
Enforcer	Abbott & Cobb	373.3	145.7 bcd	41.0 g	22.4 g	271.0 a	107.2 a	61.3 a	16.2 a	30.3 abc	13.0
8620-ACX251Y	Abbott & Cobb	363.3	146.6 bcd	107.5 cdef	54.2 cdef	204.2 bcd	79.9 bcd	51.5 ab	12.5 ab	24.6 cd	9.2
Garfield	Abbott & Cobb	362.3	136.1 cd	82.3 ef	41.0 f	232.0 ab	85.3 bc	48.0 abc	9.8 bc	40.0 a	16.7
Currier	Harris Moran	358.3	152.6 abc	137.3 abc	72.6 ab	189.0 bcd	71.9 bcde	32.0 bcde	8.1 bc	25.0 bcd	9.4
Bayonet	Syngenta	351.0	140.4 bcd	94.0 def	48.5 ef	224.3 bc	84.7 bc	32.7 bcde	7.2 c	14.3 d	5.3
Excursion II	Abbott & Cobb	348.7	143.5 bcd	141.7 ab	71.7 ab	179.0 bcd	64.5 de	28.0 de	7.4 bc	26.0 abcd	10.4
ACX297	Abbott & Cobb	348.7	146.1 bcd	104.3 def	53.5 def	223.0 bc	87.1 b	21.3 e	5.6 c	15.7 d	7.0
Aristotle	Seedway	347.0	140.1 bcd	143.7 ab	69.7 abc	174.3 d	63.1 e	29.0 cde	7.3 bc	19.3 cd	8.2
Dashen	Enza Zaden	342.0	132.2 d	100.0 def	50.2 ef	196.3 bcd	71.4 bcde	45.7 abcd	10.6 bc	20.7 cd	8.1
Islamorada	Seedway	333.3	133.2 d	102.7 def	53.3 def	194.7 bcd	69.5 cde	36.0 bcde	10.4 bc	39.0 ab	14.7
Bastille	Syngenta	325.3	155.3 ab	109.3 cde	70.0 abc	196.0 bcd	79.8 bcd	20.0 e	5.5 c	20.7 cd	9.0
Vanguard	Harris Moran	312.7	145.0 bcd	114.3 bcd	67.6 abcd	165.7 d	69.0 cde	32.7 bcde	8.4 bc	21.3 cd	9.7
Rampart	Syngenta	312.7	148.6 bcd	77.7 f	55.0 cdef	206.3 bcd	86.6 b	28.7 cde	7.0 c	24.3 cd	10.0

[z] Plot size: 180 ft^2

[y] Means within columns separated by Fisher's least significant test ($P \leq 0.05$), means with same letter are not significantly different. Means within columns without letters are not significantly different from one another.

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Table 2. Pepper harvest per acre, 2014 (July 16 – September 12), 9 harvests.

Variety	Seed Company	Total Marketable Fruit		Fancy Fruit		Number 1 Fruit		Number 2 Fruit		Cull Fruit	
		Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)
Karisma	Harris Moran	188,760	80,683 a[z]	71,487 a	38,865 a	100,527 bcd	38,430 bcd	16,795 bcde	3,437 c	11,761 cd	4,550
E3	Enza Zaden	184,188	72,552 bc	57,257 abcd	28,362 bcde	108,900 b	40,027 bc	18,731 bcde	4,211 bc	10,309 cd	3,824
Enforcer	Abbott & Cobb	180,677	70,519 bcd	19,844 g	10,842 g	131,164 a	51,885 a	29,669 a	7,841 a	14,665 abc	6,292
8620-ACX251Y	Abbott & Cobb	175,837	70,954 bcd	52,030 cdef	26,233 cdef	98,833 bcd	38,672 bcd	24,926 ab	6,050 ab	11,906 cd	4,453
Garfield	Abbott & Cobb	175,353	65,872 cd	39,833 ef	19,844 f	112,288 ab	41,285 bc	23,232 abc	4,743 bc	19,360 a	8,083
Currier	Harris Moran	173,417	73,858 abc	66,453 abc	35,138 ab	91,476 bcd	34,800 bcde	15,488 bcde	3,920 bc	12,100 bcd	4,550
Bayonet	Syngenta	169,884	67,954 bcd	45,496 def	23,474 ef	108,561 bc	40,995 bc	15,827 bcde	3,485 c	6,921 d	2,565
Excursion II	Abbott & Cobb	168,771	69,454 bcd	68,583 ab	34,703 ab	86,636 bcd	31,218 de	13,552 de	3,582 bc	12,584 abcd	5,034
ACX297	Abbott & Cobb	168,771	70,712 bcd	50,481 def	25,894 def	107,932 bc	42,156 b	10,309 e	2,710 c	7,599 d	3,388
Aristotle	Seedway	167,948	67,808 bcd	69,551 ab	33,735 abc	84,361 d	30,540 e	14,036 cde	3,533 bc	9,341 cd	3,969
Dashen	Enza Zaden	165,528	63,985 d	48,400 def	24,297 ef	95,009 bcd	34,558 bcde	22,119 abcd	5,130 bc	10,019 cd	3,920
Islamorada	Seedway	161,317	64,469 d	49,707 def	25,797 def	94,235 bcd	33,638 cde	17,424 bcde	5,034 bc	18,876 ab	7,115
Bastille	Syngenta	157,445	75,165 ab	52,901 cde	33,880 abc	94,864 bcd	38,623 bcd	9,680 e	2,662 c	10,019 cd	4,356
Vanguard	Harris Moran	151,347	70,180 bcd	55,321 bcd	32,718 abcd	80,199 d	33,396 cde	15,827 bcde	4,066 bc	10,309 cd	4,695
Rampart	Syngenta	151,347	71,922 bcd	37,607 f	26,620 cdef	99,849 bcd	41,914 b	13,891 cde	3,388 c	11,761 cd	4,840

[z] Means in columns separated by Fisher's least significant test (P ≤ 0.05), means with same letter are not significantly different. Means within columns without letters are not significantly different from one another.

Table 3. Early pepper harvest per plot[z], 2014 – Early (July 16 – July 29), 3 harvests.

Variety	Seed Company	Total Marketable Fruit		Fancy Fruit		Number 1 Fruit		Number 2 Fruit		Cull Fruit	
		Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)
8620-ACX251Y	Abbott & Cobb	157.5	74.9	75.0 abc[y]	38.7 abcd	75.3	32.7	9.3	3.5	8.4	3.2 cd
Excursion II	Abbott & Cobb	143.7	66.7	71.3 abcd	36.6 abcde	66.7	27.6	5.7	2.4	15.3	6.6 abc
Aristotle	Seedway	141.0	66.9	87.0 a	43.3 ab	50.3	22.0	3.7	1.5	13.0	5.3 abcd
Karisma	Harris Moran	133.3	68.4	70.0 abcd	40.2 abc	62.3	28.1	1.0	0.2	9.7	2.8 d
Garfield	Abbott & Cobb	132.7	59.8	45.7 ef	23.2 fgh	85.0	36.0	2.0	0.5	18.7	8.6 a
Currier	Harriss Moran	126.0	64.5	84.7 ab	45.6 a	37.3	17.3	4.0	1.7	7.7	3.1 cd
E3	Enza Zaden	125.0	58.4	58.7 cde	31.1 cdefg	65.3	26.9	1.0	0.4	7.0	2.8 d
Dashen	Enza Zaden	120.3	56.6	62.7 bcde	31.6 bcdefg	55.7	24.1	2.0	0.8	7.3	3.7 bcd
ACX297	Abbott & Cobb	118.3	57.6	36.0 gf	20.1 gh	80.7	36.8	1.7	0.6	5.3	2.6 d
Bastille	Syngenta	113.3	66.6	56.0 cdef	40.6 abc	54.3	24.8	3.0	1.1	9.7	4.5 bcd
Bayonet	Syngenta	110.7	53.0	52.0 def	26.8 efg	56.7	25.5	2.0	0.7	8.3	2.9 d
Vanguard	Harris Moran	109.3	58.1	57.0 cdef	34.4 abcdef	48.0	22.0	4.3	1.8	9.0	3.9 bcd
Rampart	Syngenta	104.0	64.2	35.3 fg	30.3 cdefg	66.7	33.2	2.0	0.8	9.0	3.7 bcd
Enforcer	Abbott & Cobb	104.0	46.8	21.3 g	11.8 h	78.3	33.4	4.3	1.6	11.7	5.3 abcd
Islamorada	Seedway	103.0	49.0	50.7 def	27.2 defg	45.3	18.5	7.0	3.2	20.0	7.3 ab

[z] Plot size: 180 ft^2

[y] Means in columns separated by Fisher's least significant test (P ≤ 0.05), means with same letter are not significantly different. Means within columns without letters are not significantly different from one another.

Table 4. Middle pepper harvest per plot[z], 2014 – Mid (August 5 – August 19), 3 harvests.

		Total Marketable Fruit		Fancy Fruit		Number 1 Fruit		Number 2 Fruit		Cull Fruit	
Variety	Seed Company	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)
Karisma	Harris Moran	65.3	30.8	21.3	12.5	38.7	17.0	5.3	1.2	3.0	1.7
ACX297	Abbott & Cobb	63.3	28.4	18.0	9.8	41.0	17.0	4.3	1.5	4.3	2.1
Vanguard	Harris Moran	56.3	29.5	19.3	12.8	33.7	15.9	3.3	0.8	4.0	2.2
Bastille	Syngenta	54.3	23.5	9.0	5.6	38.7	16.1	6.7	1.8	2.7	1.2
Rampart	Syngenta	53.7	26.0	15.0	10.0	35.3	15.1	3.3	0.8	5.3	2.9
Currier	Harris Moran	52.0	22.3	12.7	7.3	37.0	14.3	2.3	0.7	3.0	1.4
Enforcer	Abbott & Cobb	50.3	21.5	6.3	3.5	40.7	17.2	3.3	0.8	3.3	1.4
Islamorada	Seedway	49.0	22.6	11.7	7.0	30.7	13.4	6.7	2.2	6.3	3.1
Dashen	Enza Zaden	49.0	21.1	11.3	6.7	34.3	13.5	3.3	0.9	5.0	2.1
Excursion II	Abbott & Cobb	47.7	19.4	15.0	8.5	27.7	9.8	5.0	1.1	3.7	1.4
Bayonet	Syngenta	47.3	20.0	8.7	5.2	34.0	13.7	4.7	1.1	0.7	0.3
E3	Enza Zaden	46.7	23.0	12.0	6.9	32.7	15.7	2.0	0.5	4.3	1.8
Aristotle	Seedway	38.7	16.9	8.3	4.8	28.0	11.4	2.3	0.7	2.3	1.2
Garfield	Abbott & Cobb	38.3	16.2	6.0	3.3	28.0	11.7	4.3	1.3	10.7	5.0
8620-ACX251Y	Abbott & Cobb	38.2	18.7	8.4	4.9	27.7	13.2	2.0	0.6	7.1	3.4

[z] Plot size: 180 ft^2

Table 5. Late pepper harvest per plot[z], 2014 – Late (August 25 – September 12), 3 harvests.

		Total Marketable Fruit		Fancy Fruit		Number 1 Fruit		Number 2 Fruit		Cull Fruit	
Variety	Seed Company	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)	Number	Weight (lb)
Enforcer	Abbott & Cobb	219.0	77.4	13.3 f	7.1 f	152.0	56.6 a	53.7 a	13.7 a	15.3	6.3
E3	Enza Zaden	210.3	68.6	47.7 abc[y]	20.6 abc	127.0	40.1 bc	35.7 abc	7.8 bcd	10.0	3.2
Bayonet	Syngenta	193.0	67.4	33.3 cde	16.5 bcde	133.7	45.5 ab	26.0 bcd	5.4 bcde	5.3	2.2
Karisma	Harris Moran	191.3	67.6	56.3 a	27.5 a	106.7	34.4 bcd	28.3 bcd	5.6 bcde	11.7	4.8
Garfield	Abbott & Cobb	191.3	60.1	30.7 de	14.5 cdef	119.0	37.6 bcd	41.7 ab	8.0 bcd	10.7	3.1
Islamorada	Seedway	181.3	61.6	40.3 abcde	19.1 abcde	118.7	37.6 bcd	22.3 bcd	5.0 bcde	12.7	4.3
Currier	Harris Moran	180.3	65.8	40.0 abcde	19.7 abcd	114.7	40.4 bc	25.7 bcd	5.7 bcde	14.3	4.9
Dashen	Enza Zaden	172.7	54.5	26.0 ef	11.9 def	106.3	33.7 bcd	40.3 ab	8.9 ab	8.3	2.3
8620-ACX251Y	Abbott & Cobb	167.6	53.1	24.2 ef	10.6 ef	103.2	34.0 bcd	40.2 ab	8.4 bc	9.1	2.7
Aristotle	Seedway	167.3	56.4	48.3 abc	21.6 abc	96.0	29.6 cd	23.0 bcd	5.1 bcde	4.0	1.7
ACX297	Abbott & Cobb	167.0	60.2	50.3 ab	23.5 ab	101.3	33.2 cd	15.3 cd	3.4 de	6.0	2.3
Bastille	Syngenta	157.7	65.2	44.3 abcd	23.8 ab	103.0	38.9 bcd	10.3 d	2.5 e	8.3	3.3
Excursion II	Abbott & Cobb	157.3	57.5	55.3 a	26.6 a	84.7	27.1 d	17.3 cd	3.8 cde	7.0	2.5
Rampart	Syngenta	155.0	58.4	27.3 ef	14.7 cdef	104.3	38.3 bcd	23.3 bcd	5.4 bcde	10.0	3.3
Vanguard	Harris Moran	147.0	57.4	38.0 bcde	20.4 abcd	84.0	31.1 cd	25.0 bcd	5.9 bcde	8.3	3.6

[z] Plot size: 180 ft^2

[y] Means in columns separated by Fisher's least significant test (P ≤ 0.05), means with same letter are not significantly different. Means within columns without letters are not significantly different from one another.

Table 6. Fancy fruit characteristics of pepper varieties, 2014.

Variety	Seed Company	Diameter (in)	Height (in)	Wall Thickness (in)	Number of Lobes
Rampart	Syngenta	4.09 az	3.72 cdef	0.298	3.40 abcde
Enforcer	Abbott & Cobb	3.99 ab	3.71 def	0.510	3.57 abc
Vanguard	Harris Moran	3.98 ab	3.89 abc	0.275	3.37 abcde
Bastille	Syngenta	3.94 abc	3.86 abcd	0.288	3.43 abcde
Islamorada	Seedway	3.94 abc	3.89 abc	0.288	3.63 ab
ACX297	Abbott & Cobb	3.89 bcd	3.85 abcdef	0.256	3.43 abcde
E3	Enza Zaden	3.84 bcde	3.81 bcdef	0.277	3.43 abcde
Aristotle	Seedway	3.84 bcde	4.01 a	0.290	3.30 cde
Currier	Harris Moran	3.81 cdef	3.96 ab	0.272	3.33 bcde
Karisma	Harris Moran	3.78 def	3.69 ef	0.290	3.67 a
Garfield	Abbott & Cobb	3.77 def	3.73 cdef	0.280	3.40 abcde
Bayonet	Syngenta	3.76 def	3.96 ab	0.291	3.23 def
8620-ACX251Y	Abbott & Cobb	3.74 def	3.94 ab	0.268	2.97 f
Dashen	Enza Zaden	3.71 ef	3.67 f	0.258	3.53 abcd
Excursion II	Abbott & Cobb	3.67 f	3.87 abcd	0.286	3.17 ef

[z] Means in columns separated by Fisher's least significant test (P ≤ 0.05), means with same letter are not significantly different. Means within columns without letters are not significantly different from one another.

Bell and Uba Tuba Pepper: Infrared Transmitting vs. Black Plastic Evaluation

John Strang, John Snyder, and Chris Smigell, Horticulture

Introduction

Two bell pepper varieties (*Capsicum annuum*) and two Uba Tuba selections (*C. baccatum*) were evaluated in a replicated trial to determine their performance using infrared transmitting and black plastic mulches. Plots were established at the Horticultural Research Farm in Lexington, Ky. Previous research indicated that infrared transmitting mulch improved yield and axillary branching of both bell and Uba Tuba peppers.

Materials and Methods

Two bell pepper varieties, Aristotle and Alliance were seeded on April 2, 2014, into 72 cell plastic plug trays filled with ProMix MP multipurpose organic media (Premier Horticulture, Inc.) and raised in a UK Horticulture Research Farm greenhouse in Lexington. Two Uba Tuba pepper advanced selections were planted on March 15 into 72 cell plastic plug trays filled with ProMix BX general growing medium (Premier Horticulture, Inc.) and grown in a greenhouse on the University of Kentucky campus.

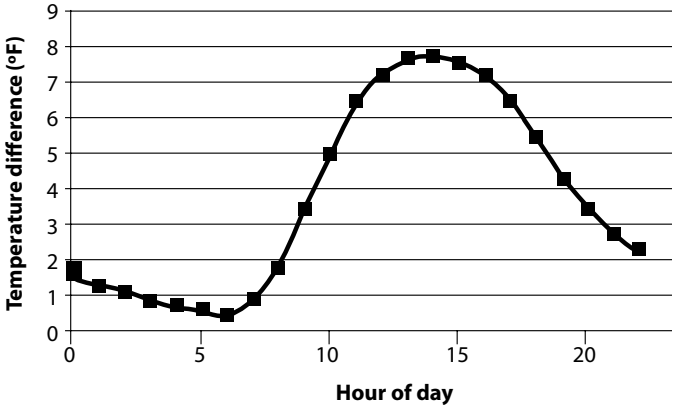
Transplants were set into the field on May 14 on either Translucent Mulch, SRM Olive an infrared-transmitting (Harris Seeds, Rochester, N.Y.) plastic or black plastic mulch-covered raised beds. Bell pepper plants were set 12 in. apart in double rows spaced 12 in. between rows. Uba Tuba peppers were set in single rows with 24 in. between plants. Each plot row was 20 feet long and contained either 40 bell pepper plants or 10 Uba Tuba plants. Varieties were replicated four times in a 2 X 2 factorial randomized complete block design.

Fifty lb. per acre of nitrogen, phosphorus and potassium were applied as 19-19-19, prior to planting, and tilled in. Approximately one cup of starter solution (6 lb. of 10-30-20 in 100 gallons of water) was applied at transplanting. The plot was drip-irrigated and fertigated weekly with 8 lb. 5 oz. of nitrogen per acre as calcium nitrate beginning on June 4 for a total of 7 fertigations and 58 lb. of nitrogen per acre. Dual II Magnum (1.5 pt./A) herbicide was applied on June 24 to the soil surface between plastic rows following a shallow cultivation. Manzate Pro-Stick (2 lb./A), Champ Formula 2 Flowable (2½ pt./A), and Bravo Ultrex (1.4 lb./A) were applied for disease control, while Mustang Max (3 fl. Oz./A), Brigade (5 fl oz/A), and M-Pede (0.25 gal/A) were used for insect control. Soil temperature at a depth of 3 in. beneath each mulch was recorded at 1 h intervals with the aid of a data logger. Temperature probes were only installed in Uba Tuba plots. Numbers and lengths of axillary branches on bell peppers grown on each mulch color were assessed early in the season, approximately four weeks after setting. Numbers of axillary branches on Uba Tuba grown on each mulch color were counted at the end of the season. Bell peppers were harvested five times during the season (July 9 and 24, Aug. 14 and 26, and Sept. 11). Marketable fruit were graded and weighed into the categories of jumbo, extra large and large (all fruit >3 in. diameter), total marketable yield (all fruit >2.5 in. diameter) and cull fruit. Uba Tuba peppers were all harvested on Oct. 8 and marketable fruit were weighed. Because several plants were destroyed during the growing season, yield is presented on a per plant basis.

Results and Discussion

During June, average soil temperatures at a depth of three in. were always greater under the SRM Olive mulch compared to those under the black mulch (Fig. 1). Differences were as great as 7°F during the midday. A similar temperature difference curve was observed for July. However, the olive mulch was only about 5°F warmer than the black mulch during midday. During August, when plant canopies completely covered the raised beds, soil temperatures beneath the olive mulch were as much as 5°F cooler than those for black mulch during late afternoon.

Fig. 1. Average difference of soil temperatures during June, 2014 under black and SRM olive mulches at three inches measured hourly. Temperatures were always cooler under the black mulch.



The growing season was cool, wet and there was a problem with mid-season bell pepper fruit set because of the cool weather. Thus yields are lower than we would expect for bell peppers. Some bacterial spot *Xanthomonas campestris* pv. *Vesicatoria* was noted early in the season, but the cool weather, and applications of Manzate Pro-Stick and fixed copper allowed the plants to grow out of it.

For bell peppers, mulch color had no effect on axillary branching (data not shown). However, the number of axillary branches was significantly greater on Alliance (4.8 axillary branches/plant) than on Aristotle (3.8 axillary branches/plant). For Uba Tuba, neither variety nor mulch color affected branching (data not shown).

Statistical analysis of the bell pepper data for all harvests showed no significant differences in total marketable yield between the SRM Olive and black plastic mulches or for the jumbo, extra large, and large size category between the SRM Olive and the black plastic mulches (Table 1). There were no differences in

Table 1. Bell pepper yield using SRM Olive and black plastic mulch.

Fruit grade	SRM Olive (lb/A)	Black plastic (lb/A)
Total marketable yield	28,380 a[1]	26,975 a
Jumbo, extra-large & large	28,137 a	26,485 a
Cull fruit	5,524 a	5,538 a

[1] Means in rows followed by the same letter are not statistically different (Duncan's Multiple Range Test LSD P≤0.05).

Table 2. Aristotle and Alliance bell pepper yields.

Fruit grade	Aristotle (lb/A)	Alliance (lb/A)
Total marketable yield	27,259 a[1]	28,099 a
Jumbo, extra-large & large	26,676 a	27,946 a
Cull fruit	4,637 b	6,425 a

[1] Means in rows followed by the same letter are not statistically different (Duncan's Multiple Range Test LSD P≤0.05).

total marketable yield or for jumbo, extra large, and large fruit yield between the Aristotle and Alliance varieties (Table 2). However Alliance produced significantly more cull fruit (1,788 lb./A) than Aristotle.

There was a variety X mulch interaction for cull fruit weight. Black plastic mulch tended to reduce the number of culls for Alliance and increase the number for Aristotle. An examination of variety harvest mid-points showed that the harvest mid-point for Alliance was reached four days later than it was for Aristotle.

Yield results for Uba Tuba were similar to those for bell peppers. When Uba Tuba plants were harvested in early October, yields were not significantly different between the two varieties, 5.3 lb. vs. 4.3 lb. per plant, and were nearly identical for the black vs. SRM Olive mulch, with both treatments yielding 4.8 lb. per plant. Clearly mulch color had no influence on yield of this specialty pepper.

Infrared transmitting mulches have been developed to provide early soil warming by allowing long wave radiation to pass through the plastic and directly warm the soil. This was a cool season which should have maximized the effect of the SRM Olive infrared transmitting plastic mulch by warming the soil early in the spring and increasing early yields. While SRM olive mulch did increase soil temperature in this study these higher temperatures did not translate into improved yields of bell or Uba Tuba peppers.

Acknowledgments

The authors would like to thank Steve Diver, Dave Lowry, Kraipop Pintatam, Supamit Songsaengchan, Natalia Truszczynski, Joseph Tucker, and Emily Vollbrecht for their hard work and assistance in the successful completion of this trial.

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Kentucky Cantaloupe Variety Trial, 2014

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Introduction

In Kentucky, cantaloupe (*Cucumis melo* L.) production is the fifth largest for fresh market vegetables with respect to area of production. In 2013, cantaloupe was grown on 618 acres accounting for 9% of the total fresh market vegetable acreage. Cantaloupe is grown in various areas across the state, most often in the same areas that are also producing watermelon. These would include, but are not limited to Casey, Lincoln, Hart, Allen, and Daviess counties. There is also potential for increased production, particularly in central and western Kentucky that are near the large industry in southern Indiana. However, moving into wholesale production has many challenges. In particular, netted cantaloupe has more challenges than other crops with respect to food safety. Additionally, with a large majority of sales occurring at the farm market, there is an opportunity to produce unique melons or grow varieties that might not be utilized by a wholesale producer. Variety selection is one of the primary decisions producers make each season to meet their needs with respect to high yield, resistance to abiotic disorders (ex. fruit splitting), and good internal qualities such as soluble solids. Harvest maturity for timing of market windows is also generally a consideration for producers. Aphrodite and Athena are the most commonly used varieties currently in the Midwest, including Kentucky and Indiana. The objective of the experiment was to evaluate nine cantaloupe varieties and one honey dew grown under Midwestern United States growing conditions at the University of Kentucky Horticulture Research Farm in Lexington, Ky.

Materials and Methods

The experiment was established when seeds of nine cantaloupe and one honey dew varieties were sown in 50-cell black seedling flats (Landmark Plastic, Akron, Ohio) on April 18, 2014. The seedling media used was Jiffy-Mix #17 (Jiffy Products of America, Lorain, Ohio). All varieties were transplanted in the field in their designated plot based on the randomized complete block design on 19 May 2014. Experimental plots were 50 ft. in length. Rows were spaced on 6 ft. centers with 30 inch in-row spacing. There were three replicates of each variety and 20 plants in each plot.

Pre-plant broadcast fertilization consisted of 109 lb. of urea (46-0-0) and 100 lb. of sulfate of potash (0-0-50) per acre based on soil nutrient analysis and fertility recommendations of ID-36, "Vegetable Production Guide for Commercial Growers." Raised-beds were formed and covered in black plastic mulch (4 ft. x 1 mil, Filmtech Plastics of the Sigma Plastics Group, Lyndhurst, NJ), while drip tape (8-in. emitter spacing, 30 gph/100 ft., Aqua Traxx, The Toro Company, Bloomington, M.N.) was installed under the plastic to allow for irrigation during the season as needed. Fertigation applications at 10 lb. N per acre were made alternating calcium nitrate and potassium nitrate weekly from June 4 to Aug. 7 utilizing the schedule provided in ID-36. Weeds on shoulders of the beds were weeded by hand and with the use of scuffle hoe. Additionally, vines were turned back on to the plastic weekly from June 9 to June 30 to keep varieties separated and to also allow for cultivation of row middles for weed management.

MELCAST disease forecasting system was utilized to determine the timing of preventative fungicide sprays. In some seasons that can result in a reduction of two or three fungicide applications. Fungicide selection and proper rotation of modes of action were done per the recommendations of ID-36. Imidacloprid was applied in the transplant water for management of cucumber beetles which vector bacterial wilt. Scouting was conducted on a weekly basis for arthropod pests. Insecticide and/or miticide applications were made based on the scouting report.

Fruit were harvested three times per week for a total of twelve harvests from July 18 to Aug. 18; each fruit was weighed individually. Nine fruit from each variety (three from each replication) were evaluated for internal quality including percent soluble solids, size, and firmness over the course of the season. Soluble solids were measured using a refractometer (RF-12, Extech Instruments, Nashua, N.H.). Fruit firmness was measured using an analog penetrometer (FT, Wagner Instruments, Greenwich, Conn.). Yield data was analyzed by Fisher's least significant difference test using SAS statistical programs (SAS Institute, Cary, N.C.).

Results and Discussion

Overall, yields in 2014 were slightly higher relative to the 2013 trial, ranging from 3,969-12,439 fruit per acre, as compared to 3,630-8,808 fruit per acre last season (Table 1). Likely the site differences and the use of weekly fertigation could have been the cause for the higher yields in 2014 relative to 2013. Average fruit weight ranged from 6.0-9.4 pounds among the varieties (Table 2).

Aphrodite and NUN 26287 had greater average fruit weight, 9.0 and 9.4 lb., respectively, compared to the other eight varieties (Table 1). Majus and NUN 7609 had smaller fruit, 6.1 and 6.0 lb., respectively, compared to seven other varieties (Table 1). The remaining varieties such as Athena, were generally in the range of 7 lb. per fruit. The honey dew variety, 252 HQ, had greater yield (12,439 fruit per acre) compared to all other varieties (Table 1). There were no significant differences for number of fruit per acre amongst the cantaloupe varieties with the exception of VAR 351, which had significantly lower yield with respect to total weight and fruit number per acre (Table 1). From a practical perspective, the majority of the cantaloupe varieties had similar yield as the typical standards, Athena and Aphrodite.

Variety 7609 had higher brix (12.8%) compared to five varieties in the trial (Table 2). Varieties that did not differ significantly from 7609 with respect to brix include Majus, 9000, Var 351, and Athena. With the exception of NUN26287, all varieties had greater than 11% brix which is considered reasonable for market (Table 2). Fruit firmness ranged from 3.0-6.3 lb. force among the varieties in the trial (Table 2). Sunny Dee had greater fruit firmness (6.3 lb. force) compared to five other varieties (Table 2). Regarding harvest maturity, no varieties had as many number of fruit per plot as Athena (24 fruit per plot) in the early harvest period (Table 3). Only Tirreno and Var 351 had fewer fruit per plot compared to 9000 and 252HQ during the middle harvest period (Table 4). However, Tirreno had greater number of fruit per plot in the late harvest period compared to six other cantaloupe varieties (Table 5).

Based on yields and fruit quality, there are multiple varieties that are comparable to Athena and Aphrodite. Examples of

Table 1. Yield of cantaloupe varieties, 2014.

Variety	Seed Company	Average Fruit Weight (lb)	Number of Fruit per plot[z]	Total Fruit Weight (lb) per plot	Number of Fruit per acre	Total Fruit Weight (lb) per acre
NUN 26287	Nunhems	9.4 a[y]	66.7 b	628.8 a	9,680 b	91,303 a
Aphrodite	Syngenta	9.0 a	67.7 b	612.4 ab	9,825 b	88,920 ab
VAR. 351	Nunhems	7.7 b	27.3 c	212.3 d	3,969 c	30,820 d
252HQ	Nunhems	7.6 b	85.7 a	652.4 a	12,439 a	94,727 a
Athena	Syngenta	7.2 bc	65.0 b	465.1 c	9,438 b	67,538 c
Tirreno	Rupp	7.1 bc	69.0 b	489.1 bc	10,019 b	71,011 bc
9000	Nunhems	7.1 bc	68.7 b	484.2 bc	9,970 b	70,305 bc
Sunny Dee	Nunhems	6.7 cd	66.3 b	444.5 c	9,632 b	64,536 c
Majus	Rupp	6.1 d	60.4 b	365.8 c	8,767 b	53,117 c
7609	Nunhems	6.0 d	63.0 b	378.4 c	9,148 b	54,945 c

[z] Plot size: 300 ft2

[y] Means in columns separated by Fisher's least significant test (P ≤ 0.05), means with same letter are not significantly different.

Table 2. Fruit quality of cantaloupe varieties, 2014.

Variety	Seed Company	Brix (% Soluble Solids)	Seed Cavity		Firmness (lbs-force)	Overall	
			Length (in)	Width (in)		Length (in)	Width (in)
7609	Nunhems	12.8 a[z]	4.7 d	2.6 de	5.3 ab	6.3 f	2.48 f
Majus	Rupp	12.6 ab	4.8 d	3.1 bc	3.9 de	6.3 f	2.47 f
9000	Nunhems	12.4 abc	5.0 cd	2.7 d	3.7 de	6.7 de	2.64 de
VAR. 351	Nunhems	11.9 abcd	5.9 a	2.6 de	5.4 ab	6.9 cd	2.71 cd
Athena	Syngenta	11.6 abcd	5.3 bc	3.3 ab	3.0 e	7.0 bcd	2.75 bcd
252HQ	Nunhems	11.4 bcd	4.7 d	3.4 ab	5.5 ab	7.7 a	3.05 a
Sunny Dee	Nunhems	11.3 bcde	3.9 e	2.3 e	6.3 a	5.7 g	2.24 g
Tirreno	Rupp	11.2 cde	5.2 bcd	2.8 cd	5.4 ab	6.4 ef	2.53 ef
Aphrodite	Syngenta	11.1 de	5.7 ab	3.5 a	4.0 cd	7.2 bc	2.83 bc
NUN 26287	Nunhems	10.0 e	5.9 a	2.8 cd	4.9 bc	7.3 b	2.88 b

[z] Means in columns separated by Fisher's least significant test (P ≤ 0.05), means with same letter are not significantly different.

varieties would include 7609 and 9000 that had yields and quality comparable to the standards as well as similar exterior appearances of netting and no sutures. These would likely fit well with the wholesale or produce auction markets. Somewhat unique varieties with sutures, sometimes referred to as Tuscan melons, that had comparable yield and good fruit quality would include Majus, Tirreno, and Sunny Dee. These have excellent quality but may be better suited to direct sales such as farm markets. Similar to last season, there were significant periods of cool and wet weather which seemed to delay maturity of the crop.

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Table 3. Early cantaloupe harvest per plot[z], 2014 – Early (July 18 – July 25), 4 harvests.

Variety	Seed Company	Number of Fruit	Total Fruit Weight (lb)	Average Fruit Weight (lb)
Athena	Syngenta	24.0 a[y]	153.9 a	6.4 abc
Sunny Dee	Nunhems	16.0 b	75.6 c	4.8 bcd
Majus	Rupp	16.0 b	93.1 bc	5.8 abc
Aphrodite	Syngenta	14.3 bc	124.4 a	8.7 a
Tirreno	Rupp	9.3 c	58.3 cd	6.2 abc
252HQ	Nunhems	3.0 d	21.3 de	6.9 ab
NUN 26287	Nunhems	2.7 d	20.0 de	8.1 a
7609	Nunhems	0.7 d	3.4 e	3.4 cd
VAR. 351	Nunhems	0.3 d	2.4 e	2.4 de
9000	Nunhems	0.0 d	0.0 e	0.0 e

[z] Plot size: 300 ft2

[y] Means in columns separated by Fisher's least significant test (P ≤ 0.05), means with same letter are not significantly different.

Table 4. Middle cantaloupe harvest per plot[z], 2014 – Middle (July 28 – August 4), 4 harvests.

Variety	Seed Company	Number of Fruit	Total Fruit Weight (lb)	Average Fruit Weight (lb)
9000	Nunhems	27.7 a[y]	194.7 ab	7.1 cde
252HQ	Nunhems	27.3 a	230.0 a	8.4 b
Athena	Syngenta	25.3 ab	188.8 ab	7.5 bcd
Sunny Dee	Nunhems	24.3 ab	164.5 ab	6.8 de
Aphrodite	Syngenta	23.0 ab	230.1 a	9.9 a
NUN 26287	Nunhems	22.7 ab	222.3 a	9.7 a
Majus	Rupp	21.3 ab	136.6 bc	6.4 e
7609	Nunhems	21.3 ab	134.8 bc	6.4 e
Tirreno	Rupp	19.3 b	148.8 bc	7.7 bc
VAR. 351	Nunhems	10.7 c	84.7 c	7.9 bc

[z] Plot size: 300 ft2

[y] Means in columns separated by Fisher's least significant test (P ≤ 0.05), means with same letter are not significantly different.

Table 5. Late cantaloupe harvest per plot[z], 2014 – Late (August 6 – August 18), 4 harvests.

Variety	Seed Company	Number of Fruit	Total Fruit Weight (lb)	Average Fruit Weight (lb)
252HQ	Nunhems	31.0 a[y]	192.4 a	6.2 cd
Tirreno	Rupp	30.3 ab	191.4 a	6.3 cd
Aphrodite	Syngenta	21.7 bc	152.3 ab	6.9 bc
NUN 26287	Nunhems	21.3 bc	184.1 a	8.7 a
7609	Nunhems	20.3 c	108.8 bc	5.4 ef
Majus	Rupp	18.0 c	92.6 bcd	5.2 f
Sunny Dee	Nunhems	17.7 c	115.5 bc	6.5 bcd
Athena	Syngenta	14.3 cd	87.6 cd	6.0 de
9000	Nunhems	13.3 cd	94.8 bcd	7.1 b
VAR. 351	Nunhems	6.0 d	42.9 d	7.1 b

[z] Plot size: 300 ft2

[y] Means in columns separated by Fisher's least significant test (P ≤ 0.05), means with same letter are not significantly different.

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Sewage Sludge Enhanced the Glucosinolates Content of Collard Greens

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Introduction

In plant protection, biofumigation refers to the suppression of soil-borne organisms including bacteria, fungi, nematodes and wireworms by biocidal compounds released into the soil during the decomposition of plant materials. Incorporation of allelopathic cruciferous tissues into soil suppresses soil-borne pests due to the biofumigant properties of the highly toxic isothiocyanates, and moderately toxic non-glucosinolate S-containing compounds. Isothiocyanates, physiologically active compounds, are the major products of hydrolysis of GSLs that are released when myrosinase (thioglucosidase), a degradative enzyme, comes into contact with GSLs in damaged plant tissues.

GSLs are present in varying amounts in many members of the *Brassicaceae* or cabbage family. When plants containing GSLs are physically disrupted, the hydrolytic enzyme myrosinase is released from ruptured cells, hydrolyzing GSLs primarily to isothiocyanates, glucose, and nitrile products. GSLs and their hydrolysis products are responsible for the sharp or biting taste of condiments (horseradish or mustard) and they contribute to the characteristic flavors of plants whose leaves (Brussels sprouts, cabbage), floral buds (broccoli, cauliflower), stems (Kohlarabi) or roots (radish, turnip) are consumed by humans. When consumed by humans and animals in moderate amounts, some GSLs, or their enzymatically-released products, could reduce the risk of cancer. On the other hand, GSLs are significant factors impairing the nutritional quality of rape seed and restricting its use as high-quality protein animal feed.

Recently, several researchers have been studying *Brassica* plants as natural fumigants (biofumigants) due to the release of isothiocyanates upon hydrolysis of their GSLs. Intact GSLs by themselves are not biologically active, they must be enzymatically hydrolyzed by myrosinase to isothiocyanates, which are capable of suppressing soil pathogens. Myrosinase is produced by plants, insects, and fungi, and is frequently found in soil.

Soil amendments such as chicken manure and sewage sludge might reduce the biomass needed to produce significant concentrations of isothiocyanate-generating GSLs in plants, suggesting that GSLs in plants grown in soil mixed with recycled waste might be of future interest. The present study is a continuation of our previous work on the GSL content of *Brassica*, natural products for pest control, GSLs in greenhouse and tunnel grown *Brassica* plants, and the impact of the growing environment on the internal composition of vegetables. The objectives of this investigation were to:

1. Assess variation in GSLs concentration among collard plants grown under three soil management practices: sewage sludge (SS) mixed with native soil, chicken manure (CM) mixed with native soil, and no-mulch (NM) native soil.
2. Quantify GSL concentrations in collard roots, leaves, and stems at harvest for potential use of their crude extracts in plant protection.
3. Assess myrosinase activity in soil amended with CM and SS compared to no-mulch native soil.

Materials and Methods

The experimental studies were conducted in Summer 2012 at the Kentucky State University Research Farm (Franklin County, Ky.) on a Lowell silty-loam soil (2.2% organic matter, pH 6.7).The soil has an average of 12% clay, 75% silt, and 13% sand. Eighteen standard plots 22 × 3.7 m each were established. The experimental design consisted of a randomized complete block design replicated three times and included three soil management practices (SS, CM, and NM treatments). The soil in six plots was mixed with SS obtained from the Metropolitan Sewer District, Louisville, KY, or CM obtained from the Department of Animal and Food Sciences, University of Kentucky, Lexington, Kentucky at 15 t acre^{-1} on dry weight basis during each of the past 4 years. Amendments were incorporated into the topsoil with a plowing depth of 15 cm. The native soils in six plots were used as a no-mulch (NM) control treatment (roto-tilled bare soil) for comparison purposes. The plots were hand transplanted with collard seedlings (*Brassica oleracea* cv. Top Bunch) of 45-day old. At harvest, representative samples of 5 plants from each soil treatment were collected for extraction of GSLs. Shoots (stems and leaves) and roots were cut into 1-3 cm and 100 g subsamples were extracted with boiling methanol (300 mL). After cooling the material was blended and then filtered. After concentration by evaporation samples were centrifuged and filtered.

Quantification of GSLs in Collard

Total GSLs were separated from the crude collard extracts ion exchange chromatography. Purified GSLs were quantitated by enzymatically hydrolyzing the glucose from the GSLs and then quantitating the glucose.

Quantification of Myrosinase in Soil

Soil samples were collected from the three soil treatments to a depth of 15 cm from field plots. After grinding the soil, myrosinase activity was determined by adding a known amount of sinigrin (2-propenyl-glucosinolate) and then determining enzymatic glucose release in a fashion similar to that for GSL quantification.

GSLs in the leaves, stems, and roots of collard plants grown under the three soil management practices (SS, CM, and NM) and myrosinase activity in soil mixed with SS, CM, and no-mulch (NM) native soil were statistically analyzed using ANOVA. The means were then compared using Duncan's multiple range test (SAS Institute 2003).

Results and Discussion

The leaves of collard plants grown in soil amended with SS contained the greatest concentration of GSLs (37 µmoles g^{-1} fresh leaves) compared to soil amended with CM and no-mulch bare soil (29 and 25 µmoles g^{-1} fresh leaves, respectively) (Fig. 1). Total GSLs (leaves, roots, and stem) in collard plants were significantly greater in plants grown in SS (45.9 µmoles g^{-1} fresh tissue) compared to plants grown in CM and NM bare soil (39.3 and 30.3 µmoles g^{-1} fresh tissue, respectively) (Fig. 2). Regardless of the soil

treatments, collard leaves contained the greatest concentrations of GSLs compared to stems and roots.

Soil incorporated with SS increased myrosinase activity (2.8 μmoles g^{-1} soil) compared to soil incorporated with CM and no-mulch native soil (1.8 and 1.1 μmoles g^{-1} soil, respectively) (Fig. 3). The enhancement of GSL formation in collard plants grown in soil amended with SS could be explored at a large-scale for control of soil-borne diseases in the agricultural field. Several studies have proposed the use of GSL-containing plants as biofumigants to control soil-borne pathogens and to reduce the use of synthetic pesticides. However, it is difficult to predict the fumigant potential of a particular *Brassica* plant on the basis of GSL concentration in its tissue since other factors in soil might increase or decrease the activity of myrosinase in soil as well as in *Brassica* plant tissues that contain GSLs.

In recent years, more research has focused on the influence of diet on human diseases. Epidemiological studies have found an inverse relationship between consumption of *Brassica* vegetables (broccoli, cabbage, Brussels sprout, kale, collard, cauliflower) and cancer risk in human organs. [20] Crucifers are important sources of GSLs, whose de-generated products, such as isothiocyanates were attributed to chemo-preventive activity such as reduced prostate cancer risk. [23] Across all treatments, SS and CM increased soil organic matter content from 2.2% in native soil to 4.2 and 6.5%, respectively (over 5 years of treatment) (data not shown) over 4 years of soil treatment. Accordingly, soil management practices that enhance GSLs formation in *Brassica* vegetables might be useful in expanding and exploring the enhancement of GSL composition in plants for use as medicinal agents and soil fumigants. Little is known about allelochemicals, such as GSLs, formation and fate in soil. Decomposition of sinigrin by myrosinase in soil mixed with SS and CM amendments might provide a new avenue for enhancement of GSL content in *Brassica* plants.

Conclusion

It is important for a natural product to be water soluble for potential field applications. GSls are hydrophilic compounds that are broken down by myrosinase to D-glucose and allelochemicals that have biological activity to suppress soil-borne diseases. Myrosinase in *Brassica* plants is released to soils via foliar leaching, root exudation, and plant residue decomposition. It is also produced by insects and fungi in soil. The GSL-myrosinase system might provide a natural alternative to methyl bromide or metam sodium soil fumigants in agricultural production systems. In the present investigation, the enhancement of extracellular myrosinase in soil amended with SS indicated that SS increased GSL breakdown and release of isothiocyanates.

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Figure 1. Concentration of glucosinolates in the leaves, roots, and stems of collard (Brassica oleracea cv. Top Bunch) grown under three soil management practices. Statistical comparisons were carried out among three soil treatments for each plant part. Bars accompanied by the same letter for each plant part are not significantly different (P> 0.05) using ANOVA (SAS Institute 2003).

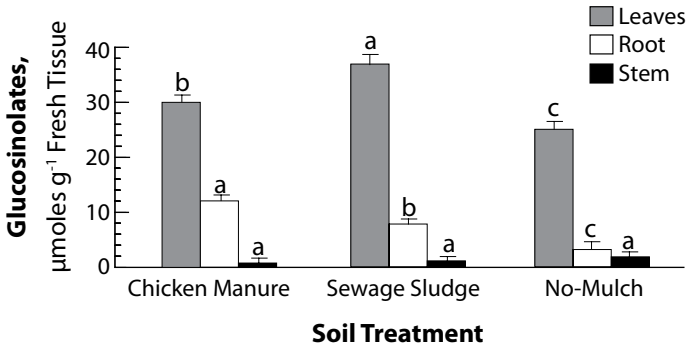


Figure 2. Impact of three soil management practices on concentration of glucosinolates in collard (Brassica oleracea cv. Top Bunch), regardless of plant part. Statistical comparisons were carried out among three soil management practices. Bars accompanied by the same letter are not significantly different (P> 0.05) using ANOVA (SAS Institute 2003).

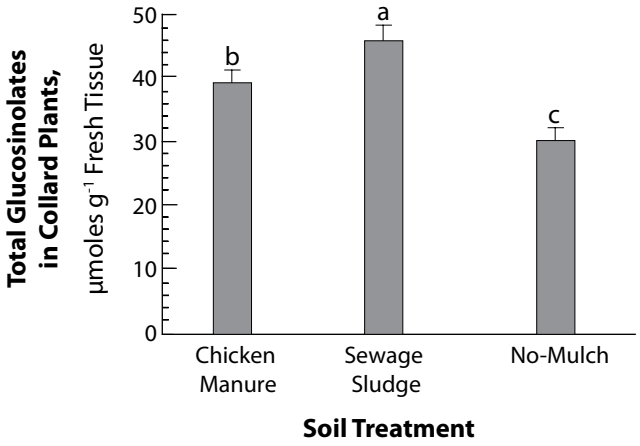
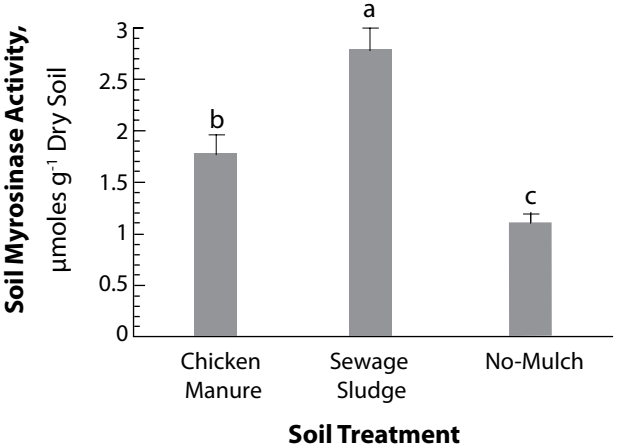


Figure 3. Soil myrosinase activity under three soil management practices. Statistical comparisons were carried out among three soil treatments. Bars accompanied by the same letter are not significantly different (P> 0.05) using ANOVA (SAS Institute 2003).



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Kentucky Triploid Watermelon Variety Trial, 2014

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Introduction

In Kentucky, watermelon (*Citrullus lanatus* L.) production area is the second largest of all fresh market vegetables. In 2013, watermelons were grown on 1,116 acres accounting for 16% of the total fresh market vegetable acreage. Watermelons are grown in various areas across the state including Casey, Lincoln, Hart, Allen, and Daviess counties. Production has the potential to be increased, particularly in Central and Western Kentucky—areas having proximity to the large industry in southern Indiana.

Selecting an appropriate variety continues to be one of the primary decisions producers make each season to meet their needs with respect to high yield, resistance to abiotic disorders (ex. hollow heart), good internal qualities such as soluble solids, and wholesale buyer acceptance. Buyer acceptance is important as wholesale buyers can have different requirements as compared to buyers at farmers markets. The objective of the experiment was to evaluate eleven triploid watermelon varieties grown under Midwestern United States growing conditions at the University of Kentucky Horticulture Research Farm in Lexington, Ky.

Materials and Methods

The experiment was established April 21, 2014, when seeds of eleven triploid watermelon varieties were sown in 50-cell black seedling flats (Landmark Plastic, Akron, Ohio). Jiffy-Mix Grower's Choice Plus (Jiffy Products of America, Lorain, Ohio) was the seedling media used. On May 27, 2013, all varieties were transplanted in the field using Accomplice (Harris Moran) as the pollenizer variety. This is a non-harvestable pollenizer with bushy growth habit. The experiment was a randomized complete block design with three replications. Experimental plots were 40 ft. in length. Rows were spaced on 8 ft. centers with 4 ft. in-row spacing. Pre-plant fertilizer application consisted of 130 lb. of urea (46-0-0) and 100 lb. of sulfate of potash (0-0-50) per acre. Raised-beds were formed and covered in black plastic mulch (4 ft. x 1 mil, Filmtech Plastics of the Sigma Plastics Group, Lyndhurst, N.J.).Simultaneously drip tape (8-inch emitter spacing, 30 gph/100 ft, Aqua Traxx, The Toro Company, Bloomington, Minn.) was installed under the plastic to allow for irrigation during the season as needed. Fertigation applications at 10 lb. N per acre were made alternating calcium nitrate and potassium nitrate weekly from June 4-Aug. 14. There were 10 plants per plot in addition to 5 pollenizers per plot. Pollenizers were interplanted between every pair of triploid watermelon plants within the row. Vines were turned back onto the plastic weekly June 9-30 to keep varieties separated and to also allow for cultivation of row middles for weed management. Weeds on shoulders of the beds were weeded by hand and with the use of scuffle hoe. MELCAST disease forecasting system was utilized to determine the timing of preventative fungicide sprays. In some seasons that can result in a reduction of 2 or 3 fungicide applications. Fungicide selection and proper rotation of modes of action was done per the recommendations in ID-36, "Vegetable Production Guide for Commercial Growers." Scouting was conducted on a weekly basis for arthropod pests. Insecticide or miticide applications were made when identified as necessary based on the scouting report. Fruit was harvested five times from July 31-Aug. 27; each fruit was weighed individually. Nine randomly chosen fruit from each variety (three from each replication) were evaluated for internal quality including percent soluble solids, size, and firmness. Soluble solids were measured using a refractometer (RF-12, Extech Instruments, Nashua, N.H.). Fruit firmness was measured using an analog penetrometer (FT, Wagner Instruments, Greenwich, Conn.). Yield data were analyzed by general linear model and means were separated by Fisher's least significant difference test using SAS statistical programs (SAS Institute, Cary, N.C.).

Results and Discussion

Yields in 2014 were higher compared to the previous season, ranging from 43,271-85,240 lbs/acre, as compared to 28,400-45,300 lb./acre last season (Table 1). Potential reasons for this increase could be due to site differences as in 2014 the trial was conducted in Lexington, Ky., as opposed to Vincennes, Ind., in previous years. However, it is more likely due to the fact that only four harvests were collected in 2013 as opposed to five in 2014. Average fruit weight ranged from 15.3-20.1 pounds amongst the varieties (Table 2).

ORS12166 had higher total yield (627 lb./plot) compared to nine of the ten other varieties (Table 1). The exception was Exclamation (564 lb./plot) (Table 1). However ORS12166 had lower soluble solids (10.2% Brix) relative to the majority of the other varieties (Table 3). Harvest Moon had significantly higher soluble solids (12.2 % Brix) than all other varieties and total yield was only less than one other variety in the trial (514 lb./plot) (Tables 1 and 3). This is a unique

Table 1. Yield of triploid watermelon varieties, 2014.

Variety	Seed Company	Total Fruit Weight (lb) per plot[z]	Total Fruit Number per plot	Fruit Weight (lb) per acre	Fruit Number per acre
ORS12166	Origene	626.2 a[y]	34.0 a	85,240 a	4628.3 a
Exclamation	Syngenta	563.8 ab	28.0 bc	76,750 ab	3811.5 bc
Premont	Clifton	523.2 bc	29.0 ab	71,223 bc	3947.6 ab
Maxima	Origene	521.4 bc	26.0 bcd	70,971 bc	3539.3 bcd
Harvest Moon	Seeds by Design	513.8 bc	33.7 a	69,937 bc	4582.9 a
Captivation	Syngenta	485.4 bc	25.0 bcd	66,078 bc	3403.1 bcd
Unbridled	Sakata	470.2 bc	26.7 bcd	64,010 bc	3630.0 bcd
Fascination	Syngenta	428.1 cd	22.7 cde	58,279 cd	3085.5 cde
SWT7829	Clifton	358.6 de	23.0 cde	48,811 de	3130.9 cde
Cut Above	Clifton	339.9 de	21.7 de	46,272 de	2949.4 de
USAWX90020	US Agriseeds	317.9 e	19.0 e	43,271 e	2586.4 e

[z] Plot size: 320 ft2

[y] Means within columns separated by Fisher's least significant test (P ≤ 0.05), means with same letter are not significantly different.

Table 2. Triploid watermelon varieties by average fruit weight, 2014.

Variety	Mean Weight (lbs)	Percent of Fruit in Each Size Class			
		60-count	45-count	36-count	30-count
		9-13.5 lbs	13.6-17.5 lbs	17.6-21.4 lbs	>21.4 lbs
Harvest Moon	20.1 a[z]	29.4	46.6	22.8	0.9
Exclamation	20.1 a	6.1	27.5	27.5	39.3
Maxima	19.4 ab	2.3	33.8	23.1	40.8
SWT7829	18.9 bc	20.0	55.2	24.8	0.0
ORS12166	18.4 bcd	9.7	30.3	37.1	22.6
Premont	18.1 cd	11.4	33.4	43.4	10.3
Captivation	17.6 de	3.6	30.4	36.0	28.4
USAWX90020	16.9 e	17.9	42.6	29.5	10.0
Cut Above	15.6 f	23.0	53.5	21.7	2.8
Fascination	15.5 f	4.0	33.9	37.9	23.8
Unbridled	15.3 f	7.5	49.8	27.3	13.5

[z] Means within columns separated by Fisher's least significant difference test (P≤ 0.05), means with same letter are not significantly different.

Table 4. Yield of triploid watermelon varieties by bin count, 2014.

Variety	Number of 60-count Bins per acre	Number of 45-count Bins per acre	Number of 36-count Bins per acre	Number of 30-count Bins per acre
Harvest Moon	22.7 a[z]	35.5 a	17.4	0.8 f
Cut Above	11.3 b	25.7 bcd	10.6	1.5 ef
SWT7829	10.6 bc	28.7 abc	12.9	0.0 f
ORS12166	7.6 bcd	23.4 bcd	28.7	17.4 bc
USAWX90020	7.6 bcd	18.2 d	12.9	4.5 ef
Premont	7.6 bcd	21.9 bcd	28.7	6.8 def
Unbridled	4.5 bcd	30.3 ab	16.6	8.3 de
Exclamation	3.8 cd	17.4 d	17.4	25.0 a
Captivation	2.3 d	17.4 d	20.4	15.9 c
Fascination	2.3 d	17.4 d	19.7	12.1 cd
Maxima	1.5 d	19.7 cd	13.6	24.2 ab

[z] Means within columns separated by Fisher's least significant difference test (P ≤ 0.05), means with same letter are not significantly different.

Table 3. Fruit quality of triploid watermelon varieties, 2014.

Variety	°Brix[z]	Firmness (lbs-force)	Fruit Length (in)	Fruit Width (in)	Degree of Seedlessness[x]	Hollow Heart[y]	Color
Harvest Moon	12.2 a[w]	2.0 e	10.07 d	9.23 bc	0.0	0.4 bc	Red
SWT7829	11.3 b	2.8 cd	10.49 bcd	8.47 g	0.1	0.7 ab	Red
Cut Above	11.3 b	2.6 d	10.93 abc	8.59 fg	0.1	1.1 a	Pink
USAWX90020	11.3 b	2.5 de	11.04 abc	8.96 cdef	0.0	0.6 abc	Pink
Unbridled	11.3 b	3.3 bc	10.41 cd	9.15 cde	0.2	0.4 bc	Red
Captivation	11.0 b	3.3 bc	11.50 a	9.04 cde	0.2	0.1 bc	Pink
Fascination	11.0 b	3.4 ab	11.37 a	8.75 defg	0.4	0.0 c	Pink
Maxima	11.0 b	3.7 ab	10.84 abcd	9.81 a	0.2	0.1 bc	Pink
Premont	10.7 bc	3.9 a	10.73 abcd	8.71 efg	0.6	0.4 bc	Red
Exclamation	10.7 bc	3.5 ab	11.21 abc	9.63 ab	0.2	0.0 c	Pink
ORS12166	10.2 c	3.6 ab	11.22 ab	9.18 cd	0.0	0.0 c	Pink

[z] °Brix: the percent of soluble solids
[x] Degree of Seedlessness: 1 = 0 seeds, 2 = 1 - 5 seeds, 3 = >5 seeds
[y] Hollow Heart: 0 = none, 1 = minor cracking, 2 = severe cracks or cavities
[w] Means within columns separated by Fisher's least significant difference test (P ≤ 0.05), means with same letter are not significantly different.

variety that might not be suited for wholesale, but might have more potential at a farm market or farm stand. Harvest Moon is a seedless version of an old variety known as Moon and Stars. Maxima also had reasonably good combination of yield (521 lb./plot) and soluble solids (11% Brix) (tables 1 and 3). Harvest Moon did have a low fruit firmness (1.9 lb.-force) compared to all but one other variety (Table 3). Varieties with higher firmness included Premont, Maxima, ORS12166, and Exclamation at 3.9, 3.7, 3.6, and 3.5 lb. force, respectively (Table 3). Wholesale markets typically do not prefer watermelons with extremely low fruit firmness from a consumer perspective but also for fresh cut possibilities with respect to shelf life.

Harvest Moon had the greatest number of 60-count bins per acre (23) relative to all other varieties (Table 4). Harvest Moon also had the numerically greatest number of 45-count bins (35) and was statistically greater than eight of ten other varieties (Table 4). Unbridled and SWT7829 also had relatively high number of 45-count bins per acre (Table 4). There were no significant differences amongst any of the varieties for the total number of 36-count bins harvested per acre. Exclamation and Maxima produced a greater amount of 36-count bins per acre relative to most other varieties in the trial (Table 4). Although it can vary from year to year, the current trend seems to be that 45-count and 60-count are the desirable sizes.

This season ended like the last, which consisted of significant periods of cool and wet weather which were ideal for certain soilborne diseases. Disease incidence was low, however both fusarium crown rot (*Fusarium solani* f.sp. cucurbitae) and pythium cottony leak (*Pythium spp.*) were identified. The cool temperatures also seemed to have an adverse impact on the maturity of the watermelons.

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Appendix A: Sources of Vegetable Seeds

We would like to express our appreciation to these companies for providing seeds at no charge for vegetable variety trials. The abbreviations used in this appendix correspond to those listed after the variety names in tables of individual trial reports.

AAS ..... All America Selection Trials, 1311 Butterfield Road, Suite 310, Downers Grove, IL 60515
AS/ASG ..... Formerly Asgrow Seed Co., now Seminis (see "S" below)
AC..... Abbott and Cobb Inc., Box 307, Feasterville, PA 19047
AG..... Agway Inc., P.O. Box 1333, Syracuse, NY 13201
AM..... American Sunmelon, P.O. Box 153, Hinton, OK 73047
AR..... Aristogenes Inc., 23723 Fargo Road, Parma, ID 83660
AT ..... American Takii Inc., 301 Natividad Road, Salinas, CA 93906
B..... BHN Seed, Division of Gargiulo Inc., 16750 Bonita Beach Rd., Bonita Springs, FL 34135
BBS..... Baer's Best Seed, 154 Green St., Reading, MA 01867
BC..... Baker Creek Heirloom Seeds, 2278 Baker Creek Rd., Mansfield, OH 65704
BK..... Bakker Brothers of Idaho Inc., P.O. Box 1964, Twin Falls, ID 83303
BR..... Bruinsma Seeds B.V., P.O. Box 1463, High River, Alberta, Canada, TOL 1B0
BS..... Bodger Seed Ltd., 1800 North Tyler Ave., South El Monte, CA 91733
BU..... W. Atlee Burpee & Co., P.O. Box 6929, Philadelphia, PA 19132
BZ ..... Bejo Zaden B.V., 1722 ZG Noordscharwoude, P.O. Box 9, The Netherlands
CA..... Castle Inc., 190 Mast St., Morgan Hill, CA 95037
CF ..... Cliftons Seed Co., 2586 NC 43 West, Faison, NC 28341
CG..... Cooks Garden Seed, PO Box C5030 Warminster, PA 18974
CH..... Alf Christianson, P.O. Box 98, Mt. Vernon, WA 98273
CIRT..... Campbell Inst. for Res. and Tech., P-152 R5 Rd 12, Napoleon, OH 43545
CL ..... Clause Semences Professionnelles, 100 Breen Road, San Juan Bautista, CA 95045
CN..... Canners Seed Corp., (Nunhems) Lewisville, ID 83431
CR ..... Crookham Co., P.O. Box 520, Caldwell, ID 83605
CS ..... Chesmore Seed Co., P.O. Box 8368, St. Joseph, MO 64508
D ..... Daehnfeldt Inc., P.O. Box 947, Albany, OR 97321
DN..... Denholm Seeds, P.O. Box 1150, Lompoc, CA 93438-1150
DR..... DeRuiter Seeds Inc., P.O. Box 20228, Columbus, OH 43320
EB..... Ernest Benery, P.O. Box 1127, Muenden, Germany
EV ..... Evergreen Seeds, Evergreen YH Enterprises, P.O. Box 17538, Anaheim, CA 92817
EX ..... Express Seed, 300 Artino Drive, Oberlin, OH 44074
EW ..... East/West Seed International Limited, P.O. Box 3, Bang Bua Thong, Nonthaburi 1110, Thailand
EZ ..... ENZA Zaden, P.O. Box 7, 1600 AA, Enkhuisen, The Netherlands 02280-15844
FED..... Fedco Seed Co., P.P. Box 520 Waterville, ME, 04903
FM ..... Ferry-Morse Seed Co., P.O. Box 4938, Modesto, CA 95352
G ..... German Seeds Inc., Box 398, Smithport, PA 16749-9990
GB..... Green Barn Seed, 18855 Park Ave., Deephaven, MN 55391
GL ..... Gloeckner, 15 East 26th St., New York, NY 10010
GO ..... Goldsmith Seeds Inc., 2280 Hecker Pass Highway, P.O. Box 1349, Gilroy, CA 95020
GU ..... Gurney's Seed and Nursery Co., P.O. Box 4178, Greendale, IN 47025-4178
HL/HOL ..... Hollar & Co. Inc., P.O. Box 106, Rocky Ford, CO 81067
H/HM..... Harris Moran Seed Co., 3670 Buffalo Rd., Rochester, NY 14624, Ph: (716) 442-0424
HMS..... High Mowing Organic Seeds, 76 Quarry Rd., Wlacott, VT 05680
HN ..... HungNong Seed America Inc., 3065 Pacheco Pass Hwy., Gilroy, CA 95020
HO..... Holmes Seed Co., 2125-46th St., N.W., Canton, OH 44709
HR..... Harris Seeds, 60 Saginaw Dr., P.O. Box 22960, Rochester, NY 14692-2960
HS..... Heirloom Seeds, P O Box 245, W. Elizabeth PA 15088-0245
HZ..... Hazera Seed, Ltd., P.O.B. 1565, Haifa, Israel
JU..... J. W. Jung Seed Co., 335 High St., Randolf, WI 53957
JS/JSS..... Johnny's Selected Seeds, Foss Hill Road, Albion, MA 04910-9731
KS ..... Krummrey & Sons Inc., P.O. 158, Stockbridge, MI 49285
KU..... Known-you Seed Co., 26 Chung Cheng 2nd Road, Kaushiung Taiwan, 80271
KY ..... Known-You Seed Co., Ltd. 26 Chung Cheng Second Rd., Kaohsiung, Taiwan, R.O.C. 07-2919106
KZ ..... Kitazawa Seed Co., PO Box 13220 Oakland, CA 94661-3220
LI ..... Liberty Seed, P.O. Box 806, New Philadelphia, OH 44663
LSL..... LSL Plant Science, 1200 North El Dorado Place, Suite D-440, Tucson, AZ 85715
MB..... Malmborg's Inc., 5120 N. Lilac Dr., Brooklyn Center, MN 55429
MK..... Mikado Seed Growers Co. Ltd., 1208 Hoshikuki, Chiba City 280, Japan 0472 65-4847
ML ..... J. Mollema & Sons Inc., Grand Rapids, MI 49507
MM..... MarketMore Inc., 4305 32nd St. W., Bradenton, FL 34205
MN ..... Dr. Dave Davis, U of MN Hort Dept., 305 Alderman Hall, St. Paul, MN 55108
MR..... Martin Rispins & Son Inc., 3332 Ridge Rd., P.O. Box 5, Lansing, IL 60438
MS ..... Musser Seed Co. Inc., Twin Falls, ID 83301
MWS ..... Midwestern Seed Growers, 10559 Lackman Road, Lenexa, Kansas 66219
NE..... Neuman Seed Co., 202 E. Main St., P.O. Box 1530, El Centro, CA 92244
NI ..... Clark Nicklow, Box 457, Ashland, MA 01721
NU ..... Nunhems (see Canners Seed Corp.)
NS..... New England Seed Co., 3580 Main St., Hartford, CT 06120
NZ..... Nickerson-Zwaan, P.O. Box 19, 2990 AA Barendrecht, The Netherlands
OE..... Ohlsens-Enke, NY Munkegard, DK-2630, Taastrup, Denmark
ON..... Osbourne Seed Co., 2428 Old Hwy 99 South Road Mount Vernon, WA 98273
OS..... Outstanding Seed Co., 354 Center Grange Road, Monaca PA 15061
OLS ..... L.L. Olds Seed Co., P.O. Box 7790, Madison, WI 53707-7790
OT..... Orsetti Seed Co., P.O. Box 2350, Hollister, CA 95024-2350

P ..... Pacific Seed Production Co., P.O. Box 947, Albany, OR 97321
PA/PK ..... Park Seed Co., 1 Parkton Ave., Greenwood, SC 29647-0002
PARA..... Paragon Seed Inc., P.O. Box 1906, Salinas CA, 93091
PE..... Peter-Edward Seed Co. Inc., 302 South Center St., Eustis, FL 32726
PF..... Pace Foods, P.O. Box 9200, Paris, TX 75460
PG..... The Pepper Gal, P.O. Box 23006, Ft. Lauderdale, FL 33307-3006
PL..... Pure Line Seeds Inc., Box 8866, Moscow, ID
PM ..... Pan American Seed Company, P.O. Box 438, West Chicago, IL 60185
PR ..... Pepper Research Inc., 980 SE 4 St., Belle Glade, FL 33430
PT..... Pinetree Garden Seeds, P.O. Box 300, New Gloucester, ME 04260
R..... Reed's Seeds, R.D. #2, Virgil Road, S. Cortland, NY 13045
RB/ROB..... Robson Seed Farms, P.O. Box 270, Hall, NY 14463
RC ..... Rio Colorado Seeds Inc., 47801 Gila Ridge Rd., Yuma, AZ 85365
RE..... Reimer Seed Co., PO Box 236, Mt. Holly, NC 28120
RG..... Rogers Seed Co., P.O. Box 4727, Boise, ID 83711-4727
RI/RIS..... Rispens Seeds Inc., 3332 Ridge Rd., P.O. Box 5, Lansing, IL 60438
RS..... Royal Sluis, 1293 Harkins Road, Salinas, CA 93901
RU/RP/RUP .. Rupp Seeds Inc., 17919 Co. Rd. B, Wauseon, OH 43567
S ..... Seminis Inc. (may include former Asgrow and Peto cultivars), 2700 Camino del Sol, Oxnard, CA 93030-7967
SE..... Southern Exposure Seed Exchange, P.O. Box 460Mineral, VA 23117
SHUM..... Shumway Seed Co., 334 W. Stroud St. Randolph, WI 53956
SI/SG..... Siegers Seed Co., 8265 Felch St., Zeeland, MI 49464-9503
SIT..... Seeds From Italy, P.O. Box 149, Winchester, MA 01890
SK..... Sakata Seed America Inc., P.O. Box 880, Morgan Hill, CA 95038
SN..... Snow Seed Co., 21855 Rosehart Way, Salinas, CA 93980
SO ..... Southwestern Seeds, 5023 Hammock Trail, Lake Park, GA 31636
SOC..... Seeds of Change, Sante Fe, NM
SST ..... Southern States, 6606 W. Broad St., Richmond, VA 23230
ST..... Stokes Seeds Inc., 737 Main St., Box 548, Buffalo, NY 14240
SU/SS..... Sunseeds, 18640 Sutter Blvd., P.O. Box 2078, Morgan Hill, CA 95038
SV ..... Seed Savers Exchange, 3094 North Winn Rd., Decorah, IA 52101
SW ..... Seedway Inc., 1225 Zeager Rd., Elizabethtown, PA 17022
SY..... Syngenta/Rogers, 600 North Armstrong Place (83704), P.O. Box 4188, Boise, ID 83711-4188
T/TR ..... Territorial Seed Company, P.O. Box 158, Cottage Grove, OR 97424
TGS..... Tomato Growers Supply Co., P.O. Box 2237, Ft. Myers, FL 33902
TS..... Tokita Seed Company, Ltd., Nakagawa, Omiya-shi, Saitama-ken 300, Japan
TT..... Totally Tomatoes, P.O. Box 1626, Augusta, GA 30903
TW..... Twilley Seeds Co. Inc., P.O. Box 65, Trevose, PA 19047
UA..... US Agriseeds, San Luis Obispo, CA 93401.
UG ..... United Genetics, 8000 Fairview Road, Hollister, CA 95023
US ..... US Seedless, 12812 Westbrook Dr., Fairfax, VA 22030
V..... Vesey's Seed Limited, York, Prince Edward Island, Canada
VL..... Vilmorin Inc., 6104 Yorkshire Ter., Bethesda, MD 20814
VS ..... Vaughans Seed Co., 5300 Katrine Ave., Downers Grove, IL 60515-4095
VTR..... VTR Seeds, P.O. Box 2392, Hollister, CA 95024
WI ..... Willhite Seed Co., P.O. Box 23, Poolville, TX 76076
WP ..... Woodpraire Farms, 49 Kinney Road, Bridgewater, ME 04735
ZR ..... Zeraim Seed Growers Company Ltd., P.O. Box 103, Gedera 70 700, Israel

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