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2016 Fruit and Vegetable Crops Research Report

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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 2016 Fruit and Vegetable Crops Research Program

Shubin K. Saha, Horticulture

Fruit and vegetable production continues to show sustained growth in Kentucky. As the industry grows around a diverse collection of marketing tactics (wholesale, farmers markets, CSAs, and direct to restaurants) as well as various production systems, there continues to be a need for applied practical information to support the industry. The 2016 Fruit and Vegetable Crops research report includes results for 15 projects including open field production and greenhouses. This year fruit and vegetable research, demonstration and insect monitoring trials were conducted in 16 counties in Kentucky: Adair, Allen, Bourbon, Breckenridge, Breathitt, Caldwell, Crittenden, Daviess, Fayette, Garrard, Larue, McCracken, Pulaski, Scott, Shelby, and Trigg. (See map, right). Research was conducted by faculty and staff from the Horticulture and Entomology Departments in the University Of Kentucky College Of Agriculture. Faculty and staff of Kentucky State University also contributed to this report in collaborative research projects.

Variety trials included in this year's publication include apples, blackberries, haskap berries, muskmelon, peaches, seedless watermelon, strawberries, and sweet corn. Additional research trials include evaluation of Bt sweet corn varieties for insect resistance, evaluation of soil amendments on tomato production, and evaluation of organic based alternative soilless media for greenhouse vegetable production. Evaluation of varieties is a continuing necessity and allows us to provide the most up to date information in communications with vegetable growers. These results are the basis for updating the recommendations in our Vegetable Production Guide for Commercial Growers (ID-36). These updates are not based solely on one season's data or location. It is necessary to trial varieties in multiple seasons and if at all possible, multiple locations. We may also collaborate with researchers in surrounding states such as Ohio, Indiana, and Tennessee to discuss results of variety trials they have conducted. 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. Following are some helpful guidelines for interpreting the results of fruit and vegetable variety trials.

Our Yields vs. Your Yields

Yields reported in variety trial results are extrapolated from small plots. Depending on the crop, individual plots range from 1 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. 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

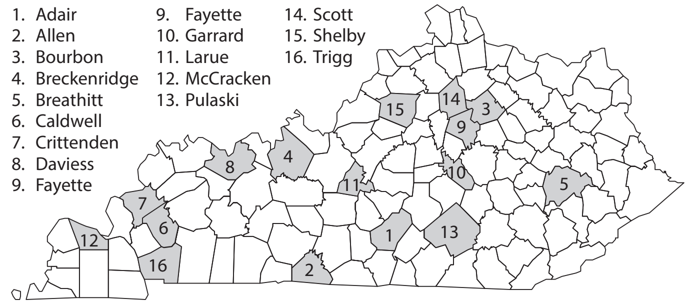
Often yield or quality data will be presented in tables followed by a series of letters (a, ab, bc, etc.). These letters indicate whether the yields of the varieties are statistically different. Two varieties may have average yields that are numerically different, but statistically are the same. For 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 yields similar to variety 1 but also 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, they are significantly different; however, if they share even one letter, 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 followed by the letters "abc" would be different from yield data followed by "efg."

When determining statistical significance we typically use a P value of 0.05. In this case, P stands for probability. If two varieties are said to be different at $P < 0.05$, then at least 95 percent of the time those varieties will be different. If the P value is 0.01, then 99 percent of the time those varieties will be different. Different P values can be used, but typically $P < 0.05$ is considered standard practice for agricultural research.

This approach 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.

Fruit and vegetable research sites, 2016



On-Farm Commercial Vegetable Demonstrations

Ty Cato and Shubin K. Saha, Horticulture

Introduction

In 2016, two on-farm commercial vegetable production demonstrations were conducted in the North-Central part of the state in Shelby County. 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. The first grower in Shelby County produced 0.4 acres of heirloom tomatoes for the wholesale market. The second Shelby County grower produced a variety of vegetable crops ranging from tomatoes, okra, peppers, pumpkins, potatoes, sweet corn, watermelons, summer and winter squash, and also cut flowers. This plot was approximately 4.02 acres. Almost all sales of this grower's produce were from farmer's markets.

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 mulch 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 and input costs. An extension associate from the Department of Horticulture made weekly visits to provide assistance with integrated pest management, harvesting practices, and other production issues. 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 first plot used conventional production techniques, including the use of synthetic fertilizers and pesticides. The second plot used organic practices in the production of crops. The two demonstrations used raised beds with plastic mulch sealed on top of the beds. The height of the beds ranged from three to six inches. The six inch beds were created using a Rain-Flo 2550 bed shaper and the three inch beds were made using a Nolt's bed shaper. The Nolt's bed shaper is smaller and only requires a tractor of approximately 30 horsepower to pull. This enables smaller scale growers to utilize plasticulture without needing a large tractor. The lower bed height does reduce some of the benefits seen on taller beds, primarily soil warming, drainage, and reduced contact with soil. The plastic used was black 1 mil on four foot rolls. The black plastic provides transplants with the heat that they need early in the growing season. The drip tape that was used was 8 mil with 12 inch emitter spacing. The flow rate was 0.45 gallons per minute, per 100 feet.

Results and Discussion

The 2016 growing season presented some problems for commercial producers in North-Central Kentucky. The most significant issue was rain, which is a common problem for growers in Kentucky who produce crops that are susceptible to fungal pathogens. Periods of heavy rain in July promoted the development of Septoria leaf blight on tomatoes in the Shelby County plots. 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 reducing yields. The Shelby County heirloom tomato grower experienced damage to his crop resulting from Septoria leaf blight and Early blight. The grower chose to spray Quadris fungicide to slow the spread of the disease, but significant damage had already occurred. The fungicide application did however prevent further spread of the pathogens from continuing. The second Shelby County grower also experienced damage from Septoria leaf blight, but chose not to spray anything. The rain also accounted for much of the splitting seen in the tomatoes from both plots. This generally can be mitigated by selecting cultivars resistant to splitting and maintaining a regular irrigation schedule. Even using plastic mulch, heavy summer downpours will allow enough water to flow into the transplant holes of the mulch and via capillary action from row middles to cause splitting problems.

Table 1. Costs and profits for mixed vegetable plots – Shelby County, 2016

	Shelby 1 (Heirloom Tomatoes)	Shelby 2 (Mixed Production)
Plot Acreage	0.4	4.02
Inputs		
Plants and Seeds	$412.00	$3618.00
Fertilizer	83.00	1500.00
Plastic Mulch	69.70	490.00
Drip Lines, Irrigation Fittings and Fertilizer Injector	227.78	2212.00
Herbicide	N/A	N/A
Insecticide	N/A	N/A
Fungicide	20.00	N/A
Water	250.00	1190.00
Manual Labor	2474.00	11800.00
Machine Labor (Fuel cost)	165.00	227.00
Marketing	N/A	557.00
Miscellaneous	N/A	1137.00
Total Expenses	3701.48	22731.00
Yield	1750 lbs.	*
Revenue	4200.00	3740.50
Profit	$498.52	-$18990.50

*Yields vary for mixed vegetable operations

Powdery mildew was a later season issue, affecting 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.

Lastly, weed management was another significant issue during the 2016 season. Weed pressure became so severe that it limited production, yield, and harvest of many of the crops planted. This plot was managed organically, not certified, and control was limited to mechanical cultivation and mowing. This was not possible when the weeds became too large, as running a bush hog through the plot would damage the vegetable crops. The first Shelby County grower planted annual Ryegrass between the raised beds and mowed on a regular basis to manage growth.

Profitability of the two demonstrations varied greatly. The first Shelby County grower experienced a profit of almost $500.00, which considering his lower yields and the smaller scale of the planting is acceptable.

Diminished yields, due to biotic and abiotic factors contributed to negative profits by the second Shelby County grower (Table 1). This grower also needed a much larger market than just farmer's markets to sell all he produced. Many first year growers experience this problem and reorganize in the following years. Initial start-up costs for this grower 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.

Yield Performance of 'Black Magic™' and 'Prime-Ark®45' Thorny Primocane-fruiting Blackberries at Kentucky State University

Jeremiah D. Lowe, Sheri B. Crabtree, and Kirk W. Pomper, College of Agriculture, Food Science, and Sustainable Systems, Kentucky State University; John R. Clark, Horticulture, University of Arkansas; and John G. Strang, Horticulture, University of Kentucky

Introduction

In Kentucky, there are over 670 farms growing berry crops, including blackberries, valued at over $2,600,000 annually (Census of Agriculture 2012). Kentucky's climate is well suited for blackberry production. With brambles there are two cane types: primocanes, or first year canes, which are usually vegetative, and floricanes, which are the same canes, flowering and producing fruit the next growing season. 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 temperature, 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.

Black Magic™' is a thorny primocane fruiting selection suited for home growers and on-farm sales (Clark et al., 2014). 'Black Magic™' was previously evaluated as an advanced selection in Kentucky, but was not compared to 'Prime-Ark®45' (Lowe et al., 2012 and 2014). 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 (Clark et al., 2005; Stanton et al., 2007). The objective of this study was to determine if 'Prime-Ark®45' is superior to 'Black Magic™' in terms of yield and fruit quality under Kentucky growing conditions. Here we report production from the trial in its fourth year.

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 either 'Black Magic™' or 'Prime-Ark®45' (total of 15 plants of each selection) in 10 foot plots with a plant spacing of 2 feet. 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. Plots were fertilized with NatureSafe 10-2-8 fertilizer at 100 lbs of N per acre. 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 twice weekly, from July through October. ANOVA and LSD means separation were performed using CoStat Statistical Software (CoHort Software, Monterey, CA).

Results and Discussion

Primocane fruit were harvested from late-July until mid-October (Table 1). Temperatures 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. Growing conditions in 2015 were hot; there were 56 out of 122 days with a daily high temperature above 85°F from June through September. The average high for July 2015 was 84.6°F. In 2016, the average high for July was 85.7°F and there were 80 out of 122 days above 85°F. Hotter temperatures in 2015 and 2016 may have reduced fruit set, size and quality on primocanes.

In 2014, 'Prime-Ark® 45' had a trend toward larger yields than 'Black Magic™', but the difference was not significant. 'Black Magic™' did have a significantly larger berry size than 'Prime-Ark® 45' (5.36 g vs. 4.31 g) in 2014 (Table 1). In 2015, 'Prime-Ark® 45' had a significantly larger yield; however, 'Black Magic™' and 'Prime-Ark® 45' had similar berry sizes (Table 1). In 2016, 'Black Magic™' had a significantly larger berry size, but yields were not significantly different between the two varieties. In Arkansas, 'Black Magic™' had smaller primocane yields (1117 lbs/acre) compared to those observed in our Kentucky trial in 2016 (Clark et al., 2014).

The University of Arkansas Blackberry Breeding Program recommends that commercial producers plant 'Prime-Ark®45' due to its superior shipping quality of the firmer fruit of. Due to softer fruit, 'Black Magic ™' is recommended for U-pick and on-farm sales as well as for home gardens (Clark et al., 2011 and 2014). Year-to year-yield characteristics will need to be further evaluated; however, the data suggest that 'Prime-Ark®45' and 'Black Magic™' have large fruit and yield well in Kentucky. 'Prime-Ark®45' as well as 'Black Magic™' should be considered by commercial growers interested in producing primocane fruiting blackberries.

Table 1. Yields and berry weights in 2014, 2015, and 2016 for 'Black Magic™' and 'Prime-Ark®45' at the Kentucky State University Research Farm , Frankfort, KY

	Fruit Weight (g)			Yield (lb/acre)		
Selection	**2014**	**2015**	**2016**	**2014**	**2015**	**2016**
Black Magic	5.36 a[1]	3.33 a	4.17 a	1026 a	852 b	2960 a
Prime-Ark 45	4.31 b	3.99 a	3.67 b	1501 a	2307 a	3892 a

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

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Cooperative Spotted Wing Drosophila Survey for First Activity, 2013-2016

Ric Bessin, Patty Lucas, Jessica Bessin, and Nathan Mercer, Entomology

Introduction

Spotted wing drosophila, *Drosophila suzukii*, is an invasive pest from Asia that was first detected in Kentucky in the summer of 2012 in Warren, Daviess, and Larue counties (Asplen et al. 2015). It is a serious pest of thin skinned fruits as the female has a hardened ovipositor capable of penetrating the undamaged skins of raspberries, blackberries, blueberries, grapes and strawberries which can result in larvae infesting fruit at harvest (Cole et al. 2014a). The fruits of these crops become vulnerable when the developing fruits begin to change color and soften approximately a week before harvest (Lee et al. 2011). This has been a 'game changer' in that prior to the introduction of this pest, producers often did not need to use insecticides during the harvest period for these crops (Cole et al. 2014b).

To determine the distribution of spotted wing drosophila in Kentucky, a monitoring program was begun in 2013 with the assistance of numerous county extension agents and commercial producers of small fruits. In particular, this survey program was used to alert producers to the start of spotted wing drosophila activity in their area so that they would know when to initiate management sprays. Producers can use this information to eliminate unnecessary insecticide sprays prior to the start of spotted wing activity.

Table 1. Date of first spotted wing drosophila capture in baited traps* by county, 2014-2017

County	2013	2014	2015	2016
Adair				June 26
Allen			June 1	May 24
Bourbon	June 13	July 10	June 15	June 24
Boyle		No detection		
Breckenridge		July 14		August 18
Breathitt	July 1	July 9	July 1	July 18
Caldwell	July 9	July 21	May 27	May 19
Christian			June 18	
Crittenden	July 8	July 2	June 2	June 3
Daviess	June 10	June 25	May 29	June 15
Fayette	August 4	July 16	May 31	June 29
Garrard		July 13		June 27
Henderson	June 27		June 25	
Larue	July 8			June 22
Letcher	July 27			
Lyon	September 9			
McCracken	June 2	June 12	June 24	June 13
Meade	July 8	July 10		
Metcalfe	July 17			
Ohio		July 3		
Owen		July 18		
Pulaski			June 17	June 16
Rowan		No detection		
Scott	July 11	July 24	July 5	
Trigg			July 2	June 10
Warren	July 2			
Webster		June 26	June 9	

* Baits varied by year as new research became available; 2013 apple cider vinegar, 2014 yeast and sugar, 2015 and 2016 Trecé SWD lure plus apple cider vinegar as a drowning solution.

Materials and Methods

County agents recruited producers willing to use baited traps to monitor for spotted wing drosophila on their farms. Traps as well as the baits were supplied by the authors and consisted of a 1-quart plastic deli container that had two 1.5 by 3 inch windows cut in opposite sides with 1/6 inch screen glued over the windows to reduce the number of larger insects. The traps were filled with a drowning solution of approximately 1 inch of apple cider vinegar with one drop of dish soap, except for 2014 where a yeast (1 tsp baker yeast)/sugar (3 tsp)/water (1/2 cup) plus one drop of dish soap solution was used as the bait and drowning solution. In 2015 and 2016, commercially available Trecé spotted wing drosophila lures were hung in the container above the drowning solution to improve trapping efficiency. Lures were changed monthly. Traps were set about two weeks prior to the anticipated start of harvest and placed in the canopy of small fruit crops. Trap contents were collected and mailed to the authors in Lexington or Princeton for identification. Producers and county agents were notified of results through email or via social media (SWDinKY on Facebook). In most cases, trapping was discontinued after the first spotted wing activity was detected or at the end of harvest.

Results and Discussion

There was considerable variation in the date of first detection of spotted wing drosophila among counties across the state and years (Table 1). Trapping indicated that spotted wing drosophila is widespread across the state by late summer but that June-bearing strawberry harvest is finished before the start of spotted wing drosophila activity and much of the blueberry harvest is complete before sprays need to be initiated. However, trapping has shown that blackberries and fall raspberries are at high risk in Kentucky as harvest coincides with widespread activity. In Boyle and Rowan counties in 2014, growers finished with harvest and stopped trapping prior to spotted wing detection.

Producers were able to use information from the trapping as a trigger to begin weekly sprays for spotted wing drosophila during the harvest period and to evaluate the effectiveness of the spray program to maintain low capture levels. Using these traps to determine spotted wing risk, producers were able to effectively manage this key pest while avoiding the use of unnecessary insecticide sprays during the harvest period.

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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 in Kentucky. Demand for this fruit at farmers' markets is strong and generally exceeds supply. Producers are looking for better cultivars that are thornless, productive and have berries with good size and flavor. Resistance to orange rust and rosette are 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, are being evaluated at the UKREC, Princeton, Kentucky.

Materials and Methods

Twenty plants each of five cultivars, Natchez, Osage, Ouachita, and two numbered selections, A-2491T and A-2434T were planted in the spring of 2013. One cultivar was allocated to each plot and each of the four rows in this trial contained five plots per row. Plants were spaced 2.5 feet apart within 12.5-foot long plots in rows spaced 18 feet between rows. 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 (1, 2). Fruit in 2016 were harvested once or twice per week as needed from June 20 through July 18. Yield and number of fruit picked were recorded. Fruit size was calculated as the average weight (yield divided by the number of berries picked) for each plot.

Results and Discussion

Yields averaged from just over 9 lbs. per 5-plant plot for A-2491 to over 47 lbs. per plot for Osage (Table 1). Yields varied significantly among cultivars in 2016 (Table 1), with Osage, A-2434-T and Ouachita being significantly more productive than Natchez and A-2491-T. But yields were lower than last year for Natchez and A-2491-T, and higher for A-2434-T, Osage, and Ouachita (Figure 1). During February of 2015 plants were exposed to -13°F and yields were very good in 2015 for thornless erect blackberries despite the low temperature. In 2016 winter temperatures were very mild so we expected to see yield increases for 2016. Osage produced significantly more fruit and A-2491-T produced significantly less than they did last year.

A-2434-T, and Natchez (Table 1) had significantly larger berries than all other cultivars/selections in 2016. However, berry size (as measured by weight per berry) for all cultivars averaged about 2 grams smaller this year compared to last year (Figure 2), and most plants had smaller leaves, especially Natchez and A-2491-T. John Clark has suggested that this may be the result of highly productive cultivars such as Natchez and A-2491-T not having sufficient nutrient reserves in the crowns and roots to produce both healthy leaves and good crop loads. Some cane blight and/or injury to the cane bases from spring herbicide applications may also have reduced leaf and berry size and yield. Primocane growth in 2016 was vigorous and leaf size was very good.

This year, all berries in this trial ripened over about a four-week period from about June 22 through about July 18. Ouachita appeared to lag the other cultivars in ripening (Table 1), but this lag was not statistically significant. Data on taste was not collected in 2016, but people who tasted them deemed taste to be rather poor during the beginning of the season but seemed to improve as the season progressed.

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Table 1. Summary of 2016 results from the blackberry cultivar trial at UKREC, Princeton, KY

Cultivar	Yield (lb/plot)	Weight (g/berry)[3]	Percent Yield			
			1st week of harvest	2nd week of harvest	3rd week of harvest	4th week of harvest
Osage	47.6[1]	3.9	32.1	38.8	21.1	8.0
A-2434-T	30.4	4.8	41.8	32.6	17.5	8.1
Ouachita	22.3	3.6	29.9	40.0	19.8	10.4
Natchez	12.3	4.8	36.9	38.2	19.7	5.2
A-2491-T	9.1[2]	2.8	34.8	37.3	22.6	5.2
LSD(0.05)[4]	9.4	0.4	(NS)[5]	(NS)	(NS)	(NS)

1 A significant increase in yield compared to 2015 (by t-test at 0.05 probability level).
2 A significant decrease in yield compared to 2015 (by t-test at 0.05 probability level).
3 Fruit weight was calculated as the average weight (yield divided by the number of berries picked) for each plot. Fruit size was significantly smaller in 2016 compared to 2015 for all cultivars.
4 Least significant difference at 0.05 probability level. Differences between two numbers within a column that are less than the least significant difference are not significantly different from one another at the 0.05 probability level.
5 NS denotes that values within a column were not significantly different from one another at 0.05 probability level.

Figure 1. Weekly and total yield per acre in 2016 and total yield per acre in 2015 of erect thornless blackberry cultivars

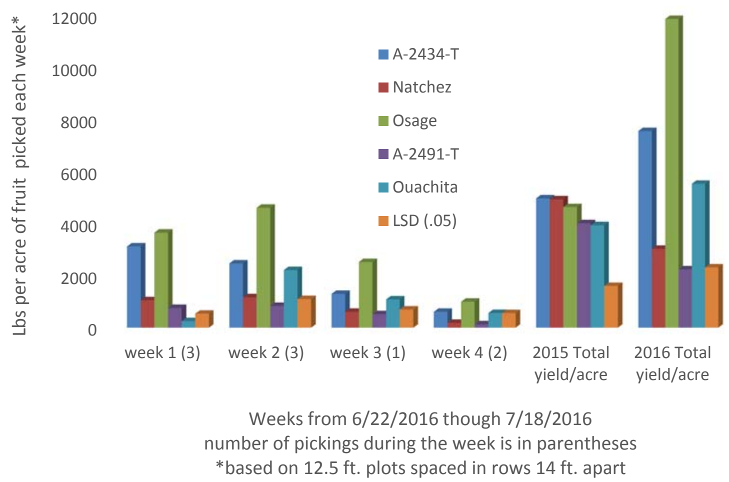
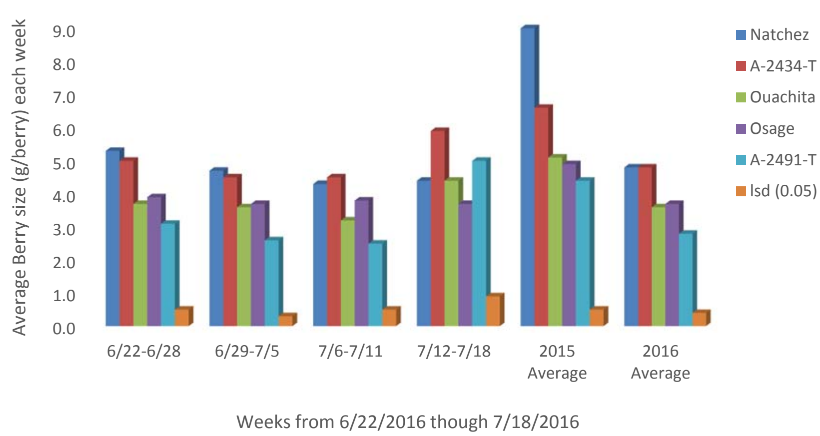


Figure 2. Weekly and seasonal average berry size (as measured by average weight per berry) in 2016 and seasonal average berry size for 2015 for erect thornless blackberry cultivars



Haskap Selection and Variety Evaluation

John Strang, Chris Smigell, and John Snyder, Horticulture

Haskap (*Lonicera caerulea*) is a blue honeysuckle subspecies. In Japan it is popular as a fresh fruit as well as in baked goods, juices, ice cream, candies and wine. It has been commercialized in Canada largely due to the work of Dr. Bob Bors at the University of Saskatchewan. Dr. Maxine Thompson, retired professor at Oregon State University, has also been making Haskap crosses and working to increase its adaptation to more moderate climates.

It differs from the Honeyberry (*Lonicera kamchatika*) grown in Russia, North Korea and the Czech Republic in that Haskaps are adapted to more moderate climates and bloom later. Even so, they bloom during April in Kentucky when frosts are prevalent. Flowers are reported to be hardy to 17°F.

Furthermore, they are not well-adapted to high temperatures and a long growing season. Plants cease growth shortly after fruiting and leaf bronzing occurs. It has been suggested that bronzing may be the result of sunburn and/or high temperature exposure, as no diseases have been associated with the problem (Bors et al. 2016). Varieties vary in the amount and timing of leaf bronzing and American varieties have resistance to this.

We are evaluating Haskaps as a potential crop for Kentucky growers since they ripen early with strawberries and thus do not need insecticide sprays to control spotted wing drosophila. The crop is reported to have few insect and disease pests other than powdery mildew and thus has potential for organic production.

Table 1. Haskap yields and fruit characteristics

Selection/ variety	Yield/ plant[1] (oz)		Wt 20 berries[1,2] (oz)		Attractiveness[3] (1-5)	Firmness (1-5)[4]	Sweetness (1-5)[5]	Flavor (1-5)[6]	Adhering flower petals (1-5)[7]
85-35	10.7	a	0.91	ab	4.0	3.2	3.8	3.7	1.3
85-19	9.9	ab	0.69	def	4.0	3.0	3.6	3.3	1.3
44-19	9.3	ab	0.70	def	3.0	3.5	3.1	3.1	1.7
21-20	8.1	abc	0.66	ef	3.3	2.2	2.8	2.6	1.9
85-28	6.2	a-d	0.75	c-f	2.6	2.9	3.3	3.0	3.0
84-105	5.9	b-e	0.67	ef	3.4	2.4	3.4	3.2	1.9
56-51	5.2	b-e	0.97	a	2.9	3.1	2.6	2.5	1.8
Borealis	3.6	c-e	0.79	b-e	3.3	3.1	3.7	3.4	1.1
46-55	3.5	c-e	0.85	bc	3.4	3.7	3.8	3.7	1.5
29-55	2.4	d-e	0.80	bcd	3.9	3.2	4.1	3.8	1.1
51-02	1.5	e	0.65	f	3.0	2.7	3.5	3.5	1.1

1 Numbers followed by the same letter are not significantly different (Duncan Multiple Range Test LSD $P \le 0.05$).
2 Average weight based on 20 berries at each harvest.
3 Attractiveness: 1 = poor; 5 = excellent.
4 Firmness: 1 = soft; 5 = very firm.
5 Sweetness based on two evaluations: 1 = tart; 5 = sweet.
6 Flavor: 1 = poor; 5 = excellent.
7 Flower petals adhering to fruit: 1 = none; 5 = many.

Table 2. Haskap plant survival, size, percent bloom, foliar frost injury and leaf bronzing

Selection/ variety	Plant mortality[1] (% dead)	Plant Volume[2] (cu ft)	Bloom 2016[3,4] (%)		Foliar frost injury 2016[4,5] (%)		Leaf bronzing 2015[4] (AUDPC)[6]		Leaf bronzing 2016[4] (AUDPC)[6]	
85-35	0	0.94	92	ab	0	d	2168	ef	944	d
85-19	17	2.47	83	ab	1	d	2720	def	2081	cd
44-19	17	1.26	80	abc	19	c	3896	bcd	2650	a-d
21-20	50	3.21	58	cd	7	d	5012	ab	4550	a
85-28	17	1.11	94	a	0	d	1567	f	2473	bcd
84-105	50	1.54	70	bc	0	d	3899	bc	3278	abc
56-51	0	2.57	77	abc	85	a	6049	a	3366	abc
Borealis	33	0.68	45	de	0	d	5233	a	3432	abc
46-55	17	1.28	19	f	41	b	5756	a	3897	ab
29-55	0	0.97	28	ef	3	d	3143	cde	1877	cd
51-02	0	1.36	27	ef	0	d	6147	a	1479	cd

1 Plant mortality was assessed on 25 October, 2016.
2 Plant volume calculated as volume of a cylinder based on plant height and width.
3 Visual estimation of plant percent bloom on 7 April, 2016.
4 Means within same column followed by the same letter are not significantly different (Duncan's Multiple Range Test LSD $P \le 0.05$).
5 Visual estimate on 24 April, 2016 of percent leaf injury following frosts at temperatures of 29.8°F on 3 April, 29.9°F on 8 April and 29.8°F on 10 April, 2016.
6 The area under the disease progress curve (AUDPC) is a quantitative summary of disease intensity over time, calculated from leaf bronzing and drop ratings taken on 1 August, 1 and 21 September, and 1 November, 2015 and 18 July, 11 August, 2 and 15 September, and 11 October, 2016. Higher numbers in the columns indicate greater cumulative leaf bronzing and leaf drop.

Haskap plants provided by Gardens Alive! Inc. were planted at the University of Kentucky Horticultural Research Farm in Lexington to evaluate their adaptation and production potential. Very few fruit were produced in 2015, the second growing season, and no yield data were collected. This report contains plant development and leaf bronzing evaluations for the second and third growing seasons as well as yield and fruit quality results for 2016.

Materials and Methods

Ten potted, actively growing Haskap selections and the variety Borealis were moved from the greenhouse and transplanted on 2 June, 2014. Plants were set 6 feet apart in rows with 12 feet between rows. Individual plant plots were replicated six times in a randomized block design. Six-foot wide DeWitt Sunbelt Weed Barrier was cut to fit around the plants and stapled to the ground with SSS8 8-inch long, 8 Gauge

Heavy Duty Staples for weed control down the row. Hard plastic, ¾-inch drip irrigation tubing was installed on top of the landscape fabric down each replication row and a one-gallon per hour emitter was inserted 6 inches from the base of each plant. Irrigation was provided as needed.

No insecticides, fungicides or herbicides were used on the planting. Plants were not fertilized the first two seasons and fertilized with one cup of Nature Safe 10-2-8 on 25 April 2016. Bird netting was erected prior to berry ripening over each row, resting on wires attached to T-shaped supports and anchored to the ground with wire staples in 2016.

Frost injury and plant bloom density were collected in Spring 2016. Fruit were harvested and weighed four times during the season. Twenty berries were weighed at two harvests to determine average berry weight. Berry appearance, firmness, sweetness, flavor, and flower petal adherence to the fruit were also assessed twice during harvest for each plant that produced fruit. Data on leaf bronzing were collected in 2015 and 2016 and plant height and width were measured on 11 October, 2016. Plant mortality was assessed on 25 October, 2016.

Table 3. Haskap selection/variety comments

Selection/ variety	Fruit Observations
85-35	Large, uniform shape; some adhering leaves, a few splits[1], some frost burn
85-19	Large, unifrom shape & size, jelly bean-shaped; nice taste; some persistent flower parts
44-19	Variable size & shape, round- to elongate-shaped; a few splits, a few adhering leaves, some frost burn
21-20	Variable size, mushy, wet-looking, some splits; a few adhering leaves & flowers; flowers adhere tightly
85-28	Variable size & shape, eggplant-shaped, wet-looking, mushy; some adhering flower parts
84-105	Variable size & shape, attractive, very soft; some with persistent leaves & flower parts
56-51	Large, round- to oval-shape, many splits; tart; persistent flower parts, some frost burn
Borealis	Variable size, several splits
46-55	Large, elongated, attractive, no splits; nice flavor and crisp; some adhering leaves, some frost burn
29-55	Medium to large, variable shape; very few splits
51-02	Variable size & shape; sweet; very little splitting; some frost burn

[1] Splits refer to berries that are open on one side exposing the two ovaries. The berries are completely covered by the epidermis and not prone to decay, but look unusual.

Results and Discussion

The 2014 season was relatively cool with slightly more rainfall than normal, while the 2015 season was extremely rainy and cool. The 2016 season was slightly warmer than the 2015 season and very wet up until early August, after which it turned dry with little rainfall. Fruit were harvested on 13, 23, April and 1, 8 June, 2016. Fruit yield and berry characteristics are shown in Table 1. Selections are ranked based on yield per plant.

Overall, selection 85-35 and 85-19 have been the best performing selections in this trial. Selection 85-35 had high yield, larger fruit size, top attractiveness rating and moderately firm fruit. Its fruit scored high in sweetness (less tart) and were ranked as having a good flavor. It was noted that the fruit were fairly uniform in shape, had minimal splitting and only a few dried flower petals and an occasional leaf that adhered to the fruit. Table 2 shows that none of the 85-35 plants have died and that plant size or volume was relatively small compared to other selections. The plants carried many blooms and no foliage frost injury was sustained following three light frosts. Leaf bronzing severity was low in both 2015 and 2016 in comparison to other selections and Borealis.

Selection 85-19 performed similarly to 85-35, but had a smaller berry size, tended to have a larger plant size and one plant died in the fall of 2016.

Borealis, the standard variety in the trial, has yielded significantly less than the top two selections and has tended to have small plants, a lower plant bloom density in 2016 and a statistically higher leaf bronzing rating, although this variety is reported to have little leaf sunburn or bronzing (Bors et. al. 2016). Two Borealis plants have died in the trial.

Selections that have performed less desirably include 21-20, 84-105, 56-51, 46-55, and 85-28. Fifty percent of the 21-20 and 84-105 plants have died. Selections 56-51 and 46-55 sustained the most foliar frost injury following three light frosts. The selections 85-28, 21-20, and 56-51 all had relatively high numbers of dried flower petals that adhered to the fruit. These fruit would not be attractive if sold fresh, and may not be useable in processed whole fruit products.

A Spearman rank correlation for comparing selection/variety leaf bronzing (AUDPC) levels between years was not significant indicating that selections/varieties that had high leaf bronzing ratings in 2015 did not have high bronzing ratings in 2016.

Japanese beetles caused some minor leaf feeding damage in 2016. One plant in April and three plants in September 2016 that were dying were taken to the Kentucky Plant Diagnostic Lab and were diagnosed with Phytophthora root rot. Cercospora was isolated from leaf spots in 2015 and no powdery mildew has been detected in the planting. This trial will be continued for several more years so these results should be considered preliminary.

Acknowledgments

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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, and can 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 researchers from 29 other states in the United States, three Canadian provinces, Mexico, and Chile 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.

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:

1. The 2009 peach rootstock trial, which compares fourteen rootstocks with 'Redhaven' as the scion cultivar (Table 1). 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.
2. The 2010 apple rootstock trial, which compares thirty-one different rootstocks with 'Aztec Fuji' as the scion cultivar (Table 2). The experimental design was a randomized complete block design with four blocks with from one to three trees per rootstock per block. The trees were planted in March 2010 and trained to the tall spindle system. 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 of 2010. The heights of the graft unions above the soil line average five inches with a range of three to seven inches.

Orchard floor management for these trials consists of 6.5 ft. bare ground, herbicide-treated strips with mowed sod alleyways. Trees are fertilized and sprayed with pesticides according to local recommendations (1, 2). Yield and trunk circumference measurements are recorded for both trials and trunk cross-sectional area (TCSA) is calculated from the trunk circumference measurements taken 12 inches above the graft union for apple, and six inches above for peach. Cumulative yield efficiency is the cumulative yield (total of all the annual yields) divided by the current year's trunk cross-sectional area. The cumulative yield efficiency is an indicator of the proportion of nutrient resources a tree is putting into fruit production relative to vegetative growth. Tree height and canopy spread (the average of the within-row and across-row tree widths) are recorded at the end of the 5th and the final (usually the 10th) seasons of each trial. Fruit size is calculated as the average weight (oz.) per fruit. All data is statistically analyzed using SAS v.9.4 (3).

Results and Discussion

The mild winter and spring of 2016 resulted in "bumper crops" of both rootstock trials.

2009 Peach Rootstock Trial

Mortality, Julian date of 90% bloom and 10% fruit maturity, cumulative yield, yield, number of root suckers, trunk cross-sectional area (TCSA), and cumulative yield efficiency varied

Table 1. Rootstocks in the 2009 NC-140 peach rootstock trial

Rootstock	Tree Vigor (Percent of Lovell)	Genetic origin	Breeding program
Atlas	120	*Prunus sp.* x almond hybrid	Zaiger Genetics
BH-5 (Bright's Hybrid #5)	110	*Prunus sp.* x almond hybrid	Bill Bright
Controller™ 5	60	*P. salicina* x *P. persica*	USDA-UC Davis
Guardian	110	Southeastern US standard	
HBOK 10 (Controller™ 8)	90	Harrow Blood, Siberian C parentage	UC Davis
HBOK 32 (Controller™ 7)	80	Harrow Blood, Siberian C parentage	UC Davis
Krymsk 1	50	*P. tomentosa* x *P. cerasifera*	a Russian rootstock
Krymsk 86	110	*P. cerasifera* x *P. persica*	a Russian rootstock
KV010-123	100	Red leaf peach x Bailey	Ralph Scorza –USDA
KV010-127	100	Red leaf peach x Bailey	Ralph-Scorza –USDA
Lovell	100	A commercial standard	
Mirobac cv. PAC 941(Replantpac™)	110	*P. cerasifera* x *P. dulcis*	Agromillora Iberia, Barcelona
Prunus americana	60	Seedling selection	Bailey's Nursery
Viking	110	*Prunus sp.* x almond hybrid	Zaiger Genetics

significantly among the fourteen rootstocks in this trial (Table 3). Krymsk1 and Bright's Hybrid have had the highest mortality rates, 75% and 50%, respectively. Krymsk 1 followed by Bright's Hybrid and Controller were the earliest to bloom. Scions on Lovell followed by Guardian and Viking were the latest to bloom. Maturity was the latest for Guardian and KV010-127, but this was not significantly different from HOBK 10, Viking, Lovell, Krymsk 86, HBOK 32, Mirobac, KV010-123, or Krymsk 1. Fruit of scions on Bright's Hybrid, Atlas, Controller 5, and *P. americana,* matured the earliest. Guardian has produced the largest trees (TCSA) to date, but they are not statistically different in size from Mirobac, Viking, Lovell, Krymsk 86, KV010-127, or Atlas. Scions on Krymsk 1 are the smallest trees in this trial. Yield per tree was highest for Atlas and lowest for Krymsk 1. Cumulative yield from 2012 through 2016 was highest for Atlas, but was not significantly different from that of Lovell, KV010-123, Guardian, Viking, or KV010-123. Atlas had the highest cumulative yield efficiency. *P. americana* had significantly more root suckers than the other rootstocks. Average fruit size tended to be largest from scions on Atlas, but not significantly larger than for fruit from scions on Lovell, Guardian, KV0101-123, KV010-127, HBOK 10, HBOK 32, Mirobac, and Viking. To date, none of the rootstocks in this trial have surpassed Lovell or Guardian, industry standards with regards to overall performance.

2010 Apple Rootstock Trial

In 2012, a tree with G.11 as the rootstock was lost due to deer damage, a tree on B.9 broke at the graft union, and two trees with M.9 NAKBT337 were lost possibly from winter injury. Three trees (one M.9 Pajam2 and two B.71-7-22) succumbed to fire blight infections in 2013, and seventeen trees succumbed in 2014 due to the results of fire blight (including two B.64-194, five M.26 EMLA, two Supporter 3, one on PiAu51-11, four with M.9 NAKBT337, and three with M.9 Pajam2). In 2015, a tree with G.935 N broke at the graft union, and three trees succumbed to winter injury (two B.70-20-20 and one M.9 Pajam2). In 2016, one tree on B.10, one on CG.2034, and one on M.26 EMLA, broke at their graft unions.

Table 2. Rootstocks in the 2010 apple rootstock trial with 'Aztec Fuji' as the scion cultivar

Rootstock	Clone status	Breeding Program—Location
B.9	named	Budagovsky—Michurinsk State Agrarian University, Michurinsk, Tambov Region, Russia
B.10		
B.7-3-150	not released	
B.7-20-21		
B.64-194		
B.67-5-32		
B.70-6-8		
B.70-20-20		
B.71-7-22		
G.11	named	Cornell-Geneva— New York State Agricultural Experiment Station
G.41 N[1]		
G.41 TC[2]		
G.202 N[1]		
G.202 TC[2]		
G.935 N[1]		
G.935 TC[2]		
CG.2034	not released	
CG.3001		
CG.4003		
CG4004		
CG.4013		
CG.4214		
CG.4814		
CG.5087		
CG.5222		
Supp.3	named	Pillnitz— Institut fur Obstforschaung, Dresden-Pillnitz, Germany
PiAu.9-90	not released	
PiAu.51-11		
M.9 NAKBT337	named	NAKB clone of M.9— NAKB, Netherlands
M.9 Pajam2	named	CTIFL clone of M.9— CTIFL, France
M.26 EMLA	named	E. Malling clone of M.26— East Malling Res. Station, Kent, England

[1] Stool bed produced.
[2] Tissue culture produced.

Table 3. 2016 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	Cumulative Yield (2011-2016) (lbs./tree)	2016 Yield (lbs./tree)	Fruit Weight (oz./fruit)	Number of Root Suckers per tree	TCSA (sq.in.)	Cumulative Yield Efficiency (2011-2016) (lbs. / sq. in. TCSA)
Guardian	0.0	91.9	192.5	396.4	149.1	4.7	0.1	28.0	14.2
Mirobac	0.0	91.0	191.0	300.7	95.3	4.6	2.6	27.5	11.0
Viking	25.0	91.8	191.7	367.5	132.6	4.6	0.0	26.0	14.3
Lovell	0.0	92.0	191.5	419.7	163.2	4.9	0.0	25.4	16.7
KV010-127	0.0	91.6	192.5	363.7	141.7	4.7	0.0	24.2	15.1
Krymsk 86	0.0	91.5	191.4	308.4	100.7	4.5	0.0	24.1	12.9
Atlas	0.0	91.5	189.1	434.2	167.4	5.0	0.0	23.9	18.2
Bright's Hybrid	50.0	89.5	188.3	268.3	85.7	4.2	0.0	23.0	11.4
KV010-123	12.5	91.7	190.9	398.1	156.5	4.7	0.1	22.8	17.4
HBOK 32	12.5	91.4	191.0	328.9	148.2	4.6	0.0	20.3	16.4
HBOK 10	0.0	91.5	191.9	319.9	126.3	4.6	0.0	19.7	16.5
Controller 5	0.0	90.9	189.9	263.6	66.7	4.3	0.0	15.5	17.1
P. americana	25.0	91.0	190.0	192.2	64.4	4.2	7.3	13.4	13.7
Krymsk 1	75.0	87.0	190.5	110.7	26.3	3.8	0.5	9.5	11.4
Mean	14.3	91.3	191.0	335.4	122.8	4.6	0.7	22.5	15.1
LSD (5%)[2]	28.3	1.2	2.1	72.7	40.9	0.5	2.5	4.2	2.9

[1] Arranged in descending order of trunk cross-sectional area (TCSA) for each rootstock.
[2] Least significant difference (LSD) at the 5% probability level. Differences between two numbers within a column that are less than the LSD value are not significantly different.

One tree on B.71-7-22 was lost to fire blight. At the November 2015 Annual NC-140 meeting, researchers agreed to discontinue the evaluation of B.70-20-20 as it has proven to produce trees too large for high density plantings. Consequently, this rootstock has been removed from this trial.

Mortality, cumulative yield from 2012 through 2016, yield per tree for 2016, average weight per fruit, TCSA, and cumulative yield efficiency varied significantly among the 31 rootstocks (Table 4). M.9 Pajam2 had the highest tree mortality (56%), but this was not significantly different from M.26 EMLA, M.9 NAKBT337, CG.2034, Supp. 3, B.71-7-22, or B.64-194.

PiAu.9-90 rootstocks produced the largest trees but they were not significantly larger than trees on B.70-6-8 or B.7-3-150. Similarly, B.71-7-22 produced the smallest trees, but they were not significantly smaller than trees on B.9, B.7-20-21, CG.2034, CG.4003, or G.41N. Yield in 2016 was greatest for CG.4004. This is the same result observed 2015 (4). CG.4004 trees have produced the most fruit in this trial (total of all harvests from 2012 through 2016), but not significantly more so than for trees on CG.5222, G.202N, CG.4814, G.41N, G.935N, G.202TC, M.9 Pajam2, B.7-3-150, G.11, CG.5087, M.26 EMLA, or PiAu.51-11. Fruit size (as measured by average fruit weight) ranged from 6.4 ounces for G.41TC down to 3.8 ounces for B.9. Root sucker number ranged from over 15 suckers for PiAu.9-90 to none for M.26EMLA. G.41N had the highest cumulative yield efficiency, but it was not significantly different from B.9, CG.4003, CG.2034, or CG.4004.

The three Malling rootstocks in this trial are typically considered to be industry standards throughout many apple producing regions, but have had survival rates of 50% or less due to their susceptibility to fire blight. Further, a number of other rootstocks in this trial are proving to be too vigorous for the tall spindle system, and some not vigorous enough. To date, any recommendations based on this data with regards to apple rootstock choices would at best be tentative.

NC-140 rootstock trials are typically carried out over ten growing seasons. There are two more growing seasons left for the 2009 peach rootstock trial, and three more for the 2010 apple rootstock trial. Consequently, results in this report must be considered as preliminary until final results are made available at the completion of each trial.

Table 4. 2016 results for the 2010 NC-140 apple rootstock trial, Princeton, KY.

Rootstock[1]	Initial Number of Trees	Tree Mortality (% lost)	Cum. Yield (2012-2016) (lbs./tree)	2016 Yield (lbs./tree)	Fruit Weight (oz./fruit)	Number of Root Suckers per Tree	TCSA (sq.in.)	Cum. Yield Efficiency (2012-2016) (lbs./sq. in TCSA)
PiAu 9-90	4	0	104.9	77.7	6.1	15.3	18.6	5.6
B.7-3-150	12	0	135.7	81.2	6.0	1.4	15.4	9.1
B.70-6-8	11	0	121.0	72.4	5.9	0.3	14.9	8.1
PiAu 51-11	11	9	122.1	85.1	6.0	2.1	14.2	8.6
B.64-194	7	29	109.8	80.7	6.1	2.2	13.5	8.1
B.67-5-32	12	0	116.6	77.0	5.8	1.8	12.0	9.7
M.26 EMLA	11	55	124.3	71.5	6.2	0.0	11.8	10.5
G.202 N	8	0	161.5	106.3	5.6	6.8	10.8	15.0
CG.5222	8	0	169.4	89.8	5.4	5.8	9.6	17.7
G.935 TC	4	0	112.0	70.8	6.0	8.8	9.3	12.0
CG.3001	3	0	105.6	61.2	5.9	1.3	9.1	11.6
G.935 N	10	10	145.6	83.6	6.0	5.0	8.8	16.5
CG.4814	4	0	158.2	101.6	5.1	7.8	8.6	18.4
M.9 Pajam2	9	56	141.2	87.8	5.3	9.5	8.6	16.5
CG.4004	4	0	187.2	109.8	6.1	6.5	7.8	23.9
G.11	8	13	134.4	81.8	5.5	0.1	7.5	17.8
G.202 TC	12	0	143.4	94.6	5.2	10.4	7.2	20.0
M.9 NAKBT337	12	50	114.4	67.1	5.1	4.2	7.2	16.0
CG.5087	2	0	132.7	68.9	5.7	2.0	6.9	19.1
Supp.3	5	40	96.8	54.1	5.3	1.0	6.9	14.1
CG.4214	4	0	121.0	86.0	5.5	2.5	6.7	18.2
CG.4013	2	0	96.6	58.5	6.1	9.0	6.6	14.6
G.41 TC	1	0	86.7	33.9	6.4	1.0	6.6	13.2
B.10	12	8	117.7	69.7	5.7	0.1	6.4	18.3
G.41 N	3	0	150.7	103.0	5.2	0.7	4.6	32.8
CG.4003	7	0	112.2	61.8	4.5	0.7	4.5	25.0
CG.2034	2	50	88.0	46.9	4.8	3.0	3.6	24.4
B.7-20-21	12	0	20.9	11.2	4.9	0.3	2.4	8.8
B.9	12	8	61.6	33.7	3.8	2.4	2.3	26.8
B.71-7-22	10	30	33.2	19.8	5.0	1.3	1.6	21.4
Means	NA	11.9	117.5	71.6	5.5	3.8	8.8	16.1
LSD (5%)[2]	NA	38.7	65.3	51.7	1.0	7.2	4.1	9.9

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

2 Least significant difference (LSD) at the 5% probability level. Differences between two numbers within a column that are less than the LSD value are not significantly different.

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Evaluation of Strawberry Varieties as Matted Rows

John Strang, Chris Smigell, and John Snyder, Horticulture

Strawberries continue to be popular with Kentucky consumers and most growers find that high quality strawberries are readily marketable. Based on the 2012 Census of Agriculture there are about 200 acres of strawberries grown in Kentucky, roughly 80 percent via the matted row cultural system and about 15 percent using the plasticulture system. This study evaluated newer strawberry varieties produced in the matted row system at the University of Kentucky Horticultural Research Farm in Lexington. This report combines the results for the 2015 and 2016 cropping seasons.

Materials and Methods

Sixteen dormant, bare-rooted strawberry varieties were planted on 24 April, 2014. Allstar, Chandler, Earliglow, and Jewel were included as standards. Each plot was a 10 ft long single row and consisted of six plants set 2 feet apart in the row with 4 feet between rows. Plots were replicated four times in a randomized block design.

Insect, disease and weed control were conducted in accordance with the Midwest Fruit Pest Management Guide (ID-232). No fungicides were applied in 2014, while Captan was applied four times during bloom in 2015 and twice during bloom in addition to two Pristine sprays in 2016. Brigade insecticide was applied on 20 May 2015 for spittlebug control, while no insecticides were used in 2016.

Chateau pre-emergence herbicide was applied over the top of the dormant plants following transplanting, in mid-march in 2015 and in early March 2016. Select Max was applied on 9 July and 10 August 2014 for post-emergence grass control. Weeds were hand-pulled on several occasions and spot sprays of glyphosate were used several times for Canada thistle, bindweed and Johnsongrass. A Sinbar application was made with a shielded sprayer to row middles following renovation in 2015. Devrinol was applied in early September 2014 and late August in 2015.

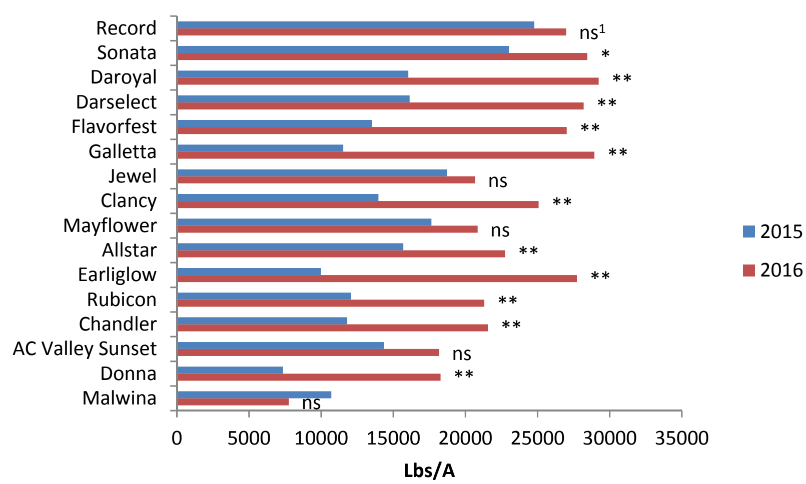
Rows were narrowed to a width of 14 inches on 25 October 2014 and 15 October 2015 because runner plants were crossing the row middles into adjoining plots. The field was mulched with Miscanthus straw on 11 December, 2014 and with wheat straw on 3 December, 2015.

Fifty-seven pounds of N per acre as ammonium nitrate and 104 lb of K as 0-0-60 per acre were tilled into the soil prior to planting. Beginning on 11 July 2014 5.2 lb of N as calcium nitrate was applied weekly for a total of 31 lb of N per acre. In 2015 50 lb per acre of $CaNO_3$ fertilizer at renovation. The plot was drip-irrigated as needed.

The 2014 season was relatively cool with slightly more rainfall than normal, while the 2015 and 2016 seasons were extremely rainy and cool. Ten-foot sections in each plot were harvested in the spring of 2015 and 2016. Yield, fruit size, flavor and appearance data were collected.

Data are shown for the 2015 and 2016 harvest seasons. Twenty berries were weighed at each harvest to determine average berry weights. Berry flavor, firmness and appearance were assessed twice for each variety in each replication during the harvest periods.

Figure 1. Variety yield per acre for the 2015 and 2016 seasons ranked based on the average yield for the two seasons, Lexington, KY



[1] Significant difference in yield between 2015 and 2016 (*, $P = 0.05$; **, $P = 0.01$) or not different between years (ns).

Results and Discussion

Both 2015 and 2016 were rainy seasons and yields and berry size were generally good, as a yield of 10,000 lb per acre is considered very good in matted row production. However, berry flavor was reduced in both seasons due to the wet weather. A frost on 24 April 2015 substantially reduced flower numbers, particularly on early-maturing varieties. There was a light frost on 3 April, 2016 but this caused very little flower loss.

Figure 1 shows yields for the 2015 and 2016 seasons ranked by average yields. Yields were significantly greater in 2016 than in 2015 for all but the later-maturing varieties Malwina, AC Valley Sunset, Jewel, Mayflower, and Record. This is attributed to greater fruit frost losses in 2015 on earlier blooming and maturing varieties, particularly Earliglow, Galletta, Daroyal, Flavorfest, and Donna.

Record and Sonata had the highest average yields, with 25,879 and 25,734 pounds per acre respectively over the two harvest seasons, and in both seasons they had significantly higher yields than all other varieties in the trial (Table 1). Record had one of the largest fruit sizes, but scored very low in flavor and had soft fruit. AC Valley Sunset, Clancy and Flavorfest also had very large fruit.

Galletta, Flavorfest, AC Valley Sunset, Daroyal, Sonata, Allstar, and Chandler were rated to have the more attractive fruit, while Clancy, Allstar, Malwina, Flavorfest and Chandler tended to have firmer fruit.

Earliglow, one of the trial standards, had the highest flavor rating. AC Valley Sunset, Flavorfest, Darselect, Rubicon, and Sonata also rated high for flavor. Earliglow, Galletta, and Daroyal were the earliest varieties to be harvested, while Malwina was by far the latest, beginning production as the other later varieties had just about finished producing.

Sonata, Darselect, and Flavorfest has some of the best yields, fruit attractiveness and fruit flavor ratings, although Sonata and Darselect had somewhat softer fruit. Galletta was notable in that it was one of the earlier-maturing varieties with a high yield, firm berries and had the highest fruit attractiveness rating, however it had a somewhat lower flavor rating. AC Valley Sunset did not have particularly high yields, but was the best late-season variety with respect to berry size, attractiveness and flavor.

The continuous wet weather promoted leaf disease development. The percentage of leaves showing any disease lesions in 2015 was high for all varieties (Table 2). Flavorfest, Allstar, Sonata, Daroyal, and Earliglow were the varieties with the fewest leaves showing any disease symptoms – in this case lesions. Varieties having a high percentage of leaves with lesions also tended to have a higher number of lesions counted per leaf. The number of lesions per leaf also tended to be similar to the percentage of leaf area affected by the lesions. Thus, each lesion tended to cover about one percent of total leaf area. Nearly all varieties had a statistically similar percentage of leaf area affected by the lesions. Leaf disease was not evaluated in 2016.

The incidence of leaf spot caused by the fungus *Mycosphaerella fragariae* was low, ranging from 1-5%, except for Malwina (Table 3). Phomopsis leaf spot was the primary disease ob-

Table 1. Two-year averages for yield, fruit characteristics, and 2016 harvest mid-point

Variety	Yield 2015-16 (lbs/A)[1]		Berry wt. (oz)[2] 2015	Berry wt. (oz)[2] 2016	Attractiveness 2015-16 (1-5)[4]	Firmness 2015-16 (1-5)[5]	Flavor 2015-16 (1-5)[6]	2016 Harvest midpoint (date)[7]
Record	25,880	a	0.65	0.61	3.9	2.4▲	3.4	10 Jun
Sonata	25,730	a	0.39	0.39	4.0	2.5▲	4.0	04 Jun
Daroyal	22,640	b	0.38	0.46	4.3	2.0	3.8▼	26 May
Darselect	22,160	bc	0.44	0.48	3.8▼	2.5▲	4.1	31 May
Flavorfest	20,270	bc	0.39	0.57▲[3]	4.4	3.3	4.2▼	30 May
Galletta	20,240	bcd	0.45	0.51	4.6	3.0▲	3.8	27 May
Jewel	19,700	b-e	0.40	0.48	3.9	3.0▲	3.4	02 Jun
Clancy	19,520	c-e	0.39	0.63▲	3.8	3.9	3.9▼	01 Jun
Mayflower	19,240	c-e	0.40	0.43	3.9▼	2.9▲	3.3	06 Jun
Allstar	19,220	c-e	0.37	0.43	4.0	3.7▲	3.9▼	01 Jun
Earliglow	18,850	de	0.22	0.35▲	3.9	2.8▲	4.5	26 May
Rubicon	16,690	e	0.37	0.39	3.9	2.3▲	4.1▼	29 May
Chandler	16,680	e	0.33	0.38	4.0	3.3▲	3.6	28 May
AC Valley Sunset	16,270	e	0.52	0.75▲	4.1▼	2.8▲	4.3	05 Jun
Donna	12,810	f	0.33	0.46▲	3.9▼	2.4▲	3.7	25 May
Malwina	9,220	g	0.49	0.38	3.5	3.4▲	3.9	17 Jun

1 Means followed by the same letter are not significantly different (Duncan Multiple Range Test (LSD P≤0.05).
2 Average weight of 20 berries measured at each harvest.
3 Averages followed by ▲ or ▼ were significantly higher or lower, respectively in 2016 than in 2015.
4 Attractiveness: 1 = poor; 5 = excellent.
5 Firmness: 1 = soft; 5 = very firm.
6 Flavor based on two evaluations: 1 = poor; 5 = excellent.
7 Date on which half of all berries were harvested, based on total yield weight.

Table 2. Disease lesion incidence and severity based on ten-leaf samples, 2015

Variety	Percent leaves out of 10 showing lesions[1]	Lesions per leaf[3] (No.)	SSe Area affected by lesions[4] (%)
Flavorfest	38 a[2]	4 f	3 b
Allstar	38 a	5 ef	6 b
Sonata	38 a	3 f	9 ab
Daroyal	43 ab	4 f	3 b
Earliglow	48 ab	6 cdef	8 ab
Chandler	53 abc	4 ef	3 b
Record	60 abcd	6 cdef	9 ab
Rubicon	65 abcd	6 def	8 ab
Galletta	68 abcd	8 cde	4 b
Donna	68 abcd	4 f	12 ab
Mayflower	73 bcd	7 cdef	7 b
AC Valley Sunset	73 bcd	9 cd	9 ab
Clancy	83 cd	10 bc	18 a
Malwina	85 d	13 b	11 ab
Darselect	90 d	20 a	10 ab

1 Ten leaves were randomly picked from the canopy top and inside of each replicate.
2 Means within same column followed by the same letter are not significantly different (Duncan's Multiple Range Test *P*≤0.05).
3 Sum of all lesions on the ten leaves that appeared to be caused by disease, divided by ten. If the ten leaves had small numbers of lesions (< 50), they were individually counted; where lesion numbers were very high, numbers were estimated.
4 Percent area of the ten leaves aggregated.

served and the captan fungicide that was applied during bloom does not control this disease. Flavorfest, Darselect, Rubicon Allstar, Daroyal, Chandler, Earliglow and Galletta showed the lowest incidence of phomopsis, while Clancy, Mayflower, Record, and Donna had the highest levels. Incidence of leaf scorch, caused by the fungus *Diplocarpon earliana*, also tended to be relatively low. Chandler, Flavorfest, Donna, Sonata, and Clancy had 2% or less incidence of leaf scorch, although most varieties had statistically similar levels.

In 2016 berries were rated for anthracnose disease incidence. Malwina was the only variety in which no sampled fruit showed the sunken rot lesions consistent with anthracnose, caused by *Colletotrichum acutatum*. Earliglow, Flavorfest, Allstar, Galletta, and Darselect had less than ten percent incidence, but most varieties had statistically similar anthracnose incidence ratings.

Overall, Flavorfest, Allstar and Earliglow tended to have the best fruit and leaf disease resistance of the varieties tested over the two years of this trial.

Table 3. Estimated incidence of three common strawberry leaf diseases, 2015

Variety	Leaf spot incidence[1,2]	Phomopsis incidence[4]	Leaf scorch incidence[5]
Flavorfest	3 b[3]	8 f	0 c
Allstar	1 b	11 f	5 bc
Sonata	1 b	25 de	2 c
Daroyal	1 b	13 ef	6 bc
Earliglow	1 b	15 def	14 b
Chandler	2 b	19 def	0 c
Record	3 b	45 b	5 bc
Rubicon	2 b	8 f	3 c
Galletta	5 b	18 def	4 bc
Donna	1 b	39 bc	1 c
Mayflower	1 b	50 b	3 c
AC Valley Sunset	1 b	28 cd	3 c
Clancy	1 b	69 a	2 c
Malwina	13 a	21 def	38 a
Darselect	3 b	8 f	31 a

1 Visual estimate of percent of entire canopy showing lesions.
2 Leaf spot caused by *Mycosphaerella fragariae*.
3 Means within same column followed by the same letter are not significantly different (Duncan's Multiple Range Test $P \leq 0.05$).
4 Leaf spot caused by *Phomopsis obscurans*.
5 Leaf scorch caused by *Diplocarpon earliana*.

Table 4. Percent of fruit with anthracnose disease, 2016

Variety	Anthracnose percent incidence[1,2]
Malwina	0 d
Earliglow	3 d
Flavorfest	3 d
Allstar	5 d
Galletta	5 d
Darselect	8 cd
Record	15 cd
Rubicon	15 cd
Daroyal	18 cd
Chandler	23 cd
Mayflower	23 cd
AC Valley Sunset	28 bcd
Jewel	30 bcd
Sonata	38 bc
Clancy	55 ab
Donna	70 a

1 Ten fruit were randomly chosen from each replicate of each variety and observed for anthracnose fruit rot symptom.
2 Means within same column followed by the same letter are not significantly different (Duncan's Multiple Range Test $P \leq 0.05$).

Acknowledgments

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Evaluation of Bt Sweet Corn Lines for Management of Corn Earworm, 2016

Ric Bessin and Nathan Mercer, Entomology

Introduction

Sweet corn remains the most widely grown vegetable crop in Kentucky with close to 2000 acres planted each year (USDA, 2013). Corn earworm, *Heliocoverpa zea* (Boddie), is the key pest in Kentucky attacking the kernels on the tip of the ear (Bessin 2006). Even low levels of infestation can be problematic as damage is concealed until the husk leaves are removed by the consumer. Because corn earworm populations increase as the summer progress, early-planted sweet corn is at much lower risk of attack than are mid-season plantings. For this reason, corn earworm is aggressively controlled in the late season with insecticides used every 3 to 5 days during the silking period.

Similar to Bt field corn, Bt sweet corn has been genetically engineered with a proteins that kill certain caterpillars. It is very selective, generally safe to beneficial insects, and has been approved for commercial production since 1998. However, there are three types of Bt sweet corn technologies that have been bred into different varieties; Attribute I (Cry1Ab gene), Performance Series (Cry1A.105 and Cry2AB genes), and Attribute II (Cry1Ab and Vip3A genes). Each of these displays different levels of corn earworm protection. They are not considered "bullet proof" when planted late as considerable earworm damage to Bt sweet corn may occur and supplemental insecticide sprays are recommended with high corn earworm populations (Shelton 2012). In this study we examined two Attribute I and one Attribute II sugar enhanced varieties in a late-planting situation without the use of supplemental insecticide applications.

Materials and Methods

The study was established on 20 June on the University of Kentucky Spindletop Farm in Fayette County using a four-row John Deere Conservation tillage planter on conventionally tilled Maury silt loam. The experimental design was a randomized complete block with four replications. Treatments included three Bt sweet corn varieties, and the non-Bt variety Providence with was grown without insecticide treatment or was treated with Coragen or Warrior II insectide. Individual plots were 33 feet in length, 4 rows wide with 2.5 feet between rows. Sweet corn was direct seeded at rate of 29,600 kernels per acre. At-planting, 300 pounds of urea was applied (46-0-0) per acre. Coragen and Warrior II were applied to the center two rows of the insecticide control treatments on 5, 8, 11, 14 and 18 August during the silking period using a CO_2 backpack sprayer with a TX-12 hollow cone nozzle delivering 36 gallons of spray per application per acre. Spray water pH measured on 5 August was 7.17. On 24 August, 50 ears were removed from the central 2 rows of each plot and the number of insect damaged kernels per ear and number of live corn earworm larvae present recorded. An ear acceptable for local sales was defined in this study as an ear with 6 or fewer damaged kernels. Sweet corn for wholesale production should have less than 1% defective ears. Data were analyzed by Analysis of Variance and means were separated by Fisher's least significant difference test using SAS statistical programs (SAS Institute, Cary, NC). The percentage of damaged and marketable ear data was transformed using arcsine of the square root prior to analysis to correct for unequal variance, values in the table are the raw data means.

Results and Discussion

The late planting resulted in very high levels of insect pressure in this study with the non-Bt untreated control sustaining 97.5 % damaged ears. While a three-day interval between insecticide applications was intended, constant rain on 17 August prevented application until the next day. The top treatment in the study was Aspire, an Attribute II Bt, which had the fewest damaged kernels (0.1 per ear), no live larvae in the ear, and smallest percentage of damaged ears (1.0%). While the number of damaged kernels with the Attribute I Bt lines, WH0809 and BC0805, were significantly less than the non-Bt untreated control, the percentage of damaged ears was not significantly different than the control. When using a more tolerant level of 6 or fewer damaged kernels per ear, that might be acceptable for local sales, the two Attribute I varieties had more marketable ears than the control. The Coragen and Warrior treatments had significantly more damage than Aspire (Attribute II) but less than the Attribute I varieties or the untreated control. Each of the insecticides suppressed the number of live larvae in the ear equivalent to the Attribute II variety.

In summary, this study demonstrates the intensity of corn earworm risk with late plantings in Kentucky. Sweet corn planted in late April and early May grown with insecticides for corn earworm can sometimes escape damage. Bt corn should not be used as a stand-alone tactic to manage corn earworm

Table 1. Mean ear damage, number of corn earworms and percentage of damaged and marketable ears at harvest, 2016

Variety	Bt type or insecticide	Rate	Damaged kernels per ear*	Live corn earworm larvae per ear	Percentage of damaged ears	Percentage of 'Local sales' marketable ears**
WH0809	Bt Attribute I	-	12.4 b	0.85 a	92.0 a	27.5 c
BC0805	Bt Attribute I	-	9.9 c	0.63 b	92.0 a	33.0 c
Aspire	Bt Attribute II	-	0.1 d	0.00 c	1.0 c	100.0 a
Providence	Warrior II	1.5 fl oz	1.2 d	0.04 c	18.0 b	93.5 a
Providence	Coragen	4.25 fl oz	1.5 d	0.03 c	24.5 b	92.0 b
Providence	Untreated	-	15.1 a	b	a	d

* Means in the same column followed by the same letter are not significantly different (LSD; *P*>0.05).
** 'Local sales' marketable ears are defined as having 6 or fewer damaged kernels.

nor are they marketed that way by seed companies. Syngenta notes that growers can decrease insecticide use by 50% with the Attribute I technology (Syngenta 2013) or up to 85% with the Performance Series (Monsanto 2016). Corn earworm has also demonstrated reduced sensitivity to pyrethroid insecticides in the southern US and Midwest resulting in reduced control in small plot studies (Fleischer 2016). Corn earworm remains a difficult to manage insect pest on late-planted sweet corn.

Acknowledgments

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Supersweet Corn Evaluations in Central Kentucky

Chris Smigell, John Strang, and John Snyder, Horticulture

Introduction

Locally produced sweet corn is a high-demand item at Kentucky retail markets. This trial was designed to evaluate some of the newest supersweet corn varieties.

Materials and Methods

Twenty-two supersweet corn varieties were planted by hand on 25 May. Plots consisted of 20 ft long rows of each cultivar and were replicated four times. Rows were spaced 33 inches apart. Roughly 200 seeds were hand-planted in each 20 ft row to assure a good stand. Seedlings were thinned to a nine-inch spacing.

Prior to planting, 80 lb of actual N, P and K per acre as 19-19-19 were applied to the soil and tilled in. Plants were fertigated with 36 lb of actual N per acre as calcium nitrate on 11 July.

Weeds were cultivated after planting, followed by application of Dual II Magnum herbicide on 14 June. Mustang Max and Baythroid were used for insect control. A low, three wire electric fence was set up around the plot at the beginning of harvest to exclude raccoons and coyotes.

Table 1. Plant characteristics and yields of sweet corn varieties, Lexington, KY, 2016

Variety[1]	Seed source[2]	Kernel Color[3]	Days to maturity[4]	Yield (dozen ears per acre)[5]	Seedling vigor[5] (1-5)	Ease of ear harvest[7] (1-5)	Height to first harvested ear (in.)
Munition (standard)	SY	w	78	3220 a	4.5	3	31.5
Cabo	SY	bc	78	2110 b	3.3	3.4	26.1
Battalion	SY	bc	77	2010 bc	3	3	24.3
GSS 1170	SY	y	78	2010 bc	3.6	3	26.5
AP 426	RU	bc	58	1980 bc	3.4	3.3	22.8
Cumberland	ST	bc	77	1900 bcd	4.3	3.1	20
Anthem XR	SW	bc	72	1850 bcde	4.9	3.5	21
Obsession (standard)	RU	bc	79	1830 bcde	3.9	3.5	23
Enchanted	RU	bc	78	1820 bcde	3.5	3.1	24
Super Surprise	RU	bc	74	1820 bcde	4.6	2.3	18.8
Prestige XR	SW	bc	77	1780 bcde	4.5	3.5	20
XtraTender 2171	JS	bc	71	1770 bcde	3.8	3.5	21.3
Nirvana	SW	bc	75	1700 bcde	3.4	4.4	18
Superb MXR	ST	bc	74	1680 bcde	5	3	18.3
Vision MXR	JS	y	75	1630 bcde	4.1	3.4	17.3
SS 3778	JS	y	76	1630 bcde	2.9	3.5	22.3
Honor XR	ST	bc	79	1620 bcde	4.3	3.4	24.8
SS 2742	JS	bc	75	1600 bcde	3.3	3.3	20.8
Eden	ST	w	76	1600 bcde	3.4	3.5	19
XTH 11274	ST	y	72	1490 cde	4.1	3.7	19.8
XtraTender 20173	JS	bc	73	1450 de	2.9	3.1	24.3
Gourmet Sweet 2171	ST	bc	72	1370 e	3.9	3.9	22.3

[1] All but Battalion, Obsession, Prestige, SS 3778 and Honor XR are augmented supersweet varieties.
[2] See appendix for seed company addresses.
[3] Kernel color: y = yellow; w = white; bc = bicolor.
[4] Days to harvest noted in seed catalogues.
[5] Numbers followed by the same letter are not significantly different (Duncan Multiple Range Test $P \leq 0.05$).
[6] Seedling vigor: 1 = poor growth, 5 = excellent growth.
[7] Harvest ease: 1 = difficult to remove ear from stalk; 5 = easy to remove.

Results and Discussion

Variety evaluation data can be found in Tables 1 through 3. The growing season was very rainy. There were 22 days having at least a tenth of an inch of rain from the planting date until first harvest. Browning/rotting on ear shanks showed up to a varying degree in most cultivars in the trial. This was diagnosed as a rot phase of Stewart's Wilt, a bacterial disease promoted by prolonged, wet conditions. Most of this was easily removed by taking off a little of the outer shuck covering. Yields for 18 of the 22 varieties were not significantly different from each other.

Munition was the best white variety and yielded significantly more ears than any other variety, Table 1. It also had good seedling vigor, tended to have some of the shorter ears, and had the highest height to the first harvestable ear. It was one of the standards for comparison in the trial.

Cabo, Battalion, AP 426, Anthem XR, and Obsession were the best bicolor varieties. AP 426 was notable in that it has a short 58-day maturity period, had one of the highest husk coverage ratings in the trial and produced an eight- inch-long ear. Husk coverage is important to reduce worm, sap beetle, and bird damage. Husk coverage was particularly poor this season in comparison to previous seasons. Tip fill was particularly good for all but two varieties. Battalion was one of the few with little to no shank decay. Obsession was a recommended variety used as a standard in the trial.

GSS 1170 was the highest yielding yellow variety, and also one with little to no shank decay, but also had the shortest ears.

Eating quality for all of the varieties evaluated was excellent (Table 3). Battalion, GSS 1170, AP 426, Anthem XR, and the standard Obsession all had high sweetness ratings.

Table 2. Ear characteristics of sweet corn varieties, Lexington, KY, 2016

Cultivar	Husk coverage[1] (1-10)	Ear length (in)	Ear width (in)	Tip fill[2] (1-10)	Row straightness[3] (1-10)
Munition	6.5	7.5	1.8	9.8	5.3
Cabo	6.5	8.1	1.9	9.8	6.5
Battalion	5	7.7	1.9	10	4.8
GSS 1170	6	7.5	1.8	9.5	4.5
AP 426	8.3	8	1.9	9.5	5.3
Cumberland	1.3	8.5	1.9	10	5
Anthem XR	7.3	7.9	2	9.8	4.8
Obsession	7	8	2	9.8	5.8
Enchanted	5.8	8.2	1.9	10	4.8
Super Surprise	4	8.2	2	9.8	5
Prestige XR	5.5	8.1	1.8	10	4.8
XtraTender 2171	4.3	7.8	1.9	10	5.8
Nirvana	1.8	8.2	1.9	9.8	5
Superb MXR	7.5	7.7	2	9.5	4.3
Vision MXR	1.5	7.6	1.9	4.3	4
SS 3778	5.3	8.3	1.8	10	6.8
Honor XR	4.5	8	1.8	10	5.3
SS 2742	5.5	8.2	1.7	9.3	8
Eden	4.5	8.2	2	9.8	3.8
XTH 11274	3.5	8.2	1.9	6.8	3.8
XtraTender 20173	3.5	7.7	1.9	9.3	4.5
Gourmet Sweet 2171	2.3	7.9	1.9	10	6.5

1 Husk coverage: 1 = corn ear protrudes from all husks, 10 = husks completely covered all ten ears.
2 Tip fill: 1 = kernels not filling out ear tips, 10 = all ears filled to the tip with plump kernels.
3 Row straightness along length of ears: 1 = poor, 10 = very straight.

Table 3. Eating quality characteristics of sweet corn, Lexington, KY, 2016

Cultivar	Pericarp tenderness[1] (1-4)	Kernel tenderness[2] (1-4)	Sweetness[3] (1-4)	Comments
Munition	3.4	2.7	3.2	Attractive husk/ear; a few tassels on ears
Cabo	3.5	2.5	3.2	Attractive husk/ear; short flags; little stalk rot
Battalion	3.5	3	3.8	Attractive husk/ear; no stalk rot; short ears
GSS 1170	2.9	2.7	3.5	Husk not attractive; short ears; some tassels on ears; short flags
AP 426	3.4	2.9	3.6	Glossy ear; a few with butt-end blanking on ear; good corn taste
Cumberland	3.5	2.5	3.2	
Anthem XR	3.5	3.1	3.7	Attractive husk; some ears with split kernels and tassels
Obsession	3.5	3	3.8	Attractive husk/ear; short flags
Enchanted	3.5	2.5	3.2	Glossy ears; some with butt-end blanking and tassels
Super Surprise	3.3	2.9	3.6	Attractive husk/ear; long flags
Prestige XR	3.5	3	3.8	Attractive ear and dark green husk; several ears with tassels; little stalk rot
XtraTender 2171	3.5	2.5	3.2	Some ears with tassels
Nirvana	3.5	3	3.8	Some with split kernels; tender kernels
Superb MXR	3.5	3	3.8	Attractive ear, some ears with tassels; long flags
Vision MXR	3.6	3.2	3.7	Some kernel splitting; sap beetle damage; some ears with tassels; raccoon damage
SS 3778	3	3.1	3.5	Attractive husk/ear; long flags; a few slightly orange kernels; some tassels; good corn flavor
Honor XR	3.5	3	3.8	Attractive husk/ear; short-med. flags; pale husk not attractive; some ear tassels
SS 2742	3.5	2.5	3.2	Attractive ear; some ears with tassels; raccoon damage
Eden	3.5	2.5	3.2	Very tender kernels; raccoon damage
XTH 11274	3.4	3.2	3.6	Attractive ear; a few with butt-end blanking; raccoon damage
XtraTender 20173	3.5	2.5	3.2	Stalk rot problems
Gourmet Sweet 2171	3.5	2.5	3.2	Some ears with tassels and butt- end blanking

1 Pericarp Tenderness: 1= tough; 4 = tender. Taste evaluations were performed by two evaluators on one ear from each replication; ear was microwaved on high setting for 2 minutes.
2 Kernel tenderness: 1 = crisp; 4 = creamy and tender.
3 Sweetness: 1 = starchy; 4 = very sweet.

Acknowledgments

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Increasing Glucosinolates in Arugula and Mustard Greens

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Introduction

Glucosinolates (GSLs) are natural products in members of the Brassicaceae family that have the potential for use as soil-incorporated biofumigants for pest and disease control. Incorporation of *Brassica* tissues into soil suppresses soil-borne pests due to the biofumigant properties of the highly toxic isothiocyanates (ITCs) liberated upon hydrolysis of GSLs. Attempts to increase the efficiency of plant extracts for use in soil biofumigation have focused on the selection of plants with greatest GSLs content. Upon hydrolysis of GSLs, myrosinase (an enzyme present in Brassica cells) break-down GSLs into oxazolidinethiones, nitriles, thiocyanates and various forms of volatile ITCs. These hydrolysis products, in particular the ITCs, are known to have broad biocidal activity including insecticidal, nematicidal, fungicidal, antibiotic and phytotoxic properties.

Investigators have been studying *Brassica* plants as natural fumigants (Brown and Morra 1997; Rosa et al. 1997). Intact GSLs by themselves are not biologically active, they must be enzymatically hydrolyzed by myrosinase to ITCs, which are effective in suppressing soil pathogens. Myrosinase is produced by plants, insects, and fungi, and is frequently found in soil (Gimsing et al. 2005). The main objective of this investigation was to assess the impact of soil amendments, sewage sludge (SS), chicken manure (CM), horse manure (HM), and no-mulch (NM) bare soil on concentration of GSLs of arugula and mustard plants grown under these soil management practices for potential use as organic biofumigants in the agricultural fields.

Materials and Methods

The experimental studies were established in mid-April 2015 at the University of Kentucky Horticulture Research Farm (Fayette County, KY). Arugula (*Eruca sativa*) and mustard (*Brassica juncea*) were grown in an area of 30 ×100 feet of freshly tilled soil at 18-inch row spacing in a randomized complete block design (RCBD) with four treatments of 750 feet each. These treatments were: 1) control (NM no-mulch untreated soil); 2) sewage sludge (SS); 3) horse manure (HM); and 4) chicken manure (CM). The entire study area contained 24 plots (2 crops × 3 replicates × 4 treatments). The soil in three plots was mixed with SS obtained from the Metropolitan Sewer District, Louisville, KY and applied at 15 t acre^{-1} on dry weight basis (Gent 2002). Three plots were mixed with CM obtained from the Department of Animal and Food Sciences, University of Kentucky, Lexington, Kentucky and applied at 15 t acre^{-1} on dry weight basis. The soil in three plots was mixed with HM obtained from the Kentucky horse park, Lexington, Kentucky, and applied at 15 t are^{-1}. The native soils in three plots was used as a no-mulch (NM) control treatment (roto-tilled bare soil) for comparison

Figure 1. Concentration of glucosinolates in crude extracts of arugula leaves of plants grown under four soil management practices. Values in the figure indicate means ± standard error. Statistical comparisons were carried out among soil treatments using SAS.

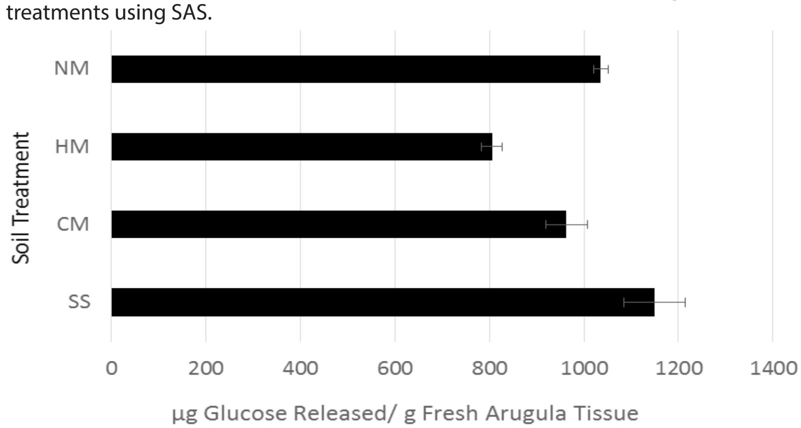
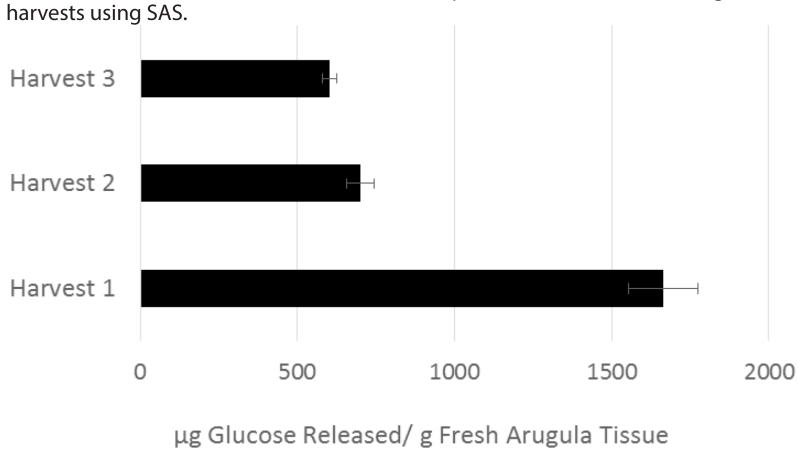


Figure 2. Concentration of glucosinolates in crude extracts of arugula leaves collected at three harvests on June 30, July 10, and July 20, 2015. Values in the figure indicate means ± standard error. Statistical comparisons were carried among three harvests using SAS.



purposes. Amendments were incorporated into the topsoil with a plowing depth of 15 cm. Plants were harvested before bolting (flowering) three times during the growing season on June 30, July 10, and July 20, 2015. At harvest, representative samples of 5 plants from each soil treatment were collected for extraction of GSLs. Shoots (stems and leaves) were cut into 1-3 cm and 100 g subsamples were dropped into boiling methanol (300 mL) for 15 min to inhibit endogenous myrosinase. Total GSLs were separated from the crude plant extracts by adsorption on DEAE-Sephadex A-25 (2-[diethylamino] ethyl ether) ion exchange resin. Concentration of GSLs in arugula and mustard shoots were determined as described by Antonious et al. (2009) and statistically analyzed using ANOVA. The means were then compared using Duncan's multiple range test (SAS Institute 2003).

Results and Discussion

The concentration of GSLs in arugula plants grown in SS amended soil was significantly greater compared to other treatments. This increase might be due to improved soil fertility, nutrient retention, soil porosity and water-holding capacity associated with SS, whereas GSLs in arugula plants grown in HM treatment were lower than NM (no-mulch) treatment (Fig. 1). Increased GSLs could be also attributed to increased soil organic matter, aggregate stability, soil moisture holding capacity and reduced soil bulk density and availability of nutrients in compost. Arugula and mustard plants were harvested three times during the growing season. Fig. 2 revealed that arugula plants collected in harvest 1 contained the greatest concentration of GSLs in their shoots compared to other two harvests. A similar trend was also observed in mustard. Mustard plants grown in soil amended with SS contained greater concentrations of GSLs in their shoots (Fig. 3) compared to other soil treatments and harvest 1 and 2 contained greater GSLs than harvest 3 (Fig. 4). Regardless of plant type, GSLs concentrations were significantly greater in plants grown in SS treatments compared to plants grown in CM, HM, and NM soil, respectively (Fig. 5). In addition, plants collected from harvest 1 contained the greatest concentrations of GSLs compared to other two harvests (Fig. 6). Results also revealed that mustard shoots contained greater concentrations of GSLs (974 μg g^{-1} fresh leaves) compared to arugula shoots (651 μg g^{-1} fresh leaves). These results indicated that soil mixed with SS increased GSLs content and their breakdown that resulted in the release of ITCs and the glucose degradation products due to the activation of myrosinase, the enzyme that hydrolyze GSLs. Investigators

Figure 3. Concentration of glucosinolates in crude extracts of mustard leaves of plants grown under four soil management practices. Values in the figure indicate means ± standard error. Statistical comparisons were carried out among soil treatments using SAS.

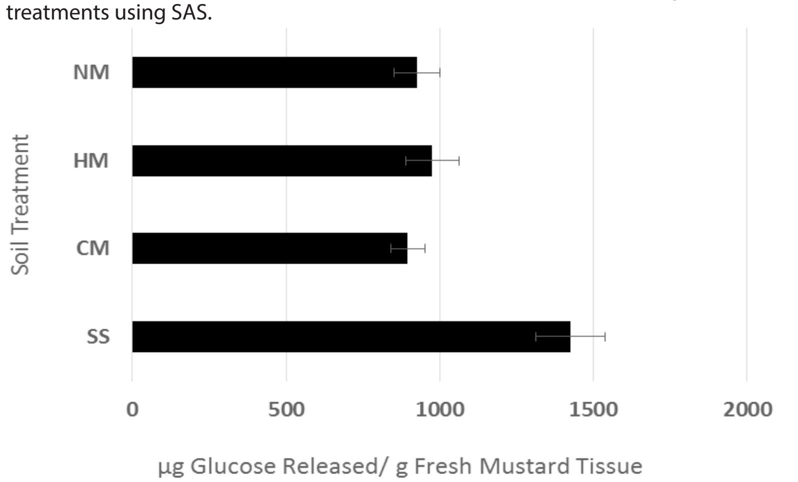


Figure 4. Concentration of glucosinolates in crude extracts of mustard leaves collected at three harvests on June 30, July 10, and July 20, 2015. Values in the figure indicate means ± standard error. Statistical comparisons were carried out among harvests using SAS.

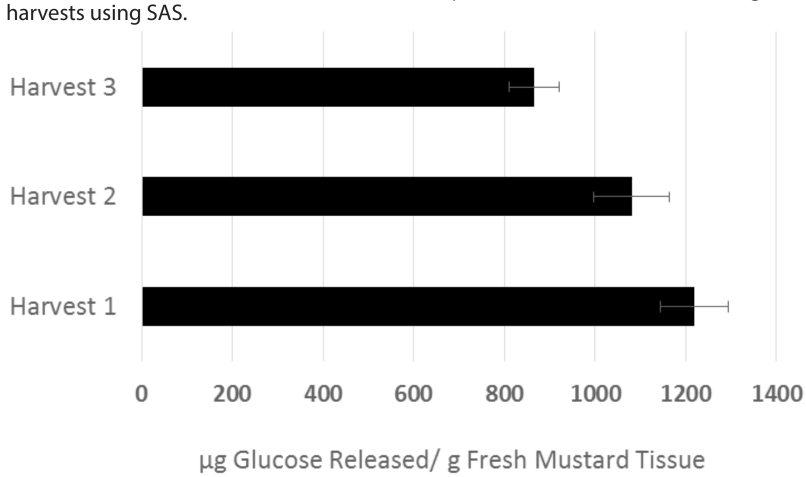
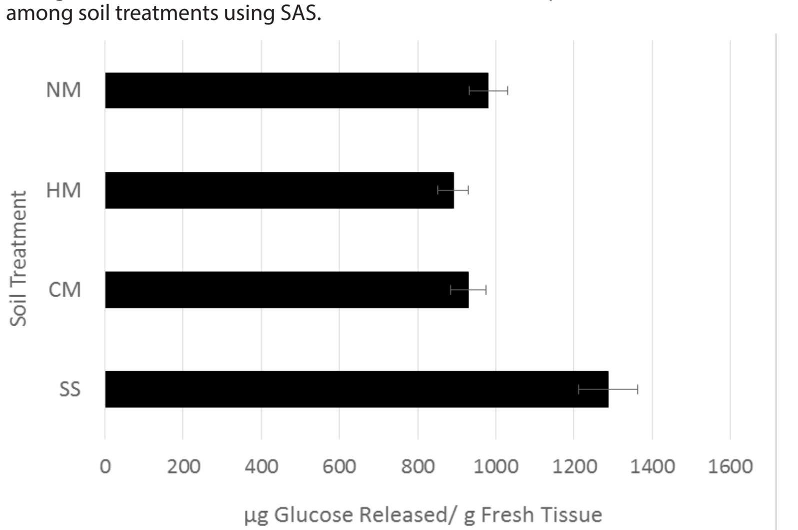
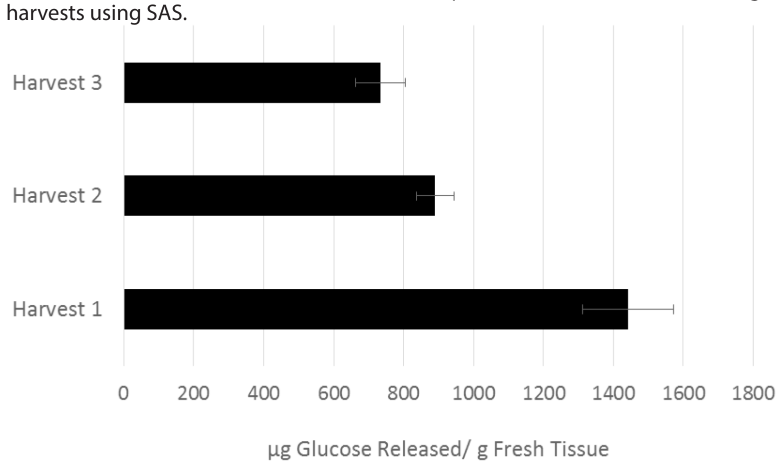


Figure 5. Overall concentration of glucosinolates in crude leaf extracts of plants grown under four soil management practices, regardless of plant type. Values in the figure indicate means ± standard error. Statistical comparisons were carried out among soil treatments using SAS.



have proposed the use of GSLs-containing plants as biofumigants to control soil-borne pathogens and to reduce the use of synthetic pesticides (Boydston and Hang 1995; Larkin and Griffin 2007). However, it is difficult to predict the fumigant potential of a particular *Brassica* plant on the basis of GSLs 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. Larkin and Griffin (2007) reported that soil-borne disease reductions were not always associated with higher GSLs-producing crops.

Figure 6. Overall concentration of glucosinolates in crude leaf extracts of plants collected at three harvests on June 30, July 10, and July 20, 2015. Values in the figure indicate means ± standard error. Statistical comparisons were carried out among harvests using SAS.



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Impact of Soil Amendments and Biochar on Yield of Tomato Grown Under Field Conditions

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Introduction

Due to the rapid growth in the poultry industry, chicken manure (CM) is accessible in increasing quantities. Studies have shown that foliar N concentrations of crops decreased when biochar was added to soil (Lehmann et al. 2003). Rondon et al. (2007) verified the potential of biochar applications for improving N input in agricultural systems, while indicating the needs for long-term field studies to better understand the effect of biochar on biological N_2 fixation. Biochar made from Brazilian pepperwood and peanut hull burned at 600^{O}C was used in column leaching experiments to assess its ability to hold nutrients. Results indicated that biochar effectively reduced the total amount of nitrate, ammonium, and phosphate in leachates by 34, 35, and 21%, respectively, relative to native soil alone (Yao et al. 2012). Biochar adsorption of ammonia decreases NH_3 and NO_3 losses during composting and after manure applications, and provides a mechanism for developing slow release fertilizers (Clough et al. 2013). However, more research on the effect and behavior of biochar in soil is needed (Renner (2007; Fraser 2010).

Biochar is the carbon-rich product obtained when biomass, such as wood, manure, or leaves, is heated in a closed container with little or no available air. In more technical terms, biochar is produced by so-called thermal decomposition of organic material under lim-

Table 1. Yield (lbs/ plant) collected from three harvests from plants grown under ten soil management practices. Statistical comparisons were carried out among soil treatments using SAS.

Treatment	Yield (lb/plant)	
CM	6.2	A
CM-Biochar	5.9	AB
HM	3.5	D
HM-Biochar	5.7	ABC
SS	5.6	ABC
SS-Biochar	5.1	ABCD
YWC	4.5	BCD
YWC-Biochar	5.4	ABC
NM	4.8	ABCD
NM-Biochar	4.0	CD

Each value in the table is an average of three replicates. Values accompanied by the letter(s) are not significantly different (*P*> 0.05).

ited supply of oxygen (O_2) and at relatively low temperature (<700°C) (Lehmann 2007; 2003). Research results indicated that the conversion of biomass into biochar can not only result in renewable energy (synthetic gas and bio oil), but also decrease the content of CO_2 in the atmosphere.

An increase of waste originating from different human productive activities is a continuous concern. Waste application to soil is proposed as a disposal solution. This practice is popular in the agricultural fields because of the value of this waste as organic fertilizer. Application of organic amendments to agricultural soils makes good use of natural resources and reduces the need of synthetic fertilizers.

Materials and Methods

The trial was established at the University of Kentucky Horticulture Resarch Farm. Tomato (*Solanum lycopersicum* var. Mountain Spring) seedlings of 52 days old were planted in raised, plastic-mulched, freshly tilled soil at eighteen inch in-row spacing on 3 June 2016. The entire study area contained 30 plots (3 replicates × 10 treatments). Each treatments was replicated three times in a randomized complete block design (RCBD) with the following treatments: 1) control (no-mulch untreated soil); 2) sewage sludge (SS); 3) horse manure (HM); 4) chicken manure (CM); and 5) yard waste compost (YWC). Each of the five treatments was also mixed with 1% (w/w) biochar obtained from Wakefield Agricultural Carbon (Columbia, MO) to make a total of 10 treatments. . Fruits were harvested three times during the growing season on August 3, August 19, and September 8, 2016. At each harvest, fruits were collected, weighed and counted. Data were statistically analyzed using ANOVA and the means were compared using Duncan's multiple range test (SAS Institute 2003).

The sewage sludge was obtained from the Metropolitan Sewer District, Louisville, KY and was 5% N on dry weight basis (Gent 2002). The chicken manure was obtained from the Department of Animal and Food Sciences, University of Kentucky, Lexington, Kentucky and the horse manure was obtained from the Kentucky Horse Park, Lexington, Kentucky. The YWC was obtained from Kentucky State University. Each amendment was applied at 5% N on dry weight basis and incorporated into the topsoil with a plowing depth of 15 cm.

Results and Discussion

Plants grown in soil fertilized with CM had 8.43 kg fruits/ 3 plants. Whereas, plants grown in soil fertilized with HM had the lowest yield. Biochar added to CM, HM, SS, and YWC soil did not affect tomato yield ($P < 0.05$, Table 1). The synergistic effects of biochar mixed with soil amendments used in this study was not observed. This could be due to the low amount of biochar (1% w/w) used in each treatment. Results in Table 1 also revealed that the addition of biochar to HM treatments significantly increased fruit yield from 4.75 kg to 7.72 kg/ 3 plants, and no significant differences were observed when biochar was added to other amendments indicating a positive effect of biochar on the growth and yield of tomato grown in HM treatments.

Table 2. Yield (lbs/plant) and number of fruit per plant collected at each of three harvests. Statistical comparisons were carried out among three harvests using SAS.

Harvest Date	Yield (lb/plant)		No. of fruit per plant	
3-Aug	3.8	B	8.0	B
9-Aug	10.3	A	24.3	A
8-Sep	1.0	C	2.8	C

Each value in the table is an average of three replicates. Values accompanied by the same letter are not significantly different ($P > 0.05$).

Generally, not all yield responded the same. There was a significant increase in fruit yield for HM plots treated with biochar. Whereas, in other treatments the presence of biochar appeared to be associated with either similar or reduced yield. We concluded that more research is needed to confirm our current findings.

Acknowledgments

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Kentucky Seedless Watermelon Variety Trial, 2016

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Introduction

Based on the most recent census data, watermelon is the second largest planted vegetable crop in Kentucky (USDA, 2013). Watermelon is a favorite summertime treat and has been increasing in acreage as have vegetables as a whole in the state (Snell et al., 2013). It is both marketed directly and via wholesale with production scattered throughout the state. Some areas of concentrated watermelon production include Allen, Casey, Christian, Daviess, Hart, Lincoln, Scott, Taylor, and Todd Counties.

Variety selection continues to be a primary consideration for farmers so they can make decisions to suit their needs in yield and disease resistance while also suiting their buyers' needs for quality and appearance. Based on an individual's market channels, their needs may differ for varieties. The objective of the experiment was to evaluate thirty-five seedless watermelon varieties produced under local conditions in Central Kentucky.

Table 1. Yield of seedless watermelon varieties, 2016

Variety	Seed Source	Total Fruit Weight (lbs) per plot[z]		Total Fruit Number per plot		Fruit Weight (lbs) per acre		Fruit Number per acre	
Talca	OR	452.0	a[y]	25.3	a	61,522	a	3,448.5	a
Maxima	OR	382.0	ab	21.0	ab	52,001	ab	2,858.6	ab
Exclamation	SY	345.6	abc	20.0	abc	47,045	abc	2,722.5	abc
Excursion	SY	319.8	bcd	18.0	bcd	43,535	bcd	2,450.3	bcd
Razorback	HI	311.6	bcde	20.3	abc	42,410	bcde	2,767.9	abc
Crunchy Red	HM	310.9	bcde	20.0	abc	42,320	bcde	2,722.5	abc
Summer Breeze	S	307.8	bcdef	20.3	abc	41,892	bcdef	2,767.9	abc
Wolverine	HI	307.6	bcdef	18.7	abcd	41,865	bcdef	2,541.0	abcd
Neptune	SW	307.5	bcdef	21.0	ab	41,852	bcdef	2,858.6	ab
Joy Ride	S	295.0	bcdefg	18.7	abcd	40,159	bcdefg	2,541.0	abcd
Unbridled	SK	280.8	bcdefgh	18.3	bcd	38,219	bcdefgh	2,495.6	bcd
Kingman	SK	270.6	cdefgh	18.0	bcd	36,838	cdefgh	2,450.3	bcd
UGR 1762-14	UG	263.5	cdefghi	17.0	bcde	35,864	cdefghi	2,314.1	bcde
UGR 1317-12	UG	261.9	cdefghi	14.0	cdef	35,647	cdefghi	1,905.8	cdef
Charismatic	SK	260.8	cdefghi	15.3	bcdef	35,501	cdefghi	2,087.3	bcdef
KB12106	KB	260.1	cdefghi	17.3	bcd	35,404	cdefghi	2,359.5	bcd
Sweet Dawn	SY	253.9	cdefghi	15.3	bcdef	34,567	cdefghi	2,087.3	bcdef
KB15010	KB	248.4	cdefghi	17.7	bcd	33,811	cdefghi	2,404.9	bcd
Road Trip	S	247.6	cdefghi	17.0	bcde	33,702	cdefghi	2,314.1	bcde
Fascination	SY	246.6	cdefghi	15.7	bcdef	33,571	cdefghi	2,132.6	bcdef
ORS 6227	OR	245.0	cdefghi	15.0	bcdef	33,355	cdefghi	2,041.9	bcdef
Secretariat	SK	237.4	cdefghij	16.3	bcde	32,312	cdefghij	2,223.4	bcde
Traveler	HM	236.6	cdefghij	16.7	bcde	32,207	cdefghij	2,268.8	bcde
Captivation	SY	231.9	defghij	16.3	bcde	31,572	defghij	2,223.4	bcde
UGR 1763-14	UG	227.8	defghij	14.3	bcdef	31,002	defghij	1,951.1	bcdef
Sugar Fresh	SY	204.0	efghij	14.3	bcdef	27,765	efghij	1,951.1	bcdef
Wayfarer	HM	199.7	fghij	14.3	bcdef	27,184	fghij	1,951.1	bcdef
Poseidon	SW	193.8	ghij	14.7	bcdef	26,379	ghij	1,996.5	bcdef
ORS 6064B	OR	192.0	ghij	14.3	bcdef	26,131	ghij	1,951.1	bcdef
Prime	KY	180.3	hij	12.7	def	24,540	hij	1,724.3	def
3F-4139	KY	174.3	hij	13.0	def	23,724	hij	1,769.6	def
ORS 12154b	OR	173.1	hij	13.7	cdef	23,563	hij	1,860.4	cdef
Chubbiness	KY	154.2	ij	13.0	def	20,995	ij	1,769.6	def
3-F4221	KY	134.0	j	10.3	ef	18,243	j	1,406.6	ef
3F-2186	KY	130.2	j	9.3	f	17,717	j	1,270.5	f

z Plot size: 320 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.

Materials and Methods

Thirty-five varieties were sown in fifty-cell black seedling flats (Landmark Plastic, Akron, OH) on 18 April and placed in a transplant production greenhouse at the University of Kentucky Horticulture Research Farm in Lexington, KY. The seedling media used was Jiffy-Mix #17 (Jiffy Products of America, Lorain, Ohio) which is a peat and vermiculate blend. The non-harvested pollenizer SP-6 was sown at the same time as the seedless varieties. Pre-emergent herbicide, Command, was applied 24 April at 0.67 pt/acre. All varieties, as well as the non-harvested pollinizer, were transplanted on 23 May with a Rain-Flo waterwheel setter into a Maury silt loam at a commercial vegetable farm in Scott County, Kentucky. Experimental plots were 40 ft. in length with ten seedless plants per plot. Rows were spaced on 8 ft. centers with 4 ft. in-row spacing. Pollenizers were interplanted within the row at a ratio of one pollenizer for every two trial plants. The experiment was a randomized complete block design with three replications. Urea (46-0-0) and muriate of potash (0-0-60) were applied pre-plant at 110 lbs. and 83.5 lbs., respectively with amounts based on soil test results. A Rain-Flo plastic layer was used to form raised beds and install black plastic-mulch (4 ft x 1 mil, Filmtech Plastics of the Sigma Plastics Group, Lyndhurst, NJ) with drip tape (12 inch emitter spacing, 30 gph/100 ft, Aqua Traxx, The Toro Company, Bloomington, MN) under the plastic. Fertigation was started on 27 May and done on a weekly basis through 5 August using calcium nitrate or potassium nitrate. Nine pounds of nitrogen per acre were applied at each fertigation event. Between the dates of 10 June and 1 July vines were turned back onto the plastic weekly to keep varieties separated and to allow for management of weeds in the row middles. Weekly scouting in conjunction with the use of the (ID-36) Vegetable Production Guide for Commercial Growers (Saha et al, 2015) to select fungicides and insecticides and to properly rotate between pesticide modes of action. MELCAST was utilized to determine the timing of preventative fungicide sprays (Egel, 2014). There is a potential for a reduction in two – three fungicide applications when utilizing this disease forecasting system (Egel and Latin, 2012).

Five total harvests were collected on a weekly basis beginning 19 July with the final harvest on 16 August. All fruit was weighed individually with any fruit weighing less than nine pounds not considered marketable. Postharvest analysis was conducted on four fruit from every variety and replication for Brix, flesh firmness, hollow heart rating, and black seed production. Brix were measured using a refractometer (RF-12, Extech Instruments, Nashua, New Hampshire). An analog penetrometer (FT, Wagner Instruments, Greenwich, Connecticut) was used for measuring fruit firmness using a 7/16 of an inch diameter cylindrical probe. Black seeds were counted by cutting the melon into half both lengthways and crossways and counting seeds on the cut faces of the fruit (USDA, 2006). 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, NC.)

Table 2. Seedless watermelon varieties by average fruit weight by percentage and total bins, 2015

Variety	Total Bins per acre		60-count 9-13.5 lbs		45-count 13.6-17.5 lbs	36-count 17.6-21.4 lbs		30-count >21.4 lbs	
Talca	86.7	a[z]	14	m	38	24	abcdef	24	ab
Maxima	74.1	ab	17	lm	26	30	ab	28	a
Exclamation	65.0	bc	19	jklm	41	22	abcdefgh	16	bcd
Crunchy Red	61.5	bcd	28	fghijklm	40	29	abc	3	efg
Summer Breeze	60.3	bcd	38	fghijklm	36	22	abcdefgh	5	efg
Excursion	59.7	bcde	24	hijklm	28	23	abcdefg	23	abc
Wolverine	59.7	bcde	18	lm	47	30	ab	5	defg
Razorback	59.5	bcde	32	fghijklm	37	27	abcde	2	efg
Neptune	59.2	bcde	46	cdefgh	38	13	defghij	3	efg
Joy Ride	58.0	bcdeg	24	hijklm	45	28	abcd	3	efg
Unbridled	55.0	bcdegh	31	fghijklm	47	16	bcdefghi	5	defg
Kingman	51.9	cdeghi	38	fghijklm	41	13	defghij	7	defg
UGR 1762-14	51.9	cdeghi	35	fghijklm	36	22	abcdefgh	8	defg
Charismatic	51.2	cdeghi	18	klm	39	29	ab	13	cde
KB12106	50.9	cdeghi	44	defghijk	37	8	hij	12	def
Sweet Dawn	49.7	cdeghi	25	ghijklm	31	34	a	9	defg
KB15010	49.4	cdeghi	46	cdefghi	40	14	cdefghij	0	g
ORS 6227	48.2	cdeghi	20	ijklm	41	32	a	7	defg
Fascination	47.9	cdeghi	36	fghijklm	43	12	efghij	9	defg
Road Trip	47.9	cdeghi	46	cdefghi	37	13	defghij	4	efg
Secretariat	46.4	cdeghij	48	cdefgh	42	8	hij	2	fg
Traveler	46.1	cdeghijk	48	cdefgh	35	14	cdefghij	3	efg
Captivation	45.1	cdeghijk	42	efghijkl	49	9	fghij	0	g
UGR 1763-14	44.4	deghijk	25	ghijklm	56	14	cdefghij	5	efg
Sugar Fresh	39.6	eghijk	51	bcdefg	36	13	defghij	0	g
UGR 1317-12	39.3	ghijk	42	efghijkl	53	4	ij	2	fg
Wayfarer	38.8	ghijk	53	abcdef	37	8	hij	2	efg
ORS 6064B	38.1	ghijk	53	abcdef	42	5	ij	0	g
Poseidon	37.8	ghijk	65	abcde	30	2	ij	3	efg
Prime	35.0	hijk	44	defghij	45	11	fghij	0	g
3F-4139	34.5	ijk	68	abcd	20	9	ghij	3	efg
ORS 12154b	34.5	ijk	70	abc	27	3	ij	0	g
Chubbiness	31.8	ijk	75	ab	25	0	j	0	g
3-F4221	26.5	jk	77	a	20	2	ij	2	fg
3F-2186	26.0	k	50	bcdefg	45	4	ij	0	g

[z] Means within columns separated by Fisher's least significant difference test ($P< 0.05$), means with same letter are not significantly different. Means without letters were not statistically different.

Results and Discussion

Yields in 2016 were higher than last season with a high yield of 61,522 lbs/acre as compared to 40,500 lbs/acre (Table 1) (Saha et al., 2015). Talca had statistically greater yield (61,522 lbs/acre) when compared to thirty-two of the other thirty-four varieties being evaluated including the standard Fascination (Table 1). Talca (3,448.5 fruit/acre) had statistically greater fruit number per acre harvested as compared to twenty-six of the varieties evaluated (Table 1). Other comparable varieties with regards to fruit number includes: Maxima, Neptune, Summer Breeze, Razorback, Exclamation, Crunchy Red, Wolverine, and Joy Ride. Talca had greater total bins per acre (86.7) as compared to all but one of the varieties, Maxima (Table 2). Talca was larger in size as 48% of the fruit harvested were in the 36 or 30-count size with 38% in the 45-count size (Table 2).

There were no statistically significant differences in percentage of fruit harvested in the 45-count size amongst varieties (Table 2). Varieties that did not differ statistically from Maxima for total bins per acre that had 40% or greater fruit in the 45-count size include: Unbridled, Wolverine, Joy Ride, Exclamation, and Crunchy Red (Table 2). Varieties that did not differ statistically from Maxima for total bins per acre that had 35% or greater fruit in the 60-count size include: Neptune (46%) and Summer Breeze (38%) (Table 2).

Sweet Dawn (34%) had greater percentage of fruit in the 36-count size as compared to twenty two of the varieties evaluated (Table 2). Other varieties that did not differ statistically from Sweet Dawn that had comparable total bin yields when compared with Maxima, includes: Wolverine, Crunchy Red, Joy Ride, Razorback, and Summer Breeze (Table 2). Maxima (28%), Talca (24%), and Excursion (23%) produced significantly more fruit in the 30-count size as compared to thirty one of the other varieties (Table 2).

Road Trip (11.9%) had an average brix statistically greater than twenty-five of the varieties evaluated (Table 3). Other varieties comparable to Road Trip with regards to brix that also had a yield greater than fifty bins per acre included: Summer Breeze, Wolverine, Razorback, Joy Ride, and Unbridled (Table 3). Maxima (10.8%) and Talca (10.3%) did not differ significantly from several varieties that had an average Brix of 11% or greater, while having greater yield (Table 2 and 3).

Only two varieties averaged greater than the maximum (10) number of allowable black seeds to be marketed as a seedless watermelon per the USDA grading standards. Those varieties were Wayfarer (14.5) and UGR 1317-12 (11.8) (Table 3). Fruit firmness ranged from 2.1 to 4.5 lbs-force with ORS 6064B having greater flesh firmness as compared to thirty-two other varieties (Table 3). Conversely, Prime (2.1 lbs-force) had softer flesh when compared to twenty-six of the varieties in the trial (Table 3). There was no statistically significant differences amongst varieties with regards to hollow heart, which was generally low this season.

In summary, varietal selection is a critical choice in preparation for each season. Further, varieties should be shown to have proven and consistent performance in our region over multiple seasons. While the results discussed here are of only one season, many of these varieties have been also seen in the last three seasons. Talca and Maxima have consistently performed well for yield and quality the last three seasons with regard to yield and quality. Other varieties performing well over multiple seasons include: Road Trip, Wolverine, Razorback, Joyride, and Unbridled. Lastly, these were all better or comparable to Fascination with regard to yield and quality, a variety widely used in the southeast and the most utilized in Kentucky comprising nearly 40% of the total watermelon acreage.

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Table 3. Fruit quality of seedless watermelon varieties, 2016. Four fruit from every replication for each variety

Variety	% Soluble solids		Number of Black Seeds		Firmness (lbs-force)		Hollow Heart[z]
Road Trip	11.9	A[x]	0.3	B	3.3	CDEFGH	1.0
3-F4221	11.7	AB	0.3	B	2.6	IJKL	1.0
Joy Ride	11.6	ABC	0.3	B	3.3	CDEFGHI	1.0
Summer Breeze	11.6	ABC	0.3	B	3.1	DEFGHIJK	1.0
UGR 1762-14	11.6	ABC	0.1	B	2.4	KL	2.0
Unbridled	11.5	ABCD	0.3	B	3.2	DEFGHIJ	1.1
3F-2186	11.5	ABCD	0.3	B	2.4	KL	1.0
Charismatic	11.4	ABCD	2.8	AB	3.7	BCDE	1.2
Prime	11.3	ABCDE	0.0	B	2.1	L	1.1
Wayfarer	11.2	ABCDEF	14.5	A	3.1	DEFGHIJ	1.0
Poseidon	11.1	BCDEFG	0.8	B	2.5	JKL	1.3
UGR 1317-12	11.1	BCDEFG	11.8	AB	3.0	FGHIJK	1.2
UGR 1763-14	11.1	BCDEFG	0.2	B	2.9	GHIJK	1.5
Wolverine	11.1	BCDEFG	0.5	B	3.3	CDEFGH	1.0
3F-4139	11.0	BCDEFGH	3.3	AB	3.3	CDEFGH	1.2
Kingman	11.0	BCDEFGH	3.2	AB	3.5	CDEFG	1.0
Secretariat	11.0	BCDEFGH	2.8	AB	3.7	BCDE	1.1
Razorback	11.0	BCDEFGH	0.7	B	3.4	CDEFGH	1.0
Neptune	11.0	CDEFGH	4.3	AB	3.2	CDEFGHIJ	1.0
Chubbiness	10.9	CDEFGH	0.1	B	2.5	JKL	1.0
Sugar Fresh	10.9	CDEFGH	0.2	B	4.3	AB	1.0
KB15010	10.9	CDEFGH	4.8	AB	2.7	HIJKL	1.4
Maxima	10.8	DEFGH	0.3	B	2.7	HIJKL	1.2
ORS 6227	10.8	DEFGH	1.0	B	3.2	DEFGHIJ	1.2
Fascination	10.6	EFGHI	5.5	AB	3.3	CDEFGH	1.0
Sweet Dawn	10.6	EFGHI	5.7	AB	3.1	DEFGHIJK	1.0
Captivation	10.6	FGHI	0.4	B	3.9	ABC	1.0
Exclamation	10.5	FGHI	1.3	B	3.0	EFGHIJK	1.0
KB12106	10.5	FGHI	0.4	B	3.8	BCD	1.1
Crunchy Red	10.4	GHIJ	1.6	B	3.2	CDEFGHIJ	1.1
Excursion	10.4	HIJ	0.7	B	3.7	BCDEF	1.0
Talca	10.3	HIJ	1.8	AB	3.3	CDEFGHI	1.0
Traveler	10.0	IJ	0.3	B	3.2	CDEFGHIJ	1.0
ORS 6064B	9.9	IJ	0.3	B	4.5	A	1.0
ORS 12154b	9.8	J	1.0	B	2.7	HIJKL	1.2

[z] Hollow Heart: 1-none, 2-slight carpel separation, 3-One large gap evident, 4-2 large gaps, 5-severe carpel separation, 3 or more large gaps; fruit cut crosswise

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

Evaluation of Cedar as an Alternative Soilless Media

Alexis A. Sheffield and Shubin K. Saha, Horticulture

Introduction

As the use of greenhouses and high tunnels grows throughout Kentucky, partly in thanks to the EQUIP Seasonal High Tunnel Initiative, more and more growers are looking to alternative, high value vegetable crops. Depending on structure type, greenhouse versus high tunnel, and soil quality, some growers are looking into using a container based, soilless system for vegetable production. For soilless production a growing medium, other than soil, is typically used to avoid soilborne disease problems, and to provide maximum aeration and water in a highly controlled environment (Olle et al., 2012).

While soilless container production allows growers to produce a higher value crop, the economic, and environmental sustainability is an aspect that needs to be considered. The most common media used for container production include coconut coir, perlite, and rockwool. While all three are naturally derived products, none are native to Kentucky, resulting in higher input costs. Disposal also becomes a problem when working with rockwool and perlite products, because they fail to decompose in a compost pile, and most growers do not have the capability to adequately sanitize them for repeated use.

For these reasons, there is a need for an alternative, more sustainable, hydroponic container medium for Kentucky growers. The goal of the experiment was to compare Eastern Red Cedar (*Juniperus virginiana* L.*)* to perlite as a medium to produce English cucumbers. Eastern Red Cedar is native to every U.S. state east of the 100th meridian, and grows in USDA hardiness zones 3 to 9 (Dirr, 2009). In parts of the Midwest, as well as in Oklahoma and Texas, there has been an all-out war declared on the species due to its ability to invade prime pasture land (Olszowy and Thompson, 2011). Eastern Red Cedar can be found in almost any fence row, or roadside in Kentucky, and has remained historically marketable in the Commonwealth. Mills that process cedar are typically left with abundant piles of waste product that may be suitable for soilless media production. Cost difference of the media for this experiment were $1.25 per cubic foot for cedar and $3.38 per cubic foot for perlite. For these reasons, Easter Red Cedar was a prime candidate for this trial.

Materials and Methods

Cucumbers were grown at the Horticulture Research farm in Lexington, Kentucky. The multibay 25'X54' greenhouse structure was covered with six mil Double layer polyethylene, with 39" sidewalls, and an orientation running east to west. An evaporative cooler was located on the west end with two 3ft. vents on the east end. Greenhouse temperatures were regulated to heat if temperatures dropped below 72°F during the day, and 68°F at night. Venting and cooling was regulated to achieve 80°F during the day, and 80°F at night.

Seeding of European cucumber 'Kalunga' (Enza Zaden/Vitalis, Salinas, OH) began on January 13, 2015 into 1.25-inch Oasis RootCubes (Oasis Grower Solutions, Kent, OH). Seeded RootCube sheets were placed on a heat mat, and under misters to achieve germination temperatures of 84°F, and provide consistent moisture to avoid drying out of the RootCubes.

On March 4, 2015 seedlings with at least two true leaves, were planted into three-gallon Bato Buckets (Cropking Inc., Lodi, OH) of various media. The greenhouse consisted of four rows; two guard rows of 24 buckets of pine bark each, and two rows of alternating blocks of perlite (Thermorock East Inc., New Eagle, PA) and shredded cedar, which included both bark and wood particles from freshly cut trees, (Glascock Log and Lumber, Bloomfield, KY) for a total of 24 buckets per row. Each row contained four blocks of six buckets of perlite or cedar. Rows were four feet apart with buckets in row 15 inches apart.

Each Bato Bucket contained two drip stakes with spaghetti tubing (Netafim, Fresno, CA) each connected by an emitter (2L/hr, Netafim, Fresno, CA) inserted into ¾ inch poly tubing (Toro, El Cajon, CA) that was run down each row. Bato Buckets drained into a PVC pipe with holes cut out to allow for bucket drains to sit down into the PVC pipe. As plants grew, they were trellised using tomato twine, tomahooks, and 23mm tomato clips (Paskal, San Diego, CA).

To meet fertilization needs, 20.8 lbs of 5-11-26 (Peters Professional, Allentown, PA), 13.4 lbs of calcium nitrate (Haifa, Altamonte Springs, FL), and 8.45 fl oz of sulfuric acid were mixed into three separate, 25 gallon stock tanks, at an injector ratio of 100 ppm. On April 13th, stock tanks were refilled and sulfuric acid input was adjusted to 4.23 fl oz with other fertilizer inputs staying the same. This adjustment was due to change in water pH. Fertigation started with 90 second cycles at 30 minute intervals. Fertigation times were adjusted as needed throughout the growing season to achieve 20% leachate (UK Research and Education Center Horticulture, 2016). Leachate was collected from randomly selected perlite and cedar buckets to compare water holding capacity of the media.

On March 19th a foliar fungicide (Inspire Super, 0.389 fl. oz. /1000 sq. ft.) and insecticide (Entrust SC, 0.169 fl. oz. /1000 sq. ft.) application was done to control powdery mildew (*Podosphaera xanthii)* and thrips (*Thrips tabaci*). On March 26th a second foliar application of Inspire Super, mixed with Malathion 57 EC (0.549 fl. oz. /1000 sq. ft.) for melon aphids (*Aphis* gossypii) was applied.

Throughout the season, lateral shoots were pruned to develop a central leader. Once the central leader reached the braided cable that was 8 ft. off the ground, the top was pinched to remove the apical dominance, allowing for two lateral shoots to grow back down. This technique is known as umbrella trellising (Papadopoulos, 1994). This helps to maximize production in the small allotted area. Blossoms were removed below the 4th node to keep fruit from sitting on the media which can lead to curved unmarketable fruit.

The first harvest began April 4th, exactly one month after planting. Cucumbers were harvested one or two times a week, and harvests terminated May 8th for a total of 12 harvests. Cucumbers were graded into one of three tiers defined by the

Table 1. Average fruit yield per plot[z] of English cucumbers in 2 different soilless media, 2015

Growth Media	#1 Fruit Wt. (lbs)	#1 Fruit Number	#2 Fruit Wt. (lbs)	#2 Fruit Number	Cull Fruit Wt. (lbs)	Cull Fruit Number	Total Marketable Fruit Wt. (lbs)	Total Marketable Fruit Number
Cedar	66.6	68.2	12.6	12.0	5.0	4.5	80.8	78.5
Perlite	64.5	68.2	12.2	12.0	4.4	4.5	80.3	76.5

[z] Plot was 6 plants and 13.5 ft^2

United States Standards for Greenhouse Cucumbers (USDA, 1997). The highest quality fruit, #1 were free from damage, well-formed and well colored, with a minimum length of 11 inches. #2 fruit could have some slight damage and slight deformation, with a minimum length of 11 inches. All fruit not meeting these minimum requirements were culled. Yields were analyzed by general linear model and means were separated by Fisher's least significant difference test using SAS statistical programs (SAS Institute, Cary, NC).

Results and Discussion

Weight of cucumbers picked per harvest ranged from 14 to 115 lbs., with 115 lbs. being picked on the 10th harvest occurring May 3, 2015. The 10th harvest also had the highest average fruit weight of 1.22 lbs. (cedar) and 1.25 lbs. (perlite). When data were analyzed there was no statistical significance of total yield between cedar and perlite. Numbers of #1 and #2 grade cucumbers were statistically the same between the perlite and the cedar, as well as pounds of fruit per grade, and even the number and weight of culled fruit (Table 1). Both treatments had fruit ready to harvest at the same time as well.

This initial evaluation data shows that neither quality, nor quantity of cucumber fruit differed between the plants grown in the cedar and perlite treatments. This leads us to believe that there is a good possibility of cedar being an alternative to perlite as a soilless medium, and merits further research. If cedar were to prove to be a worthy alternative to perlite as a soilless medium for vegetable crops, this would reduce input costs to growers, increase sustainability by using a local product that will breakdown via composting, enhance local economics by using a product typically deemed waste by sawmills, and aid in reducing the noxious weed population of *Juniperus virginiana* L.

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Cantaloupe Variety Trial for Kentucky, 2016

John Walsh, Shubin K. Saha, and John Snyder, Horticulture

Introduction

Cantaloupe is the fifth largest fresh market vegetable crop produced in Kentucky (USDA, 2013). It is a popular summer crop grown in many areas of the state and is commonly found at farmers markets and produce auctions. Although there continues to be standard varieties produced in the state, evaluation of new varieties is important to find those with improved fruit quality, yield, and shelf life. The objective of the trial was to evaluate yield, fruit quality, and maturity for fourteen different cantaloupe varieties.

Materials and Methods

On 14 April seeding of the cantaloupe varieties began using 50-cell black seedling flats (Landmark Plastic, Akron, OH). The seeding media used was Jiffy-Mix #17 (Jiffy Products of America, Lorain, Ohio), which is a common peat based substrate designed for vegetable transplant production. Due to the poor germination of a few of the varieties, a second seeding occurred on 20 April, using the same methods, with much better results. On a commercial production farm in Scott County on 19 May, each of the fourteen varieties was transplanted in the assigned plot into Maury silt loam soil. Transplanting was executed using a Rain-Flo waterwheel setter, with a water-soluble transplant fertilizer mixed into the water. The plots were 6 ft apart, 50 ft in length, with 20 plants in each plot spaced 30 in apart. At the end of each plot was a 10 ft break in order to have the plots separated and to have room to easily gain access to each plot. A plasticulture production system was employed using black plastic mulch-covered (4 ft. x 1 mil, Filmtech Plastics of the Sigma Plastics Group, Lyndhurst, NJ) raised beds with drip tape (12 in. emitter spacing, 30 gph/100 ft., Aqua Traxx, The Toro Company, Bloomington, MN). Using a Rain-Flo plastic layer/ bed shaper, plastic mulch and drip tape was installed on 15 April. Urea (46-0-0) was applied at a rate of 110 lbs to the acre and muriate of potash (0-0-60) was applied at a rate of 83.5 lbs to the acre as pre-plant fertilizer. Starting on 27 May fertigation occurred every week using calcium nitrate until 1 July, at which time potassium nitrate was applied until 22 July and then, for the last two fertigation events until 5 August, calcium nitrate was used again. At each fertigation event 9 lbs of nitrogen per acre were applied, based on the recommended rate of actual nitrogen for the season. Fertilization, diseases, and arthropod pests were managed using recommendations in the ID-36 *Vegetable Production Guide for Commercial Growers* (Saha et. al., 2015). Preventative fungicide applications were determined using MELCAST (Egel and Latin, 2012). Insecticide applications were based on weekly scouting reports throughout the production season.

Beginning on 13 July and terminating on 8 August, fruit was harvested three times per week for a total of 12 harvests. Every fruit harvested was then weighed and nine fruit from each variety, three for each replication, were then sampled for fruit quality on the same day, including brix (soluble solids), firmness, and other internal parameters. Measuring fruit firmness was done with an analog penetrometer (FT, Wagner Instruments, Greenwich, Connecticut). A manual refractometer (RF-12, Extech Instruments, Nashua, New Hampshire) was used for measuring soluble solids. 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, NC).

Table 1. Marketable Yield of cantaloupe varieties, 2016

Variety	Seed Company	Number of Fruit per plot[z]		Average Fruit Weight (lbs)		Total Fruit Weight (lbs) per plot		Number of Fruit per acre		Total Fruit Weight (lbs) per acre	
8H2111	OG	53.0	a[y]	6.9	cde	357.3	a	7695.6	a	51887	a
ME3716	SY	38.3	b	6.8	cde	260.3	b	5566.0	b	37792	b
UGR1037-11	UG	37.7	b	5.4	g	202.2	bcd	5469.2	b	29364	bcd
8H245	OG	35.7	bc	6.3	ef	224.2	bcd	5178.8	bc	32553	bcd
ME3743	SY	35.0	bcd	7.4	bc	257.9	b	5082.0	bcd	37452	b
8H277	OG	34.3	bcd	7.1	cd	243.6	bc	4985.2	bcd	35368	bc
UGR2101-14	UG	32.7	bcd	6.3	ef	204.8	bcd	4743.2	bcd	29730	bcd
Aphrodite	SY	30.0	bcde	8.4	a	252.0	bc	4356.0	bcde	36594	bc
Orange Sherbet	SI	26.0	bcdef	8.4	a	214.4	bcd	3775.2	bcdef	31129	bcd
Athena	SY	24.3	cdef	6.7	cde	159.9	de	3533.2	cdef	23215	de
8H229	OG	22.7	def	8.1	ab	183.0	cd	3291.2	def	26567	cd
8260b	OG	19.3	ef	5.4	g	102.6	e	2807.2	ef	14893	e
UGR1727-13[x]	UG	18.7	ef	5.8	fg	107.6	e	2710.4	ef	15618	e
SV5196MF	S	17.0	f	6.4	def	108.6	e	2468.4	f	15765	e

z Plot size: 300 ft^2

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

x Galia-Type

Results and Discussion

Yields in 2016 were increased, ranging from 2,468 to 7696 fruit to the acre compared to 1600 to 6,490 fruit in 2105 (Table 1) (Saha, 2015). The increase in yield from 2015 to 2016 was likely due to the comparative reduction of rainfall over the 2016 growing season. Average precipitation in July in Scott County is 4.65 inches; in 2016 4.98 inches fell (Weather Underground, 2016). 2015 was an extremely wet season in July with nearly double the average rain fall for the month. Comparatively, rainfall in July 2016 was close to the annual average for the month. These relatively drier conditions allowed for timely preventative fungicide applications and more fertigation events than in the 2015 growing season, ultimately leading to more fruit set.

In terms of fruit count 8H2111 was the standout when compared to industry standards Aphrodite and Athena, with 7696 fruit/A (Table 1). Average fruit weights ranged from 5.4 to 8.4 pounds (Table 1). Orange Sherbet and Aphrodite had greater average fruit weights when compared to the other varieties, with the exception of 8H229 (Table 1). All other varieties excluding UGR1037-11, 8260b, and UGR1727-13 were comparable to Athena in terms of average fruit weight (Table 1). 8H2111 had the highest yield by weight as compared to all other varieties (Table 1). Varieties that were comparable to Aphrodite with respect to fruit weight per acre were UGR1037-11, 8H245, ME3743, ME3716, 8H277, UGR2101-14, and Orange Sherbet.

SV5196MF had significantly greater soluble solids (14.0 Brix) as compared to all other varieties other than UGR1037-11 (Table 2). However, it had the lowest numerical fruit number per acre as compared to all other varieties. UGR1037-11 and 8H277 had statistically higher brix as compared to both standards and comparable yield. Further 8H277 had an average fruit weight of 7.1 lbs which is the typical desirable size. SV5196MF, UGR1037-11, 8260b, UGR2101-14, and 8H229 had statistically greater firmness than Aphrodite and all other evaluated varieties. 8H277 and 8H211 had firmness statistically the same as Athena, while UG- 1037-11 was slightly more firm (Table 2).

Yields from industry standard Aphrodite and Athena prove why they have become the standards. 8H211 was comparable in soluble solids and average fruit weight with the standards and better in terms of number of fruit and fruit weight. Orange Sherbet and 8H229 were comparable to Aphrodite with respect to yield and quality. Orange Sherbet is a Tuscan type that can be substituted for the standards for individuals that are direct marketing. Variety selection is largely dictated by market. Based on this season's results, wholesalers should likely continue with Aphrodite and Athena, but could explore using 8H211 and 8H277 instead once released, because they are comparable; Direct marketers, such as those utilizing farmers markets and roadside stands, could consider other possibilities. For example, many of the Tuscan types such as Orange Sherbet are of excellent quality and are comparable in terms of yield. Although a bit smaller UGR1037-11 (5.4 lbs) also had good yield and fruit quality, which may be worth consideration for direct marketers as well.

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Table 2. Fruit quality of cantaloupe varieties, 2016

Variety	Seed Company	Brix (% Soluble Solids)		Seed Cavity Length (in)		Seed Cavity Width (in)		Firmness (lbs-force)		Overall Length (in)		Overall Width (in)	
SV5196MF	S	14.0	a[z]	4.5	cde	2.9	abc	4.7	ab	6.9	e	6.4	c
UGR1037-11	UG	13.4	ab	4.1	def	2.8	abcd	4.1	bcde	6.9	e	5.8	d
8H277	OG	12.9	bc	5.4	ab	3.1	ab	3.3	efgh	8.8	a	6.9	ab
8260b	OG	12.2	cd	4.3	cdef	2.2	e	5.0	a	7.3	de	6.7	abc
UGR2101-14	UG	12.1	cd	2.9	i	2.4	cde	3.7	cdef	5.5	f	5.5	d
8H229	OG	11.7	de	4.9	bc	2.4	cde	4.4	abc	8.2	abc	7.0	a
Orange Sherbet	SI	11.6	de	5.7	a	3.3	a	3.4	efg	8.3	ab	6.6	abc
8H245	OG	11.5	de	4.7	cd	2.3	de	3.2	fgh	7.5	cde	6.8	abc
Athena	SY	11.5	de	3.1	hi	2.6	bcde	2.8	gh	5.4	f	5.6	d
ME3743	SY	10.9	ef	3.3	ghi	2.6	bcde	4.2	abcd	5.9	f	5.8	d
8H2111	OG	10.8	efg	4.7	bcd	2.6	bcde	3.5	defg	8.0	bcd	6.9	ab
Aphrodite	SY	10.8	efg	3.7	fgh	3.3	a	2.5	h	6.0	f	6.4	bc
ME3716	SY	10.3	fg	3.9	efg	3.0	ab	3.6	defg	6.9	e	6.3	c
UGR1727-13[Y]	UG	9.8	g	4.1	def	2.2	e	3.1	fgh	7.0	e	6.5	abc

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

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Appendix A
Sources of Vegetable Seeds

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
HI .... High Mark Seeds, 5313 Woodrow Ln, Hahira, GA 31632
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
KB .... K&B Development, LLC., 10030 New Avenue, Gilroy, CA 95020
KS .... Krummrey & Sons Inc., P.O. 158, Stockbridge, MI 49285
KY/KU .... 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
OR.................. Origene Seeds, P.O. Box 699, Rehovet, Israel

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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